TELEDYNE PARADISE DATACOM
A Teledyne Technologies Company

Q-MultiFlex™
'Hub-in-a-box'
Installation and Operating Handbook

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Table of Contents

Chapter 1 Welcome

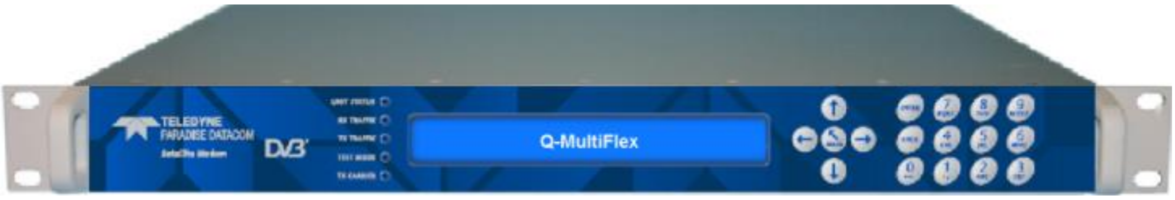


Figure 1-1 Q-MultiFlex™ Advanced Satellite Modem

The **Q-MultiFlex™** (**Figure 1-1**), a variant of our versatile **Q-Flex™** satellite modem, is a modulator/multi-demodulator system that supports efficient, cost-effective point-to-multipoint IP operation.

We refer to the **Q-MultiFlex™** as a '**hub-in-a-box**' because it incorporates all of the following functions in a single rack unit that replaces a whole rack of traditional hub equipment:

- Modulator
- Multiple demodulators
- Ethernet managed switch
- Router
- IP bandwidth optimizer
- ACM controller
- Packet encapsulator/decapsulator
- Spectrum analyser
- Oscilloscope (constellation monitor)
- Interference detector
- Traffic generator/analyser
- PRBS BER tester
- Redundancy system controller

A standard **Q-Flex™** modem can easily be converted into a **Q-MultiFlex™**, giving the ultimate in flexibility: a modem that can be configured dynamically for point-to-point, point-to-multipoint, IF, L-band, plus a wide range of data rates, Forward Error Correction (FEC) and terrestrial interfaces.

The **Q-MultiFlex™** supports a highly efficient shared DVB-S2/S2X outbound carrier with multiple low-latency inbounds and can be used for star, full mesh and hybrid networks.

For maximum flexibility, **Q-MultiFlex™** supports both a Layer 2 bridge and a Layer 3 router, allowing the user to provide a full Layer 2 or Layer 3 solution. **Q-MultiFlex™** can therefore act as either a transparent bridge for all protocols, or it can perform explicit packet forwarding, as required.

The **Q-MultiFlex™** and associated **Q-Flex™** remote modems can be controlled from a web browser using the built-in web user interface that is supported on each device. Alternatively, a **Q-MultiFlex™** network can be controlled via our innovative **Q-NET™ Bandwidth Manager**, supporting a wide range of bandwidth management, network management, monitoring and reporting functions. **Q-NET™** is an open management platform that is vendor-agnostic and will support any type of satellite or IP device, such as BUCs, Ethernet switches and routers. The **Q-MultiFlex™** interoperates with low-cost **Q-Lite™** and **Q-Flex™** remote network modems.

The satellite bandwidth-saving features include:

- **DVB-S2** and **DVBS2X** state-of-the-art Forward Error Correction (FEC) representing the most bandwidth-efficient FEC technology available.
- **Spectral roll-off factors down to 5%**, saving up to 15% bandwidth compared with 20% roll-off.
- **IP compression**, saving up to 50% bandwidth.
- **Adaptive Coding and Modulation (ACM)**, saving up to 50% bandwidth.
- **TCP Acceleration**, enabling up to 93% bandwidth utilization for TCP traffic.
- **ClearLinq™ Tx adaptive pre-distorter**, providing up to 2dB compensation for linear and non-linear distortion in the channel.
- **9-tap Rx adaptive equaliser**, providing compensation for linear distortion in the channel, such as from group delay. The equaliser is automatically switched on in all modes of operation above 10Msps.

New levels of usability are provided by a leading set of built-in diagnostic tools including spectrum and constellation monitors that facilitate the detection of any link degradation. In addition, **LinkGuard™** (U.S. patent 8351495) monitors underneath the received carrier for any interference, while on traffic.

DVB-S2X, the successor to DVB-S2, is the most efficient and robust coding and modulation standard available for satellite transmission and supports transmission of modulations up to 256APSK.

FastLink™ Low-Density Parity-Check (LDPC) combines high coding gain with low latency. **FastLink™** is used on the inbounds and can optionally be used on the outbound.

This handbook will guide you through the process of setting up and using your **Q-MultiFlex™** satellite modem network.

The **Q-NET™ Bandwidth Manager** is documented in '*Q-NET™ Bandwidth Manager User Handbook*'.

Redundancy Switch operation is documented in '*Q-NET™ PDQS Redundancy Switch Installation and Operating Handbook*'.

Chapter 2 About This Handbook

2.1 Conventions

This warning symbol is intended to alert the user to the presence of a hazard that may cause death or serious injury.

This information symbol is intended to alert the user to the presence of important operating instructions critical to correct system function.

2.2 Trademarks

All trademarks used in this handbook are acknowledged to be the property of their respective owners.

2.3 Disclaimer

Although every effort is made to ensure the accuracy and completeness of the information in this handbook, this cannot be guaranteed and the information contained herein does not constitute a product warranty. A separate product warranty statement is available. Teledyne Paradise Datacom maintains a programme of continuous product improvement and reserves the right to change specifications without prior notice.

Chapter 3 Safety and Compliance Information

PLEASE READ THE FOLLOWING INFORMATION BEFORE INSTALLATION AND USE.

3.1 Safety Compliance

To ensure operator safety, this satellite modem conforms to the provisions of EMC Low Voltage Directive 2006/95/EC and complies with the following standard:

- EN 60950-1:2006 'Safety of Information Technology Equipment, Including Electrical Business Equipment'.

Prior to installation and at all points during operation the following points must be observed.

- ***This satellite modem must be operated with its cover on at all times in order to provide protection from potentially lethal internal voltages. Never operate the unit with the cover removed.***
- ***This satellite modem must be directly connected to a protective earth ground at all times using the chassis ground stud situated on the rear of the unit.***
- ***The power system to which this satellite modem is connected must provide separate ground, neutral and line conductors. The power system must have a direct ground connection. Note that the ground stud in itself does not provide a protective earth connection until the satellite modem is coupled to a suitable power supply cord containing a protective earth terminal.***
- ***This satellite modem has double pole/neutral fusing. To ensure operator safety, fuses should always be replaced with identical type and rating.***
- ***To allow rapid disconnection from the mains in an emergency, the equipment should be installed near the mains socket outlet, which should be easily accessible.***

3.2 Environmental Compliance

All Teledyne Paradise Datacom satellite modem products are compliant with the following EC environmental directives:

- The Reduction of Hazardous Substances (RoHS) Directive 2011/65/EU.
- The Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.

The equipment is designed to operate in a static 19-inch rack system conforming to IEC 297-2.

The equipment should not be directly connected to the Public Telecommunications Network.

Operation of the equipment in an environment other than that stated will invalidate the safety standards.

The equipment must not be operated in an environment in which it is exposed to:

- ***Unpressurised altitudes greater than 3000 metres.***
- ***Extreme temperatures outside the stated operating range.***
- ***Excessive dust.***
- ***Moisture or humid atmosphere above 95% relative humidity.***
- ***Excessive vibration.***
- ***Flammable gases.***
- ***Corrosive or explosive atmosphere.***

3.3 Electromagnetic Compatibility (EMC) Compliance

This satellite modem conforms to the provisions of EMC Directive 2004/108/EC and complies with the following EC and FCC standards:

- Emissions: EN 55022:2010 Class B – 'Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement'.

- Immunity: EN 55024:2010 (incorporating EN61000-4-2:2009; EN61000-4-3:2006, A1, A2; EN61000-4-4:2012; EN61000-4-6:2009) – 'Information Technology Equipment – Immunity Characteristics – Limits and Methods of Measurement '.

- Federal Communications Commission (FCC) Federal Code of Regulation Part 15, Subpart B.

All D-type connectors must have grounding fingers on the plug shell to guarantee continuous shielding. The back-shells must comply with the requirements of VDE 0871 and FCC 20708, providing at least 40dB of attenuation from 30MHz to 1GHz. A good quality cable with a continuous outer shield, correctly grounded, must be used.

Connections to transmit and receive IF interfaces must be made with double-screened coaxial cable (for example, RG223/U).

The modem Ethernet ports should not be connected directly to outdoor Ethernet cables that may be be subject to transient overvoltages due to atmospheric discharges and faults in the power distribution network. Instead, the modem should be connected via an Ethernet switch or router to provide isolation from overvoltages as recommended in clause 6 of EN 60950-1.

Chapter 4 Installation

4.1 Unpacking

Prior to unpacking, inspect the exterior of the shipping container for any sign of damage during transit. If damage is evident, contact the carrier immediately and submit a damage report.

Carefully unpack all items, taking care not to discard any packing materials. Should the unit need to be returned to Teledyne Paradise Datacom then you should use the original packing carton as it is designed to provide the necessary level of protection during shipment.

Once unpacked, visually inspect the contents to ensure all parts are present and that there is no visible damage.

4.2 Line Supply

This satellite modem is classified by the EN 60950-1 safety standard as a 'pluggable equipment Class A'. The mains operating range is 90V to 250V. A 48V DC input option is available. Power consumption ranges from 40W to a maximum of 300W (when a BUC PSU is fitted).

A power cord suitable for use in the country of operation is provided.

The installation of the satellite modem and the connection to the line supply must be made in compliance with local and national wiring regulations for a Category II 'impulse over-voltage' installation. The satellite modem should be positioned to allow a convenient means of disconnection from the line supply.

4.3 Rack Mounting

A fully-wired rack-mount turnkey solution can be optionally provided. However, if the unit is being installed in a user-provided rack then adequate ventilation and cooling should be provided. There must be adequate clearance around the two side-mounted fans and the ventilation holes on both sides of the unit.

For rack mounting, there are screw positions on the unit's front panel for attaching it to the rack, which prevent the unit from moving. These must always be used in conjunction with full-length L-brackets fitted on both sides of the unit (or a tray underneath the unit) to support its weight.

A 1U gap between units in the rack is not necessary but if extra space is available then any gap will help to minimise the temperature inside each unit, which may contribute to improving long-term reliability (due to the well-known relationship between the temperature and reliability of electronic components).

4.4 Getting Started

Connect the appropriate cables to the transmit and receive IF and/or L-band connectors at the rear of the unit, along with the cable(s) for the traffic interface.

Power the unit and wait for it to complete its initialization when it will display summary status information.

The unit can be set up from a web browser as described in Section 6.2. It can also be set up from the front-panel menus by selecting **Edit** and then **Service->General** and configuring all of the submenu settings (covering System, Service, Modcod, Carrier and Demods).

When setting up a number of units that have similar configurations, the configuration settings of one unit can be saved, extracted and then transferred to each of the other units in turn, using either the web user interface or the USB interface on the modem.

Chapter 5 Introduction

5.1 Overview

The **Q-MultiFlex™** satellite modulator/multi-demodulator is designed for point-to-multipoint IP networks and supports any network topology including star, mesh and hybrid star/mesh networks. No fixed hub is required and all communications involve only single satellite hops. **Q-MultiFlex™** units can be daisychained to create arbitrarily large networks supporting any number of remote sites. Layer 2 and Layer 3 solutions are supported.

Features include:

- DVB-S2 (EN 302 307-1) and DVB-S2X (EN 302 307-2) shared outbound, including Adaptive Coding and Modulation (ACM). **FastLink™** low-latency LDPC can also be used for the outbound.
- Modulator and up to 16 demodulators. **Q-MultiFlex™** units can be cascaded together to provide a single transmit carrier to any number of remote sites, each of which provides a return carrier to the hub. Multi-transponder/satellite solutions are supported.
- Dual IF/L-band operation.
- Scalable to any network size. Star and mesh networks are supported.
- **FastLink™** low-latency LDPC returns.
- Data rates to 200Mbps, outbound and aggregate inbound.
- Spectral roll-off factors of 5%, 10%, 15%, 20%, 25% and 35%.
- **Q-NET™ Navigator** control application, included as standard, allows all elements of the network to be controlled from a single multi-operator application.
- Optional **Q-NET™ Bandwidth Manager**, which supports multi-transponder/satellite carrier planning typically required for larger networks.
- Supports low-cost **Q-Lite™** and **Q-Flex™** remote modems.
- **LinkGuard™** signal-under-carrier interference detection.
- Built-in spectrum and constellation monitors.
- DVB Carrier ID. Fully compliant with DVB-CID standard.
- IF frequency ranges of 50 to 90MHz and 100 to 180MHz; L-band frequency range of 950MHz to 2150MHz.
- 4-port Ethernet switch included as standard.
- Automatic Uplink Power Control (AUPC) automatically adjusts modem output power to maintain a constant Eb/No at the distant end of the satellite link. Available for the shared outbound and for the individual inbounds.
- Front panel display and keypad for local control.
- Remote equipment can be controlled over the satellite via serial or IP traffic interfaces. Remote modem control is supported via web browsing, the Simple Network Management Protocol (SNMP), Telnet and the proprietary Paradise Universal Protocol (PUP) command protocol. As well as supporting the development of third-party user interfaces for modem control, the PUP protocol includes many useful hooks for satellite listening applications (such as the output of I and Q baseband samples). Remote control is supported using a specific VLAN (separate from any traffic VLANs) where all the M&C packets are sent over satellite in a VLAN that is received by all of the remotes.

- Compact 1U chassis, 405mm deep.
- **XStream IP™**, providing an advanced integrated suite of IP optimisation and traffic management features. These include Transport Control Protocol (TCP) acceleration, header and payload compression, encryption, static and dynamic routing, Dynamic Host Control Protocol (DHCP), IEEE 802.1p Quality of Service (QoS) support, IEEE 802.1q VLAN support, traffic shaping and Adaptive Coding and Modulation (ACM). A dual IPv4/IPv6 TCP/IP stack is provided. IPv4 support is provided for all IP functions as the default. With respect to IPv6, bridging and routing are supported along with an IPv6 embedded web server. Modem IP addresses and static routes can also be entered and displayed in IPv6 format. **TCP acceleration** is supported at up to the maximum data rate for the modem. Up to 10000 concurrent accelerated TCP connections are supported along with up to 40,000 unaccelerated TCP connections. Bandwidth utilization when TCP acceleration is enabled is typically over 90%. **Bridging** and **static routing** are supported. Ethernet, IP, User Datagram Protocol (UDP) and Real Time Protocol (RTP) **header compression** are supported. The 14-byte Ethernet frame is typically compressed to one byte. IP/UDP/RTP headers are typically compressed to between one and three bytes. The one-way packet processing limit for header compression is 60,000 packets per second (pps); the two-way limit is 45,000 pps. IP/UDP/RTP header compression is compliant with the RFC 3095 (Robust Header Compression) standard. **IP payload compression** is provided (compliant with the RFC 1951 'DEFLATE' standard). This compresses TCP and UDP packet payloads by typically 50%.
- Trunk and access VLAN modes are supported, along with filtering on specific VLANs at the remote modems.

5.2 Standard-Fit Hardware

5.2.1 IF/L-band Operation

The following are provided as standard:

- IF operation, via transmit and receive IF BNC connectors (supporting 50Ω and 75Ω operation at 50 to 90MHz and 100 to 180MHz).
- L-band operation, via transmit and receive L-band N-type connectors (supporting 50Ω operation at 950 to 2150MHz).
- A high-stability L-band 10MHz reference signal for output to a Block Up Converter (BUC) or Low-Noise Block (LNB) in order to phase-lock the BUC or LNB's local oscillator to a highly stable frequency reference. The 10MHz reference can also be output through the 50Ω BNC station clock connector.
- A Frequency Shift Keying (FSK) capability for performing FSK communications to and from a compatible BUC or IF transceiver. This allows remote monitoring and control of the BUC or transceiver via a modulated FSK signal on the Inter-Facility Link (IFL) cable.

Note that a single Rx BNC and a single Rx N-type connector are provided. The inbound carriers must all be contained within a 72MHz frequency span in order for the different carriers to be processed correctly by the multiple demodulators.

5.2.2 Ethernet Operation

Four Gigabit Ethernet RJ45 connectors are fitted as standard. These can be used for modem Monitor and Control (M&C) and satellite traffic. These provide a combined 150,000 packets-per-second processing capability and an overall data rate over satellite of up to 200Mbps. Layer 2 bridging and Layer 3 routing are supported in software.

Trunking mode is our name for a hardware Layer 2 switch that supports 200Mbps bi-directional traffic at up to 500,000 packets per second with zero jitter.

Ethernet speed, duplex and cable termination (crossover versus straight-through) are auto-negotiated. Speed and duplex can be set to fixed values if desired.

5.3 Hardware Options

5.3.1 BUC Power Supply Options

The satellite modem may optionally be fitted with a Power Supply Unit (PSU) for powering a Block Up Converter (BUC) when operated in L-band mode. Refer to **Table 5-1** for the available BUC power supply options.

Part Number	BUC PSU	Type
P3543	200W 24V output	A.C. in/D.C. out
P3544	200W 48V output	A.C. in/D.C. out
P3545	+/-48V input, 200W 24V output	D.C. in/D.C. out
P3546	+/-48V input, 200W 48V output	D.C. in/D.C. out
P3547	+48V input, 200W 48V output	D.C. in/D.C. out

Table 5-1 BUC Power Supply Options

5.4 Software Options

Several software options, known as Software Activated Features (SAF), are available as shown in **Table 5-2**. These can be purchased on a pay-as-you-go basis and retrospectively activated in deployed units as required. The SAF concept (including time-limited free access to most features) is explained in Section 8.5.

In the table, the *SAF Code* column lists the acronyms by which features are referred to on the modem's local user interface.

Feature	SAF Code	Description
Tx Terrestrial data rate to 200Mbps	DR6	Enables data rates in the given range.
Rx Terrestrial data rate to 200Mbps	DR1	Enables data rates in the given range.
DVB-S2X CCM Tx	S2XT	Enables DVB-S2X Tx operation for all supported modulations. Includes XStream IP™ Tier 1 (Tx only).
DVB-S2 CCM Tx	DVB2T	Enables DVB-S2 Tx operation for all supported modulations. Includes XStream IP™ Tier 1 (Tx only). Bundled together with **DVB-S2X CCM Tx.**
FastLink™ LDPC Tx	FL	Enables **FastLink™** low-latency LDPC Tx to 100Mbps/40Msps. Includes all relevant modulations, FEC rates and roll-offs.
4 multi-demodulator operation	RX4	Controls access to the Rx service for multi-demodulators numbers 1 to 4.
8 multi-demodulator operation	RX8	Controls access to the Rx service for multi-demodulators numbers 1 to 8.
12 multi-demodulator operation	RX12	Controls access to the Rx service for multi-demodulators numbers 1 to 12.
16 multi-demodulator operation	RX16	Controls access to the Rx service for multi-demodulators numbers 1 to 16.
XStream IP™ Tier 1 (Tx only)	XS1	Provided as standard with **DVB-S2X CCM Tx** and **DVB-S2 CCM Tx**; includes: • **Traffic Shaping:** CIR/BIR/priority settings for IP streams classified by VLAN ID, IP address, IEEE 802.1p priority and Diffserv DSCP • **IP-over-DVB Encapsulation:** transmission of IP packets and Ethernet frames over DVB-S2/S2X using Paradise XStream Encapsulation (PXE)
XStream IP™ Tier 2 (Tx only)	XS2	Requires **DVB-S2X CCM Tx** or **DVB-S2 CCM Tx** option; includes: • DVB-S2/S2X point-to-multipoint ACM • DVB-S2/S2X point-to-multipoint VCM

Table 5-2 Software Activated Features (continues over page)

Feature	SAF Code	Description
XStream IP™ Tier 3 (Tx & Rx)	XS3	Applies to Tx and Rx (does not require XStream IP™ Tier 1 or Tier 2 options); supports all enabled demodulators; includes: • **Header Compression:** IP/UDP/TCP/RTP packet header compression (RFC 3095) plus Ethernet header compression • **Payload Compression:** TCP/UDP packet payload compression using the Deflate algorithm (RFC 1951) • **TCP Acceleration:** Supports up to 10,000 concurrent accelerated TCP connections at up to 100Mbps • ***AES-256 Encryption:*** *Please note that AES-256 Encryption (TCP/IP packet payload encryption using AES with 256-bit keys) is supported on the* ***Q-MultiFlexE™*** *model only. The Q-MultiFlexE™ is identical to the standard Q-MultiFlex™ in every other respect*
DVB-CID	CID	DVB Carrier ID. Tx carrier identification per ETSI 103 129.

Table 5-2 Software Activated Features

5.5 Front Panel

Figure 5-1 Front Panel

The front panel, shown in **Figure 5-1**, comprises:

- Light Emitting Diodes (LEDs) that provide basic modem status.
- A Liquid Crystal Display (LCD) that acts as the local user interface.
- A keypad for menu navigation and alphanumeric entry.
- USB port for software upgrades, copying configuration memories, etc.

5.5.1 Status Indicators

The five front-panel LEDs display warning and fault information as shown in **Figure 5-2** and as described in **Table 5-3**.

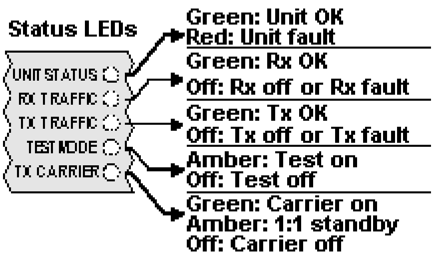


Figure 5-2 Front-panel Status Indicators

	Off	**Red**	**Amber**	**Green**
Unit Status	*Not used*	Unit fault	*Not used*	Unit OK
Rx Traffic	Rx fault or Rx disabled	*Not used*	*Not used*	Rx OK
Tx Traffic	Tx fault or Tx disabled	*Not used*	*Not used*	Tx OK
Test Mode	Normal mode	*Not used*	Test mode	*Not used*
Tx Carrier	Carrier muted	*Not used*	1:1 standby	Carrier active

Table 5-3 Front-panel LED Status

Note that the Rx Traffic LED is a summary status for all of the active demodulators.

5.5.2 LCD Display

The backlit LCD is a graphical display formatted to give three lines of 40 text characters and is highly legible even in strong ambient light. The contrast is adjustable and the backlight can be dimmed or brightened as required.

5.5.2.1 Keypad

The keypad (see **Figure 5-3**) is incorporated into a sealed tactile membrane and allows full alphanumeric entry and navigation using arrow keys.

Figure 5-3 Front-panel Keypad

5.6 Rear Panel

The rear panel, shown in **Figure 5-4**, provides a full set of terrestrial and satellite data interfaces. Connector pinouts are defined in Chapter 11.

Figure 5-4 Rear Panel

From left to right, the rear panel consists of:

- **IEC Mains Power Connector/Voltage Selector/Fuse**

  The modem is designed to operate from a mains AC supply of 90V to 264V (1A @100V, 0.5A @ 240V, 47 to 63Hz). The IEC connector incorporates two fuses, independently fusing both live and neutral lines. Access to the fuses is provided by a slide-out tray. Both fuses are standard 20mm type, rated T3.15A, of the slow-blow (time-delay) type.

- **Chassis Ground Stud**

  There is an M4 stud for connecting a safety earth conductor directly to the chassis of the unit.

- **Alarms and AGC Connector**

  This is a 15-pin D-type male connector that provides access to four 'form-C' relay contacts that indicate alarm conditions. An AGC output is provided that is suitable for peaking antenna position.

  The alarm relays have the following definitions:

  Unit Fault: A fault exists on the unit indicating an equipment failure.

  Traffic Prompt: A Tx traffic fault exists.

  Rx Traffic Prompt: An Rx traffic fault exists.

  Deferred Alarm: One of the following conditions exists:

  - The receive Eb/No is lower than the user-defined threshold.
  - Buffer slips are more frequent than the user-defined threshold.

- **Async ESC Connector**

  This is a 15-pin D-type female connector. This is currently unused.

- **Tx IF Output**

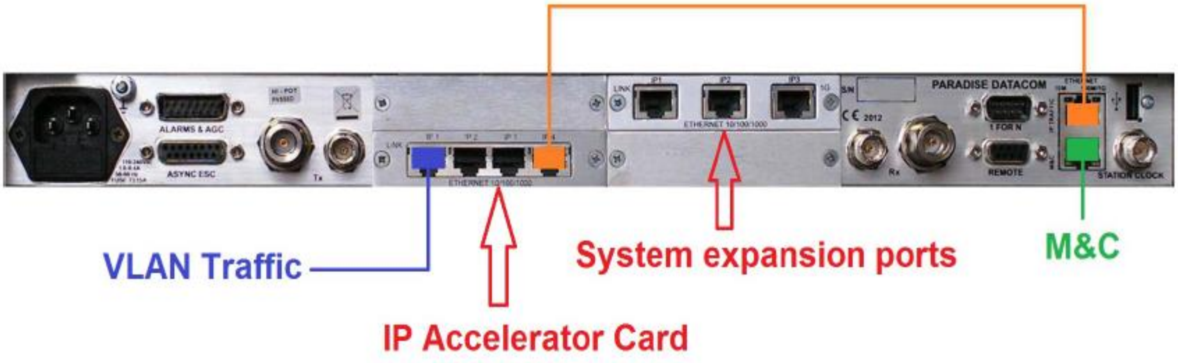
  This is a 50Ω/75Ω BNC female connector. The output power level can be varied from 0dBm to -25dBm.

- **Tx L-band Output**

  This is a 50Ω N-type female connector (although 75Ω cables can also be used without any problem). The output power level can be varied from 0dBm to –40dBm.

- **Terrestrial Interface Positions**

  Q-MultiFlex rear panel will only have Ethernet option cards. Three additional Ethernet ports will always be fitted. These are reserved for system expansion. In addition, newer Q-MultiFlex units will always have an IP accelerator card fitted. The connections are shown below. A short Ethernet cable (shown in orange) is required to connect the IP Accelerator card and the base Modem. It is important that this connection is between the base Modem IP traffic port (above the M&C port) and the IP Accelerator port IP4. Do not plug anything into ports IP2 & IP3 on the IP accelerator card.



If the IP accelerator card is not fitted, the LAN router/switch connects directly to the IP TRAFFIC port above the M&C port.

- **Rx IF Input**

This is a 50Ω/75Ω BNC female connector. The carrier signal level at the input of the modem must be in the following range:

Minimum signal level: -115 +10 log (symbol rate) dBm

Maximum signal level: -80 + 10 log (symbol rate) dBm

The maximum wanted-to-composite power level that is supported with no implementation loss is defined by the equation:

Maximum wanted-to-composite power level: -94 + 10 log (symbol rate) dBm

The maximum composite power level is +10dBm.

- **Rx L-band Input**

This is a 50Ω N-type female connector (although 75Ω cables can also be used without any problem). The carrier signal level at the input of the modem must be in the following range:

Minimum signal level: -130 +10 log (symbol rate) dBm

Maximum signal level: -80 + 10 log (symbol rate) dBm

The maximum wanted-to-composite power level that is supported with no implementation loss is defined by the equation:

Maximum wanted-to-composite power level: -102 + 10 log (symbol rate) dBm

The maximum composite power level is +10dBm.

- **Fans**

  There are two side-mounted high-performance fans that draw air in through ventilation holes in the sides of the unit and expel the air outwards. The side vents must not be blocked.

- **1:1 Redundancy Connector**

  The modem has a built-in 1:1 redundancy controller that connects to the other modem in the 1:1 pair via a 9-pin D-type male connector. A 1:1 redundancy system requires two modems, a 1:1 control cable between the two redundancy connectors, a 'Y' cable for splitting the traffic path and passive splitters and combiners for the IF ports. An overview of 1:1 operation is provided in Section 7.3. A 1:N redundancy system is also available.

- **Serial Remote M&C Connector**

  This is currently not used.

- **Ethernet IP Traffic and Remote M&C Connectors**

  Two Gigabit Ethernet RJ45 connectors are provided on the base unit for modem Monitor and Control (M&C) and satellite traffic respectively. Ethernet speed, duplex and cable termination (crossover versus straight-through) are auto-negotiated. Line speed and duplex can also be set to fixed values. The two Ethernet ports can be bridged together under software control. A further three Gigabit IP traffic ports are available as standard on an extension card, creating a four-port switch when combined with the base modem IP traffic port.

  M&C control can be via the Simple Network Management Protocol (SNMP), an embedded web server that sends web pages to a web browser, a Telnet-style terminal emulation application or via TCP packets that encapsulate Paradise Universal Protocol (PUP) commands.

SNMP is disabled by default and must be enabled before it can be used. Once enabled, the modem will always respond to SNMP commands regardless of whether it has been placed in a mode that restricts user control to the front panel only.

  When using the M&C interface, an M&C IP address (including subnet mask and default gateway) must be set. An IP traffic address is not required when operating in Ethernet bridging modes. IP addresses are described in Section 7.8.2.

- **Station Clock**

  This is currently not used.

Chapter 6 User Interfaces

6.1 User Control

The modem has both front-panel and web browser user interfaces.

For remote web browsing, there are two fixed user names, namely, *admin* and *user*. The *admin* user can view and change the modem configuration, while *user* can only view the modem settings. Only *admin* can change the passwords associated with these two user names.

There is no restriction on the number of users (as either *admin* or *user*) that can be logged in at the same time. Remote *admin* users who log in while the modem is under local front-panel control will be restricted to view-only permissions.

6.1.1 Local Mode

Local mode allows control of the modem from the front-panel interface only. Web users are still able to log in and view the modem settings in this mode.

6.1.2 Takeaway Mode

In *Takeaway mode*, the modem can be controlled through the front-panel or via a remote *admin* user at the same time. When the modem is switched out of *Takeaway mode* to *Local mode* then all remote *admin* users will be automatically logged out.

While *Takeaway mode* is very convenient, it is essential for there to be clear operational procedures in place to avoid conflicts arising in relation to modem control.

6.2 Web User Interface

The modem includes an embedded web server that allows full monitoring and configuration of the modem via a web browser (on port 80).

Secure connections via HTTPS (on port 443) are also supported. Non-secure connections via HTTP (port 80) can optionally be disabled.

Google Chrome, Mozilla Firefox and Microsoft Internet Explorer web browsers are supported.

6.2.1 Login Screen

To connect to the modem from a web browser, ensure an Ethernet cable is connected into the Remote M&C RJ45 socket on the rear of the modem. From the modem front panel enter (under *Edit->Unit->M&C->IP Address*) an IP address and subnet mask that are compatible with your network. Then enter the modem's IP address into the web browser address bar.

The browser will then request (as shown in **Figure 6-1**) a user name and password. The default *admin* and view-only *user* passwords are both set to *paradise*. It is recommended that passwords are changed from their default values. When entered, the login details are sent in an encrypted form back to the modem.

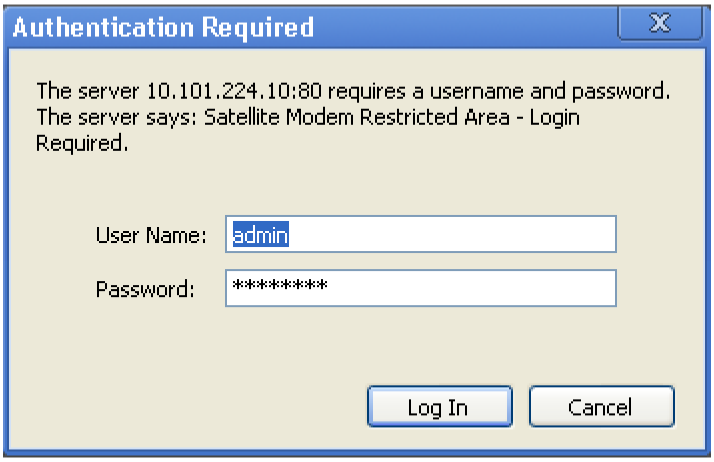


Figure 6-1 Web User Interface Login Screen

On successfully logging in, the user will be presented briefly with the screen shown in **Figure 6-2**.

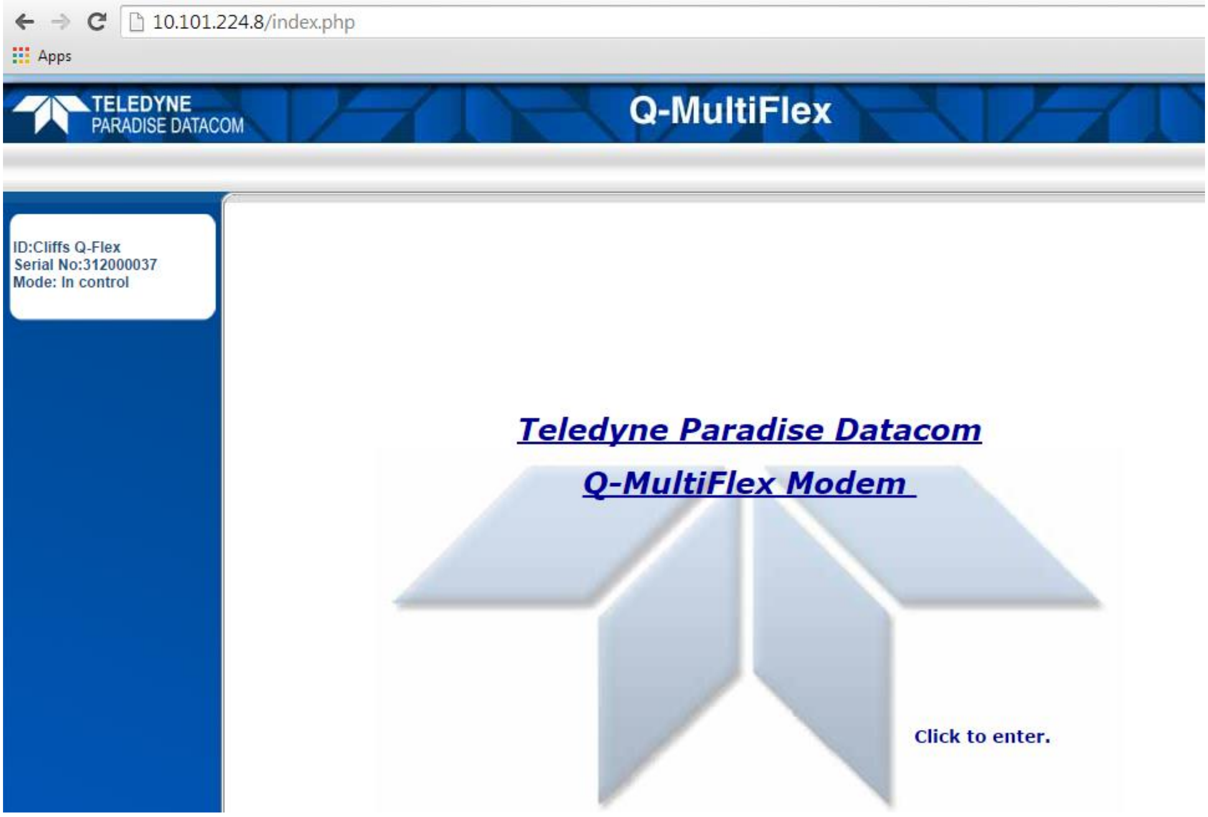


Figure 6-2 Web Server Welcome Screen

This screen will include the text 'The web user interface is in 'View-only' mode' when the modem is in *Local* control mode, in which modem control is restricted to front-panel operation only. The Status screen shown in **Figure 6-3** will then be presented.

6.2.2 Status Screen

The Status screen is shown in **Figure 6-3**.

Note that 1:N backup modems will show additional status information as defined in the document '*Q-NET™ PDQS Redundancy Switch Installation and Operating Handbook*', which is available for download from http://www.paradisedata.com.

Figure 6-3 Status Screen

The line of buttons across the top of the display (i.e. STATUS, EDIT, VIEW, TEST and HELP) give access to the major modem functions, while the tabs below the buttongs give access to individual menus. Tabs are nested and several levels of tab may be displayed at once, allowing the user to see where they currently are in relation to the overall menu system. The main part of the screen will change with the tab menu that is selected. The panel on the left-hand side of the web page contains summary status information and is always displayed. This area is also used to display Help information when the cursor is moved over individual menu options. The Light-Emitting Diodes (LEDs) displayed in the left-hand panel mimic the front-panel LED indicators of the modem.

Note that the web browser pages served by the modem will be automatically reconfigured to hide irrelevant information and options, in accordance with the available features and the current user selections. Actual web pages may therefore look significantly different to those shown in this handbook.

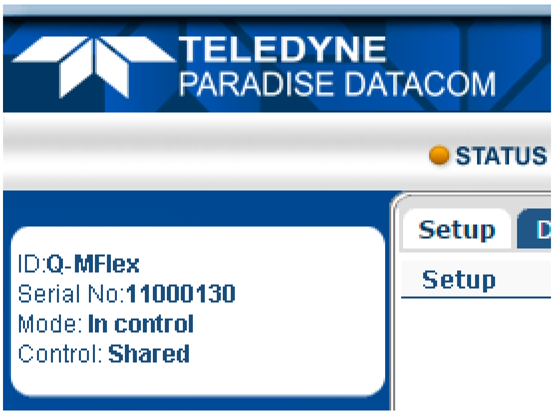


Figure 6-4 Unit Summary Status

Summary status information for the modem is shown at the top left-hand side of the screen as shown in **Figure 6-4**. This presents the following:

- 'ID': The user-entered modem-identification text string.
- 'Serial No.': The modem serial number.
- 'Mode': This will show either 'In control', when the web user has full control over the modem or, 'View only' when the web user is restricted to viewing modem information but cannot change the modem's configuration.

The *Status* screen contains the current modem status split over several screens as described in the following sections.

6.2.2.1 Setup

The *Setup* section (right-hand side) of the *Status Summary* page shows the following information:

- *Transmit carrier frequency.*
- *Transmit and receive terrestrial data rates.*
- *Transmit and receive symbol rates.*
- *Transmit carrier bandwidth at the -3dB point.*
- *Transmit carrier bandwidth at the -30dB point*.
- *The number of demodulators that have been enabled*.

The carrier bandwidth values are useful for performing bandwidth comparisons between different modem configurations, including the use of different spectral roll-off factors. The carrier does not contain any useful information below the -3dB point. There are various definitions of occupied and allocated bandwidth and therefore the -30dB point is used in order to provide an unambiguous reference point. When determining the bandwidth of the carrier, various cut-off points are used by satellite operators, with -30dB being the worst case. Satellite operators will also add a guard band that further increases the overall bandwidth requirements.

6.2.2.1.1 Status

The *Status* section (left-hand side) of the *Status Summary* page is continually updated with the following information:

- *Transmit path status*. When there is no transmit path fault then the message 'Tx OK since HH:MM:SS on DD/MM/YY' is displayed (where 'HH' indicates hours, 'MM' indicates minutes, 'SS' indicates seconds, 'DD' indicates the day of the month, 'MM' indicates the month of the year and 'YY' indicates the year). When a transmit path fault exists then a fault message is displayed instead that indicates the nature of the fault.
- *Receive path status*. When there is no receive path fault then the message 'Rx OK since HH:MM:SS on DD/MM/YY' is displayed (where the time and date format is as above). When a receive path fault exists then a fault message is displayed instead that indicates the nature of the fault.
- *IP Tx buffer fill status*. This shows, as a percentage, how full the modem's transmit buffer towards satellite is.
- *Receive composite power level* (i.e. all of the power in the whole receive channel, consisting of both wanted and unwanted signal).

6.2.2.2 Status ACM

The *Adaptive Coding and Modulation* (*ACM)* section of the *Status* screen is displayed and continually updated with the following while ACM is active:

- *Remote modem Es/No* (energy per symbol to spectral noise density ratio).
- *Transmit data rate*. This is the instantaneous transmit data rate, which varies with *modcod* (modcod is the term used to describe the combination of modulation and FEC rate).
- *Transmit modcod*. This is the current transmit modulation and FEC rate, which vary with remote Es/No.
- *Receive data rate*. This is the instantaneous receive data rate, which varies with modcod.
- *Receive modcod*. This is the current receive modulation and FEC rate, which the remote modem varies in accordance with the Es/No being received by the local modem.

ACM operation is described in Section 7.8.12.

6.2.2.3 Status AUPC

The *Automatic Uplink Power Control (AUPC)* section of the *Status* screen is displayed and continually updated with the following information when AUPC is enabled:

- *Remote Eb/No*. This is the current Eb/No reported by the remote modem.
- *Power offset*. This is the current offset that has been applied to the nominal modem power output level in order to maintain the remote Eb/No at the target level.
- *Link*. This is the status of the Engineering Service Channel (ESC) link, which in non-DVB-S2 modes is used to pass AUPC control messages to the remote

modem and to read back the remote Eb/No level. The ESC channel is not used when AUPC is used with DVB-S2. The status is shown as *Failed* if the link is not working correctly otherwise it will be shown as *OK*.

6.2.2.4 Status Demodulators

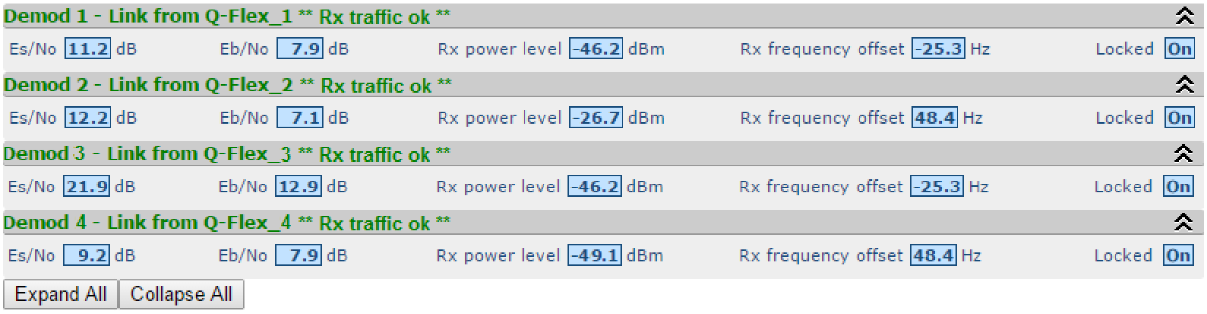


Figure 6-5 Status Demodulators Screen

Under the *Status Demod* tab(s), the screen is continually updated with the following information for each active demodulator:

- *Receive Es/No* (i.e. energy per symbol to spectral noise density ratio).
- *Receive Eb/No* (i.e. the energy per bit to spectral noise density ratio).
- *Receive power level* (i.e. the level of the wanted signal).
- *Receive frequency offset.* This is the measured offset from the expected carrier centre frequency. It indicates any frequency shift that is introduced by the satellite and frequency conversion equipment.
- *Receive composite power level* (i.e. all of the power in the receive channel, consisting of both wanted and unwanted signal).

The visibility of individual demodulators is controlled by the  icons on the right hand side of the screen.

6.2.2.5 Status BUC/LNB

Under the *Status BUC/LNB* tab, Block Up Converter (BUC) status is continually updated with the following information when a BUC is being controlled from the modem:

- *BUC output.* This is the output power in dBm at the waveguide flange, or *Off* when the BUC is not transmitting.
- *BUC temperature*. This shows the temperature in degrees Centigrade reported by the BUC.
- *BUC class*. This shows the BUC power class in Watts.
- *BUC current*. When a BUC PSU is fitted then this shows the BUC current level in Amperes.
- *LNB voltage.* When an LNB is fitted then this shows the LNB voltage in Volts.

- *LNB current.* When an LNB is fitted then this shows the LNB current in milli-Amperes.

All of the BUC status, other than BUC current, requires a communications link to exist between the modem and the BUC. BUC and LNB under and over-current alarms can be controlled via the *Edit->Unit->Alarms* screen. (Note that only **Q-Flex™** modems produced from the second half of 2014 onwards support the LNB current monitor function.)

6.2.3 Edit Screen

The *Edit* screen contains the following tab menu options:

- *Service.* These menus allow setup of the modem transmit and receive paths plus BUC/LNB.
- *Unit.* These menus contain all of the general modem configuration settings including the terrestrial interface, monitor and control, alarms, station clock and Software Activated Features (SAF) settings. They also include a software upgrade factility.
- *IP.* This menu allows setup of the IP traffic interface.
- *Memories.* These menus support the storing, recall, deletion, upload and download of modem configurations.
- *Redundancy.* These menus control modem 1:1 and 1:N redundancy.

When a value is changed in an edit or dropdown box, the background for the box will change to red while the modem is actioning the change, as shown in the example below.

Example of Modem Actioning a User-Requested Change

The box will change back to its standard background color when the modem has implemented the change. Note that each change must be fully completed before the next change can be made.

6.2.4 Edit->Service->General Screen

The *Edit->Service->General* screen is shown in **Figure 6-6**.

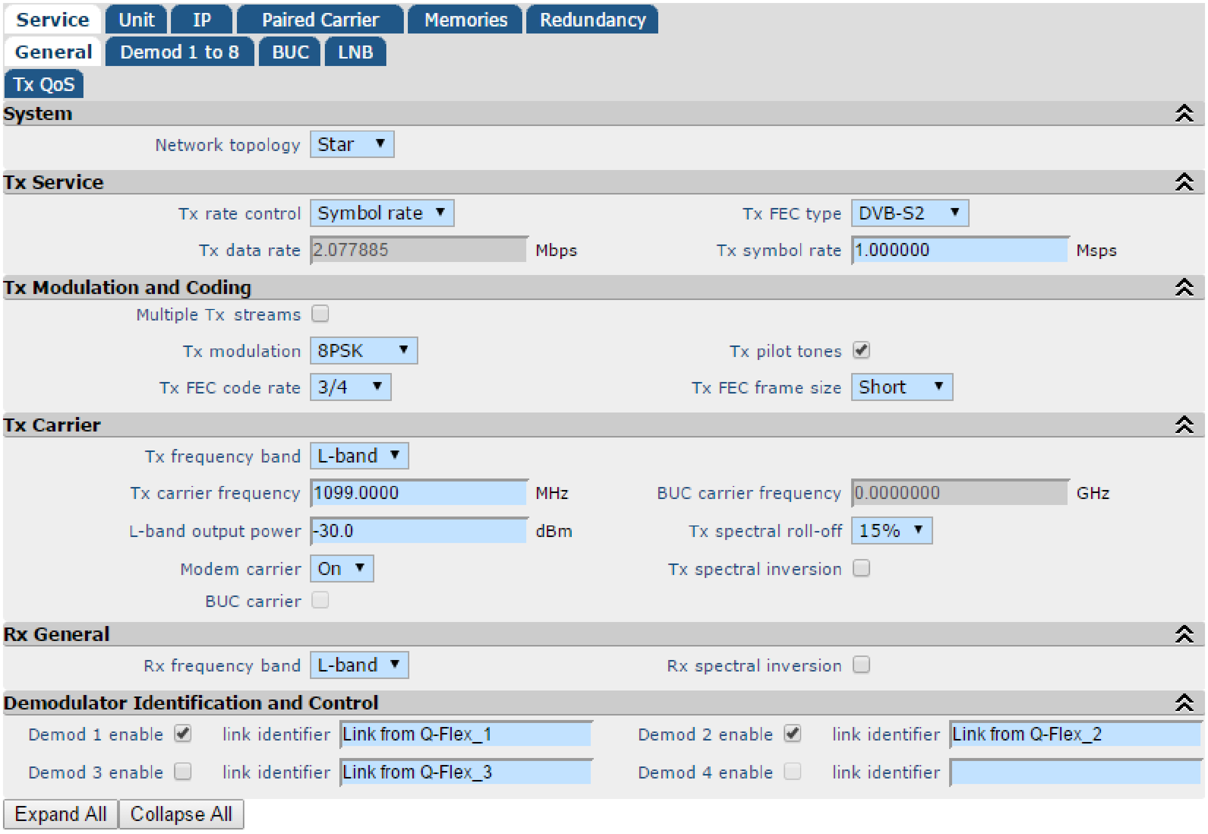


Figure 6-6 Edit->Service->General Screen

It should be noted that some of the underlying transmit service settings are fixed and cannot be changed. This is explained below.

- **FastLink™ will always use the FastLink™ *Balanced* optimization mode.**
- **Mesh network mode always uses FastLink™ for both the outbound and inbounds.**
- **The transmit clock source will always be set to *Internal*.**

6.2.4.1 Network Topology

Table 6-1 shows the *Network topology* options.

Mesh	Mesh mode supports direct site-to-site communications. Mesh communications requires the same FEC to be used on the outbound and inbound carriers. When mesh is selected, **FastLink™** will be automatically selected as the outbound FEC in place of DVB-S2/S2X.
Star	Star mode supports hub and spoke communications. DVB-S2/S2X and **FastLink™** are supported for the shared outbound. The inbounds will use **FastLink™** LDPC, which supports low latency. The remote modems should be set to receive DVB-S2/S2X or **FastLink™** and to transmit **FastLink™** (set to *Balanced* optimization mode). Remote-to-remote communications are supported via the hub.

Table 6-1 Network Topology

6.2.4.2 Tx Rate Control

Data rate	This allows the user to enter a data rate, from which a symbol rate is calculated.
Symbol rate	This allows the user to enter a symbol rate, from which a data rate is calculated.

Table 6-2 Tx Rate Control

6.2.4.3 Tx Data Rate

Range:	0.0048Mbps to 200.0Mbps; step size: 0.000001Mbps
Description:	The terrestrial data rate is the maximum number of data bits that the modem will process in relation to the selected terrestrial interface. The relationship between the terrestrial data rate and the size of the satellite channel is complex. The modem will calculate and display the channel symbol rate for the current configuration, or alternatively, for link budget analysis, a comprehensive *Rate Calculator* is available from Technical Support. For IP, the terrestrial data rate must allow for all overhead due to IP headers and Ethernet frames. As an alternative to setting the terrestrial data rate, the modem also allows the satellite-link symbol rate to be set and will use this to determine the terrestrial data rate.

	The minimum and maximum data rate limits are determined by a number of factors such as the FEC type and FEC rate. The modem will generally prevent invalid data rates from being set and in the event that a limit is exceeded then a configuration warning will be generated.

Table 6-3 Tx Data Rate

6.2.4.4 Tx Symbol Rate

Range:	0.0018Msps to 50.0Msps; step size: 0.000001Msps
Description:	As an alternative to setting the terrestrial data rate, it is possible to set the symbol rate for the satellite link, which will then determine the data rate. In the absence of the user setting the symbol rate, it will be determined by other settings such as the terrestrial data rate, modulation and FEC rate.

Table 6-4 Tx Symbol Rate

6.2.4.5 Tx FEC Type

DVB-S2X	This enables DVB-S2X operation, making all of the DVB-S2X modulation and FEC rates available (from QPSK to 64APSK). DVB-S2X is not available as an option when *Mesh* network mode is selected.
DVB-S2	This enables DVB-S2 operation (from QPSK to 32APSK).
FastLink	This enables *FastLink* low-latency Low-Density Parity-Check (LDPC) FEC. *FastLink* gives BER performance approaching that of conventional LDPC but with latency nearer to that of TPC.

Table 6-5 Tx FEC Type

6.2.4.6 Multiple Tx Streams

This is an On/Off checkbox that controls whether the terrestrial traffic coming into the **Q-MultiFlex™** consists of a single stream or multiple streams.

Single stream mode allows a single modcod to be applied to the shared outbound carrier, whereas with multiple streams, potentially different modcods can be applied to the individual streams when they are transmitted over satellite in the shared outbound carrier (a feature known as Variable Coding and Modulation (VCM)). There is no change to the overall symbol rate or power of the outbound carrier when the bandwidth is shared between several different modcods.

In addition, the traffic shaping options differ between single stream and multiple streams.

When the shared outbound is represented by a single stream (i.e. single modcod) then the QoS classification methods are VLAN IDs, IP addresses, Diffserv and IEEE 802.1p priority tags.

With multiple streams, there are two tiers of QoS classification. The primary multistreaming QoS classification methods are VLAN ID and IP address. If VLAN ID is used for the primary classification then a secondary classification method can be selected (from amongst IP address, Diffserv and IEEE 802.1p priority tags).

Multiple streams are supported only when DVB-S2 or DVB-S2X is used as the Tx FEC. The number of streams that are supported is the same as the number of demodulators that have been SAF enabled.

In summary, when the terrestrial traffic is treated as a single stream, it is defined by a single modcod and an optional set of QoS classes. Multiple streams are defined by a set of modcods (one per stream) and up to two tiers of QoS classes. The first tier defines which packets go to which remote (and how much bandwidth each remote gets as part of the shared outbound) and the second tier defines how the bandwidth is split between the different types of packets destined for a particular remote. As an example, bandwidth in the shared outbound may be shared equally between all remotes based on VLAN ID and then the bandwidth may be further subdivided based on Diffserv classes that represent different applications running at each remote.

When multiple streams are enabled then the normal ‘single stream modcod’ (i.e., modulation, FEC rate, pilots and frame size) described in the following sections is disabled, being replaced by multiple stream equivalents that are specified under the *Edit->Service->General->Tx QoS* tab.

6.2.4.7 Tx Modulation

The modulations that are available depend on the FEC type. The supported combinations are listed in **Table 6-6**.

6.2.4.8 Tx FEC Code Rate

The FEC rates that are available depend on the FEC type and modulation that are selected. The supported combinations are listed in **Table 6-6**.

FastLink	BPSK: 0.499 QPSK (and OQPSK): 0.532, 0.639, 0.710, 0.798 8PSK: 0.639, 0.710, 0.778 8QAM: 0.639, 0.710, 0.778 16APSK: 0.726, 0.778, 0.828, 0.851 16QAM: 0.726, 0.778, 0.828, 0.851 32APSK: 0.778, 0.828, 0.886, 0.938 64QAM: 0.828, 0.886, 0.938, 0.960
DVB-S2	QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10
DVB-S2X *DVB-S2X Low-latency Mode*	**Normal Frame:** QPSK: 13/45, 9/20, 11/20 8PSK: 23/36, 25/36, 13/18 8APSK-L: 5/9, 26/45 16APSK: 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90 16APSK-L: 5/9, 8/15, 1/2, 3/5, 2/3 32APSK: 32/45, 11/15, 7/9 32APSK-L: 2/3 64APSK: 11/15, 7/9, 4/5, 5/6 64APSK-L: 32/45 **Short Frame:** QPSK: 11/45, 4/15, 14/45, 7/15, 8/15, 32/45 8PSK: 7/15, 8/15, 26/45, 32/45 16APSK: 7/15, 8/15, 26/45, 3/5, 32/45 32APSK: 2/3, 32/45 **Very Short Frame:** (Frame size of 5,400 bits, reducing latency to 33% of standard DVB-S2 Short frame) QPSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 8PSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 16APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 32APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 **Ultra Short Frame:** **(**Frame size of 3,240 bits, reducing latency to 20% of standard DVB-S2 Short frame) QPSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 8PSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 16APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 32APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9

Table 6-6 Tx Modulation and FEC Code Rates

6.2.4.9 Tx Pilot Tones

Pilots are an On/Off control that controls whether DVB-S2 pilots, which are unmodulated symbols, are injected into the carrier on a regular basis in order to help the demodulator lock onto the carrier. The pilots are 36 symbols long and are injected every 1440 symbols, representing an additional overhead of around 2.4%. Pilots are recommended for FEC rates below rate ½ and for situations where the receive signal may be degraded.

6.2.4.10 Tx Frame Size

Short	This represents a frame size of 16,200 bits per frame.
Normal	This represents a frame size of 64,800 bits per frame. This is more bandwidth efficient than short frames but has four times the latency. As a guideline, short frames have a latency of around 25ms at 1Mbps, whereas the latency for normal frames is around 100ms at 1Mbps. The latency will halve as data rate doubles.
Very short	This represents a frame size of 5,400 bits, reducing latency to 33% of the standard DVB-S2 Short frame.
Ultra short	This represents a frame size of 3,240 bits, reducing latency to 20% of the standard DVB-S2 Short frame.

Table 6-7 Tx Frame Size

6.2.4.11 Tx Frequency Band

The modem supports independent selection of IF and L-band operation in transmit and receive. This menu option controls the transmit frequency band.

IF	This selects the 70MHz and 140MHz IF bands, allowing operation from 50MHz to 90MHz and 100MHz to 180MHz.
L-band	This selects L-band, allowing operation from 950MHz to 2150MHz.

Table 6-8 Tx Frequency Band

6.2.4.12 Tx Carrier Frequency

There are various Tx frequency control options, depending on whether IF or L-band has been selected and whether a BUC is fitted that is being controlled via the modem. The frequency control options are presented in **Tables 6-9** through **6-11**.

Range:	50.0MHz to 180.0MHz; step size: 0.0001MHz (i.e. 100Hz)
Description:	This is the IF frequency used in transmitting to satellite. Note that values between 90MHz and 100MHz cannot be selected.

Table 6-9 Tx Carrier Frequency (IF)

Range:	950.0MHz to 2150.0MHz; step size: 0.0001MHz (i.e. 100Hz)
Description:	This is the L-band frequency used in transmitting to satellite. If the *BUC LO frequency* has been set on the *Edit->Service->BUC* menu then the L-band transmit frequency will no longer be available and will be automatically controlled by the modem to achieve the requested BUC transmit frequency.

Table 6-10 Tx Carrier Frequency (L-band)

Range:	0.0GHz to 99.999GHz; step size: 0.0000001GHz (i.e. 100Hz)
Description:	This is the BUC frequency used to transmit to satellite.

Table 6-11 BUC Carrier Frequency

6.2.4.13 IF/L-band Output Power

Range:	0.0dBm to -25.0dBm; step size: 0.1dBm
Description:	This sets the transmitted output power when using IF.

Table 6-12 IF Output Power

Range:	0.0dBm to -40.0dBm; step size: 0.1dBm
Description:	This is the transmitted output power when using L-band.

Table 6-13 L-band Output Power

6.2.4.14 Modem Carrier

This allows the modem carrier to be switched on/off.

6.2.4.15 Tx Spectral Roll-off

The spectral roll-off determines the slope of the carrier at its edges. The supported roll-off factors are listed in **Table 6-14**.

Range:	5%, 10%, 15%, 20%, 25%, 35%
Description:	All spectral roll-off factors are available for all FECs (with the exception of the low-cost version of DVB-S2, which supports roll-off factors down to and including 15% roll-off). A comparison of the different spectral roll-offs, including their effect on carrier power, is provided in the document '*Saving Satellite Bandwidth by Optimising Spectal Roll-off*'. This is available from the White Papers section of the Paradise web site at http://www.paradisedata.com.

Table 6-14 Tx Spectral Roll-off

6.2.4.16 Tx Spectral Inversion

Spectral inversion is an On/Off control that controls whether the carrier I and Q components are swapped or not, allowing the modem to compensate for any other equipment in the transmit or receive chain that has introduced a spectral inversion.

6.2.4.17 BUC Carrier

This allows the BUC carrier to be switched on/off. BUC carrier control requires a control channel (i.e. FSK or RS485) to exist between the modem and the BUC.

6.2.4.18 Rx Frequency Band

The modem supports independent selection of IF and L-band operation in transmit and receive. This menu option controls the receive frequency band.

IF	This selects the 70MHz and 140MHz IF bands, allowing operation from 50MHz to 90MHz and 100MHz to 180MHz.
L-band	This selects L-band, allowing operation from 950MHz to 2150MHz.

Table 6-15 Rx Frequency Band

6.2.4.19 Rx Spectral Inversion

Spectral inversion is an On/Off control that controls whether the carrier I and Q components are swapped or not, allowing the modem to compensate for any other equipment in the transmit or receive chain that has introduced a spectral inversion.

6.2.4.20 Demod Enable/Disable & Demod Link Identifier

Each demodulator is controlled by an invidual checkbox that enables or disables the associated demodulator, as desired. Each demodulator can optionally be associated with a link identifier that represents a meaningful name (alpha-numeric text string) for the associated inbound carrier or remote site.

In order not to interfere with other active demodulators, a demodulator needs to be disabled before its configuration can be changed.

6.2.5 Edit->Service->General->Tx QoS Screen

The *Edit->Service->General->Tx QoS* screen is shown in **Figure 6-7**.

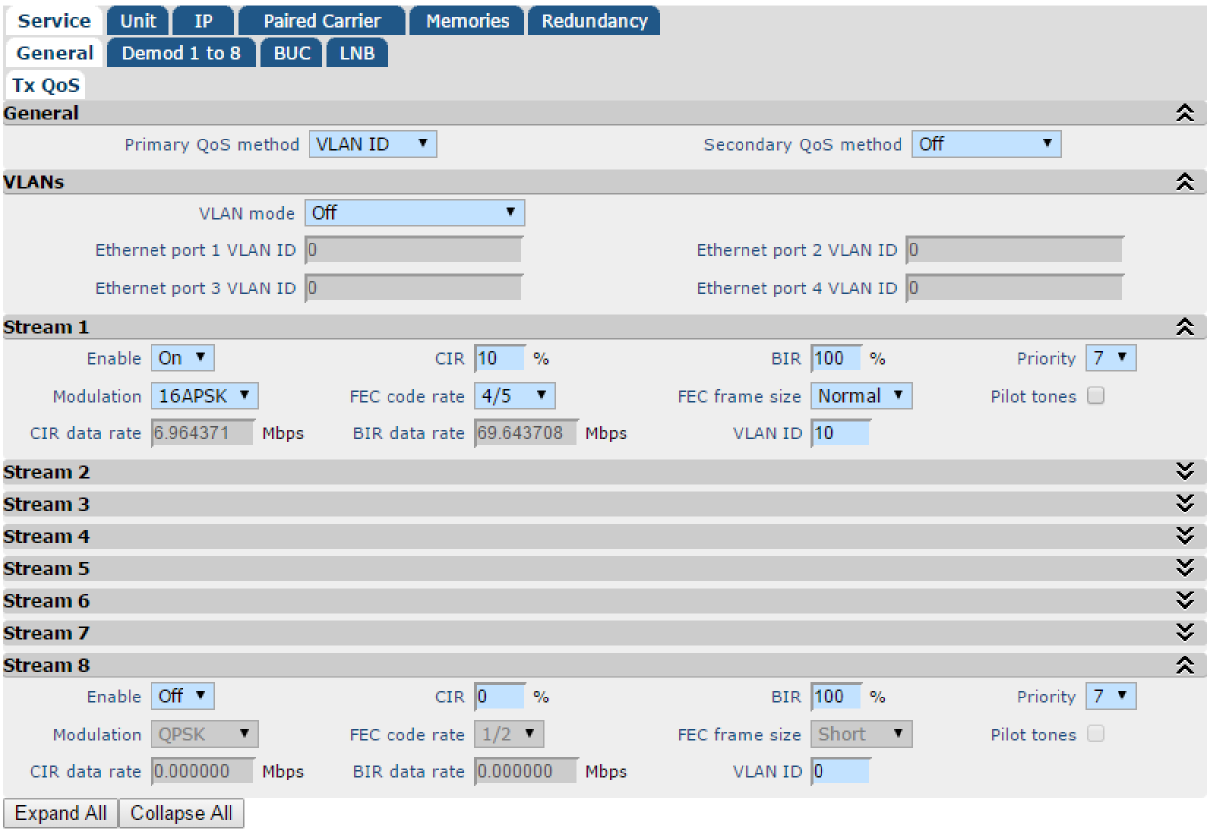


Figure 6-7 Edit->Service->General->Tx QoS Screen

Traffic shaping allows the bandwidth in the shared outbound carrier from the hub to be allocated according to the needs of the remote sites. It can be used to guarantee the level of bandwidth and also allows any excess remaining bandwidth to be shared in a defined way. When traffic shaping is disabled, the outbound bandwidth is allocated on a first-come-first-served basis.

Traffic shaping works by recognising markings (such as VLAN IDs) in the terrestrial packets coming into the **Q-MultiFlex™** for transmission. The markings may be in the Ethernet frame or the IP header and therefore both Layer 2 and Layer 3 traffic shaping is supported.

The outbound carrier can be defined by a single modcod that all the remote sites receive. Alternatively, the outbound carrier can consist of multiple modcods, where the packets for a particular remote are all transmitted using the same modcod. The use of a single modcod is referred to as 'single stream' mode, whereas the use of multiple modcods is referred to as 'multiple stream' mode. Traffic shaping can be used in both cases but varies in how it is applied.

There is no change to the overall symbol rate or power when the outbound carrier is transmitted using several different modcods.

When the shared outbound is represented by a single stream (i.e. a single modcod) then the QoS classification methods used in traffic shaping are VLAN IDs, IP addresses, Diffserv and IEEE 802.1p priority tags.

With multiple streams, there are two tiers of QoS classification. The primary multistreaming QoS classification methods are VLAN IDs and IP addresses. When classifying using VLAN IDs, a secondary classification method can be chosen from amongst IP addresses, Diffserv and IEEE 802.1p priority tags.

Multiple streams are supported only when the Tx FEC is DVB-S2 or DVB-S2X. The number of streams that are supported is the same as the number of demodulators that have been SAF enabled.

QoS Traffic Shaping Overview

Please see Section 7.8.8 for an overview of how traffic shaping works including definitions of terms and worked examples.

6.2.5.1 Primary QoS Method

Off	This switches traffic shaping off. When off, incoming packets are buffered and transmitted on a first-come-first-served basis. Arriving packets will be dropped when the buffers are full.
VLAN ID	Traffic shaping is based on VLAN ID. The *Secondary QoS method* can then be used to refine the shaping of packets that share the same VLAN ID.
IP address	Traffic shaping is based on IP address (any mixture of destination and source addresses and port numbers). The *Secondary QoS method* can then be used to refine the shaping of packets that share the same IP address classification.
DIffserv	In single stream mode only, the primary QoS method can be set to Diffserv. Traffic shaping is based on the standard Diffserv classes.
IEEE 802.1p	In single stream mode only, the primary QoS method can be set to IEEE 802.1p. Traffic shaping is based on the standard IEEE 802.1p priority tags (which form part of the IEEE 802.1Q header).

Table 6-16 Primary QoS Method

6.2.5.2 Secondary QoS Method

Off	This switches the secondary level of traffic shaping off.
IP address	The secondary level of traffic shaping is based on IP address (any mixture of destination and source addresses and port numbers).
DIffserv	The secondary level of traffic shaping is based on the standard Diffserv classes.
IEEE 802.1p	The secondary level of traffic shaping is based on the standard IEEE 802.1p priority tags (which form part of the IEEE 802.1Q header).

Table 6-17 Secondary QoS Method

6.2.5.3 VLAN Mode

Off	This switches explicit VLAN processing off. In bridge mode, any VLAN headers on incoming packets (terrestrially and over satellite) will be retained and handled transparently by the modem.
VLAN access mode	In this mode, the modem adds VLAN tags to packets arriving on the terrestrial ports. A specific VLAN tag can be associated with each physical port. VLAN tags are removed from packets arriving over satellite before being forwarded via the appropriate port. A non-standard form of access mode is also supported whereby if just the primary IP traffic port is active (i.e. all per-port VLAN IDs are set to 0) then the modem will tag all packets according to which remote site they are destined for (the user having entered a unique VLAN ID on each remote modem). VLAN filtering should be enabled on the remote modems (unless the filtering is being done by an external switch). All packets arriving over satellite that do not match the modem's VLAN ID will be dropped. All packets that have the correct VLAN ID will be forwarded onto the local network after the VLAN tag has been removed. Packets transmitted over satellite by the remote modem will be tagged with the relevant VLAN ID.
VLAN trunking mode	In this mode, the VLAN tags are added externally to the modem (e.g. by a suitable Ethernet switch) and are passed transparently in all cases. VLAN filtering should be enabled on the remote modems (unless the filtering is being done by an external switch). All packets arriving over satellite that do not match the modem's VLAN ID will be dropped. All packets that have the correct VLAN ID will be forwarded onto the local network after the VLAN tag has been removed. Packets transmitted over satellite by the remote modem will be tagged with the relevant VLAN ID.

Table 6-18 VLAN Mode

<u>VLAN Filtering</u>

In star networks, VLAN filtering can be applied at the remote modems in order to drop unwanted packets. The remote modem does this by matching the received packets against a single VLAN of interest.

In mesh networks, each site will consist of only Q-MultiFlex™ units, each of which potentially transmits to all other sites and listens to all other sites at the same time. In this scenario, it is likely that each site will want to forward multiple VLANs from amongst the packets received over satellite. This can be achieved by adding an external Ethernet switch to do the VLAN filtering, with the Q-MultiFlex™ passing all received packets onto the switch.

6.2.5.4 Ethernet Port VLAN ID

Range:	0 to 4094
Description:	For each of the four physical Ethernet ports, this sets the VLAN ID to be used when VLAN access mode is active. Terrestrial incoming packets will be tagged with the relevant VLAN ID before being transmitted over satellite. Packets received over satellite will have their VLAN ID removed before being forwarded out of the terrestrial port. The VLAN ID fields are not used when the VLAN mode is set to *Off* or *VLAN trunking mode*.

Table 6-19 Ethernet Port VLAN ID

6.2.5.5 Screens for Primary QoS: VLAN ID

The *Edit->Service->General->Tx QoS* screen reconfigures itself depending on the settings for the primary and secondary QoS methods.

When the primary QoS method is set to *VLAN ID* then the screen shown in **Figure 6-8** will be displayed in the case where a single stream (i.e. single modcod) is being used for the shared outbound carrier.

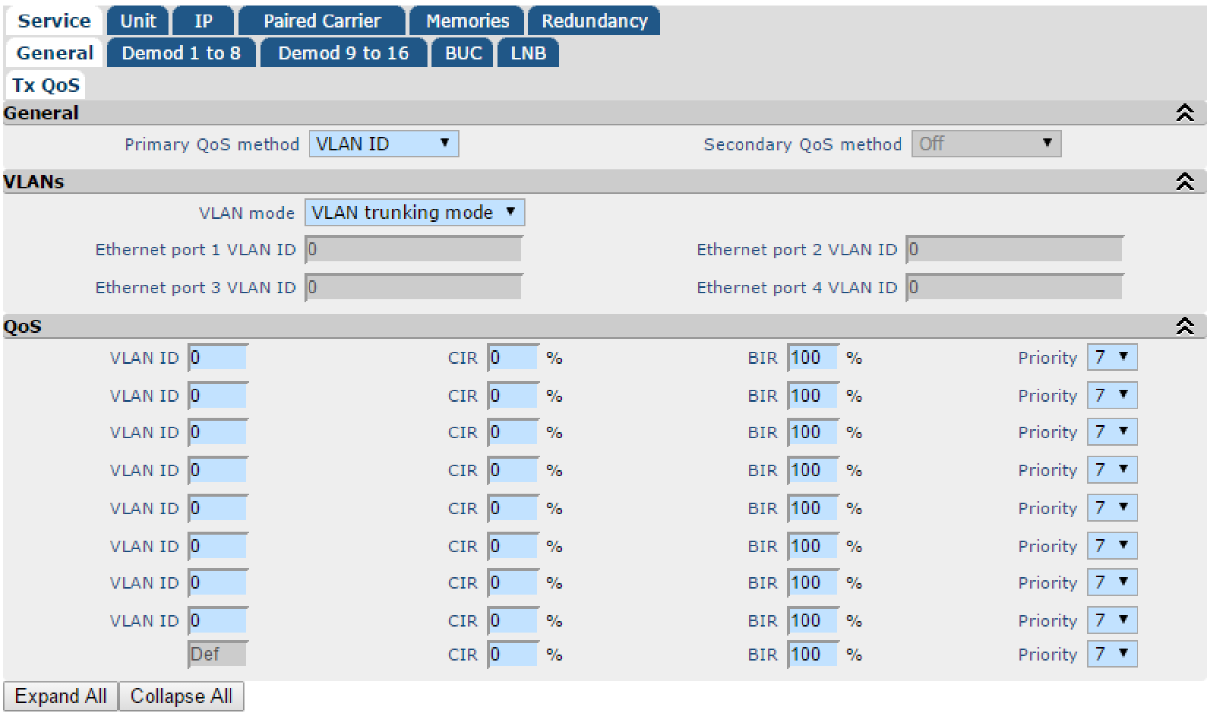


Figure 6-8 Edit->Service->General->Tx QoS Screen for Primary QoS: VLAN ID (Single Stream)

Using VLANs with Cascaded Q-MultiFlex™ Units

Multiple Q-MultiFlex™ units can be cascaded together in order to transmit a single outbound carrier to an arbitrarily large number of remote modems.

The number of supported VLAN ID rules is determined by the number of demodulators that are available and whether multiple Q-MultiFlex™ units have been cascaded together

When cascading, the number of VLAN ID QoS rules that are supported will automatically expand up to 64. When cascading more than four Q-MultiFlex™ units together, please consult Technical Support for further set up details.

Please see Cascading Multiple Q-MultiFlex™ Units for further setup details.

For multiple streams, with the primary QoS method set to *VLAN ID*, the screen shown in **Figure 6-9** will be displayed.

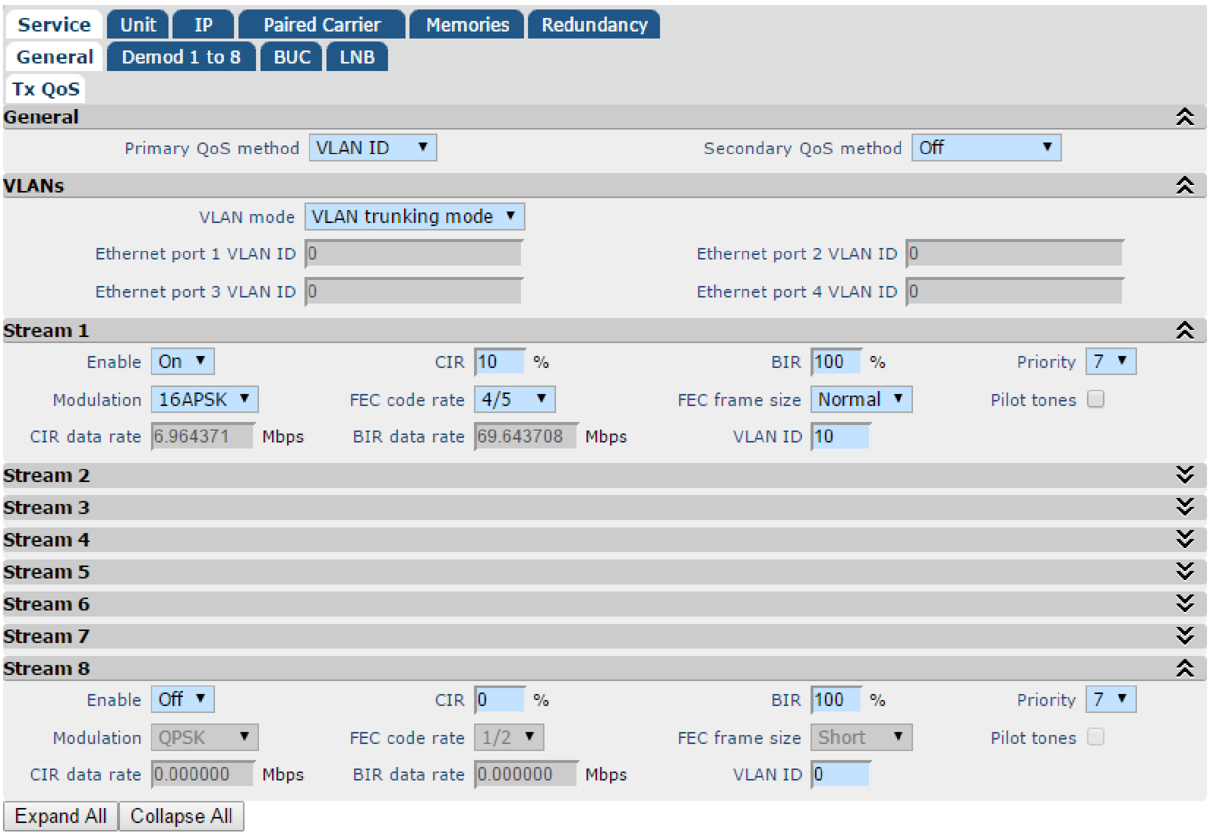


Figure 6-9 Edit->Service->General->Tx QoS Screen for Primary QoS: VLAN ID (Multiple Streams)

The number of available streams is determined by the number of demodulators that are enabled.

When multiple streams are enabled then each stream is associated with its own modcod. All packets that have the specified VLAN ID will be placed into the stream. A stream will be accorded the bandwidth defined by the CIR and BIR values.

<u>The Benefits of using Multiple Streams</u>

Using multiple IP streams in the shared outbound carrier is a useful way of segregating data for each remote modem so that each remote modem processes only the packets in the shared outbound that are destined for the particular remote modem.

The streams allow data destined for particular remote modems to be transmitted with the optimal modulation and FEC rate (modcod) to suit the receive signal strength at the remote site. Multistreaming works in conjunction with traffic shaping whereby packets for transmission can be classified according to a wide range of criteria and then transmitted using the appropriate modcod.

6.2.5.6 Stream Enable

This is an On/Off control that controls whether a particular stream forms part of the shared outbound or not. When enabled, all packets associated with the relevant stream will form part of the shared outbound.

When all streams are disabled then the contents of the shared outbound is determined purely by the output of the traffic shaper, if enabled. When the traffic shaper is not used then all received packets will be transmitted up to the limit of the available bandwidth and thereafter will be dropped at random (subject to the IP buffer settings in the modem).

6.2.5.7 Stream CIR, BIR and CIR/BIR Data Rates

The Committed Information Rate (CIR) is the guaranteed bandwidth for the stream. The Burst Information Rate (BIR) is the desired maximum data rate should excess bandwidth (after all the CIRs are satisfied) becomes available.

The CIR and BIR are entered as percentages of the available data rate. Using percentages has several advantages over absolute numbers:

- When the overall data rate for the outbound carrier is changed then the changes automatically ripple down to the traffic shaping rules.
- When ACM is used then the traffic shaping rules adapt automatically to changes in the absolute data rate for the shared outbound, with no user intervention required.
- Potential misconfiguration of the CIR and BIR values is reduced.

For clarity, the CIR and BIR percentages are translated into absolute data rate values for display purposes. For greater accuracy in allocating bandwidth, all percentages can be entered as decimal values supporting up to two decimal places following the point.

6.2.5.8 Stream Modulation

Each stream transmitted within the shared outbound carrier can use any of the supported DVB-S2/S2X or **FastLink™** modulations listed in **Table 6-20**.

FastLink™	BPSK: 0.499 QPSK (and OQPSK): 0.532, 0.639, 0.710, 0.798 8PSK: 0.639, 0.710, 0.778 8QAM: 0.639, 0.710, 0.778 16APSK: 0.726, 0.778, 0.828, 0.851 16QAM: 0.726, 0.778, 0.828, 0.851 32APSK: 0.778, 0.828, 0.886, 0.938 64QAM: 0.828, 0.886, 0.938, 0.960
DVB-S2	QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10
DVB-S2X *DVB-S2X Low-latency Mode*	**Normal Frame:** QPSK: 13/45, 9/20, 11/20 8PSK: 23/36, 25/36, 13/18 8APSK-L: 5/9, 26/45 16APSK: 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90 16APSK-L: 5/9, 8/15, 1/2, 3/5, 2/3 32APSK: 32/45, 11/15, 7/9 32APSK-L: 2/3 64APSK: 11/15, 7/9, 4/5, 5/6 64APSK-L: 32/45 **Short Frame:** QPSK: 11/45, 4/15, 14/45, 7/15, 8/15, 32/45 8PSK: 7/15, 8/15, 26/45, 32/45 16APSK: 7/15, 8/15, 26/45, 3/5, 32/45 32APSK: 2/3, 32/45 **Very Short Frame:** (Frame size of 5,400 bits, reducing latency to 33% of standard DVB-S2 Short frame) QPSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 8PSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 16APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 32APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 **Ultra Short Frame:** **(**Frame size of 3,240 bits, reducing latency to 20% of standard

	DVB-S2 Short frame) QPSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 8PSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 16APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 32APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9

Table 6-20 Tx Modulation and FEC Code Rates

6.2.5.9 Stream FEC Code Rate

Each stream can use any of the supported **FastLink™** or DVB-S2/S2X FEC code rates listed in **Table 6-20**.

6.2.5.10 Stream Pilot Tones

Pilots are an On/Off control that controls whether DVB-S2/S2X pilots, which are unmodulated symbols, are injected into the carrier on a regular basis in order to help the demodulator lock onto the carrier. The pilots are 36 symbols long and are injected every 1440 symbols, representing an additional overhead of around 2.4%.

6.2.5.11 Stream Frame Size

The stream frame size is used in connection with DVB-S2/S2X.

Normal	This represents a frame size of 64,800 bits per frame. This is more bandwidth efficient than short frames but has four times the latency. As a guideline, short frames have a latency of around 25ms at 1Mbps, whereas the latency for normal frames is around 100ms at 1Mbps. The latency will halve as data rate doubles.
Short	This represents a frame size of 16,200 bits per frame.
Very short	This represents a frame size of 5,400 bits, reducing latency to 33% of the standard DVB-S2 Short frame.
Ultra short	This represents a frame size of 3,240 bits, reducing latency to 20% of the standard DVB-S2 Short frame.

Table 6-21 Stream Frame Size

6.2.5.12 Screens for Primary QoS: IP Address

When the primary QoS method is set to *IP address* then the screen shown in **Figure 6-10** will be displayed when using a single stream (i.e. a single modcod is being used for the shared outbound).

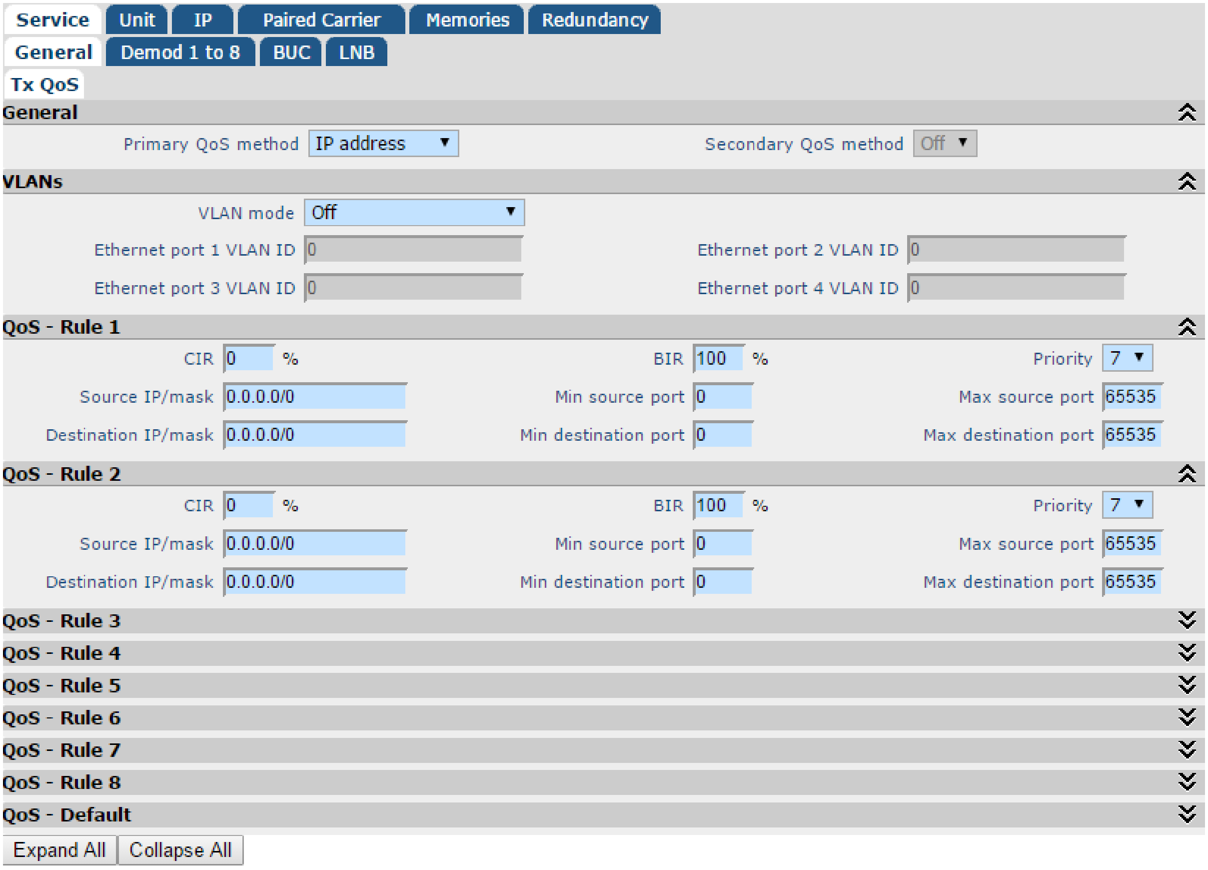


Figure 6-10 Edit->Service->General->Tx QoS Screen for Primary QoS: IP Address (Single Stream)

Any combination of source and destination addresses and ports can be used to define the packets that will be governed by each QoS rule. For each QoS rule, the bandwidth to be made available is defined by the CIR and BIR values.

For multiple streams, with the primary QoS method set to *IP address,* the screen shown in **Figure 6-11** will be displayed. This allows the modcod associated with each stream in the shared outbound carrier to be set up. Selecting the primary QoS tab then allows the IP address rules for each stream to be set up as shown in **Figure 6-12**.

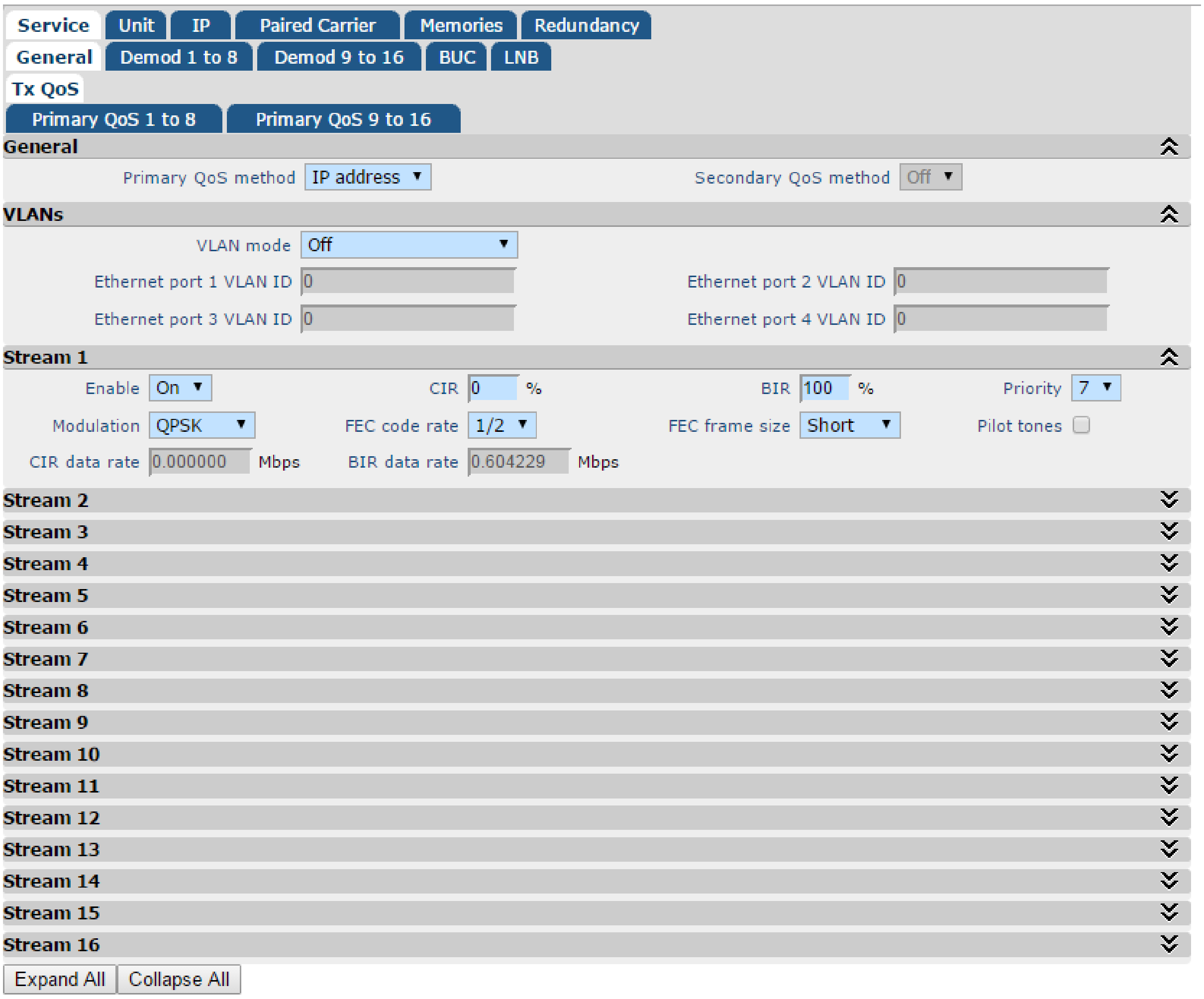


Figure 6-11 Edit->Service->General->Tx QoS Screen for Primary QoS: IP Address (Multiple Streams) – Modcod Definition

The number of available streams is determined by the number of demodulators that are enabled.

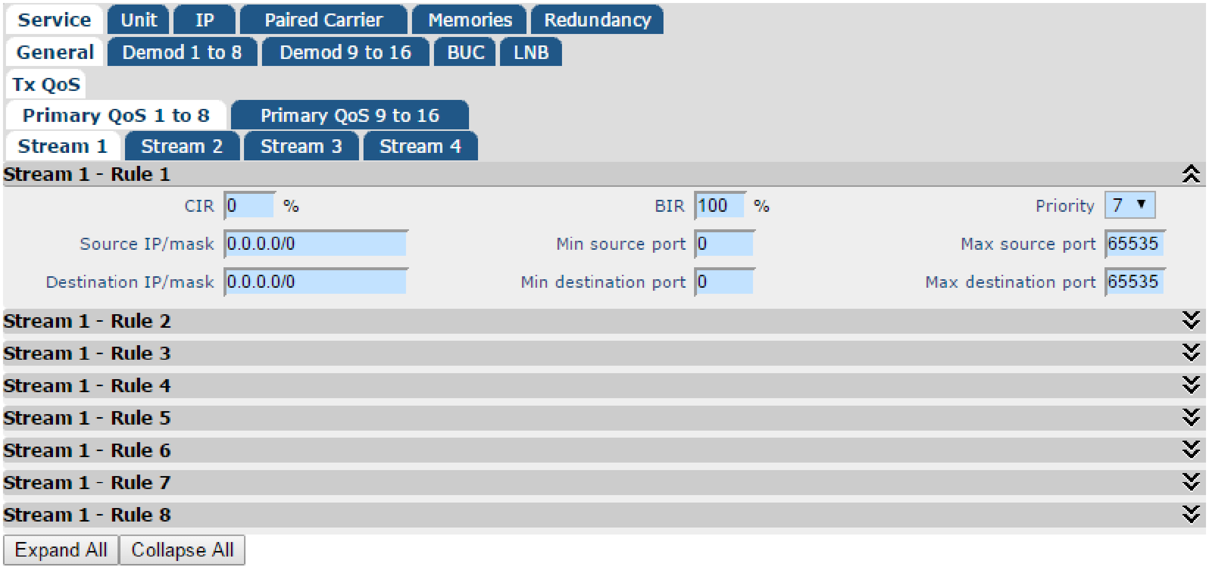


Figure 6-12 Edit->Service->General->Tx QoS Screen for Primary QoS: IP Address (Multiple Streams) – QoS Rule Entry

Any combination of source and destination addresses and range of ports can be used to define the packets that will be governed by each QoS rule. For each QoS rule, the bandwidth to be made available is defined by the CIR and BIR values.

6.2.5.13 Screen for Primary QoS: Diffserv

When the primary QoS method is set to *Diffserv* then the screen shown in **Figure 6-13** will be displayed.

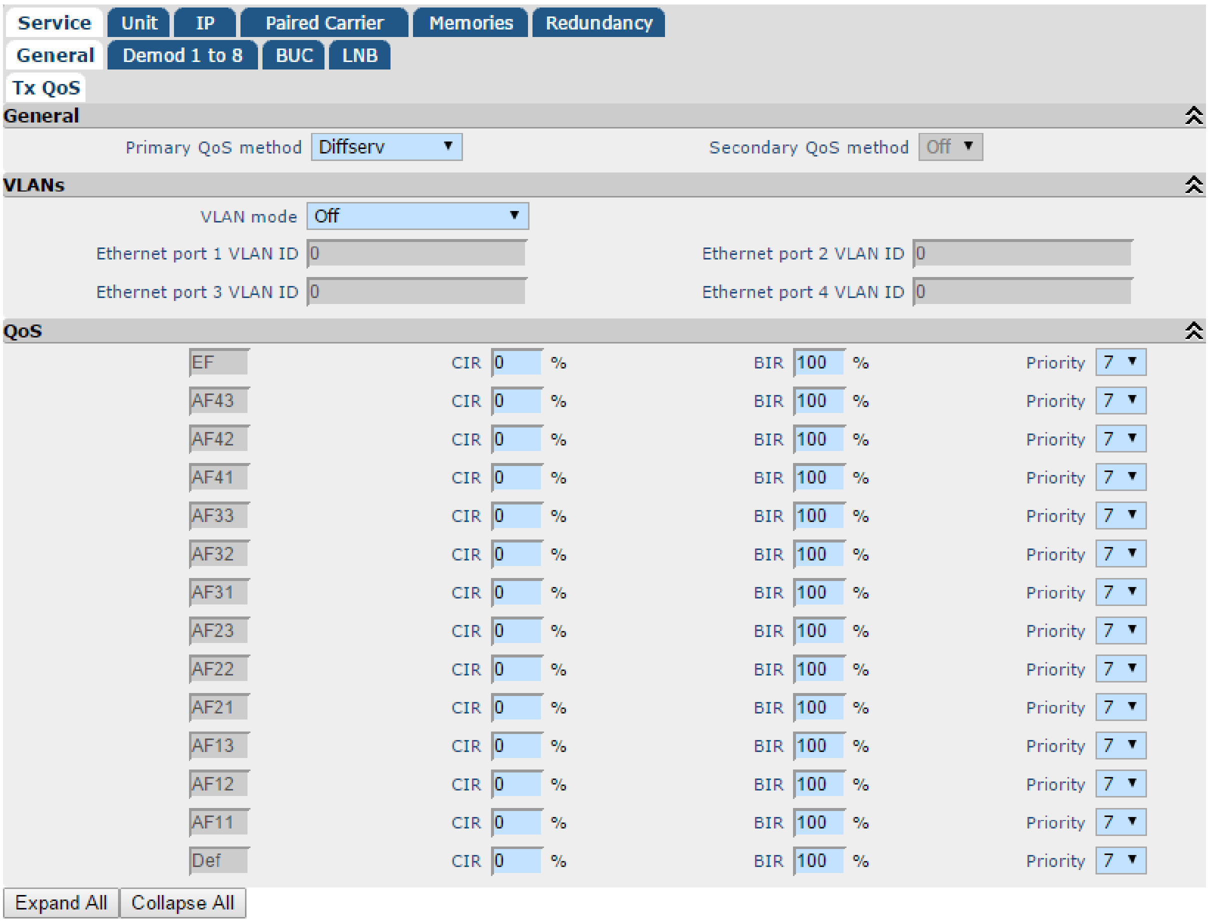


Figure 6-13 Edit->Service->General->Tx QoS Screen for Primary QoS: Diffserv (Single Stream)

The standard Diffserv classes are listed in the left hand column. A default rule is available to explicitly reserve bandwidth for non-Diffserv packets.

6.2.5.14 Screen for Primary QoS: IEEE 802.1p

When the primary QoS method is set to *IEEE 802.1p* then the screen shown in **Figure 6-14** will be displayed.

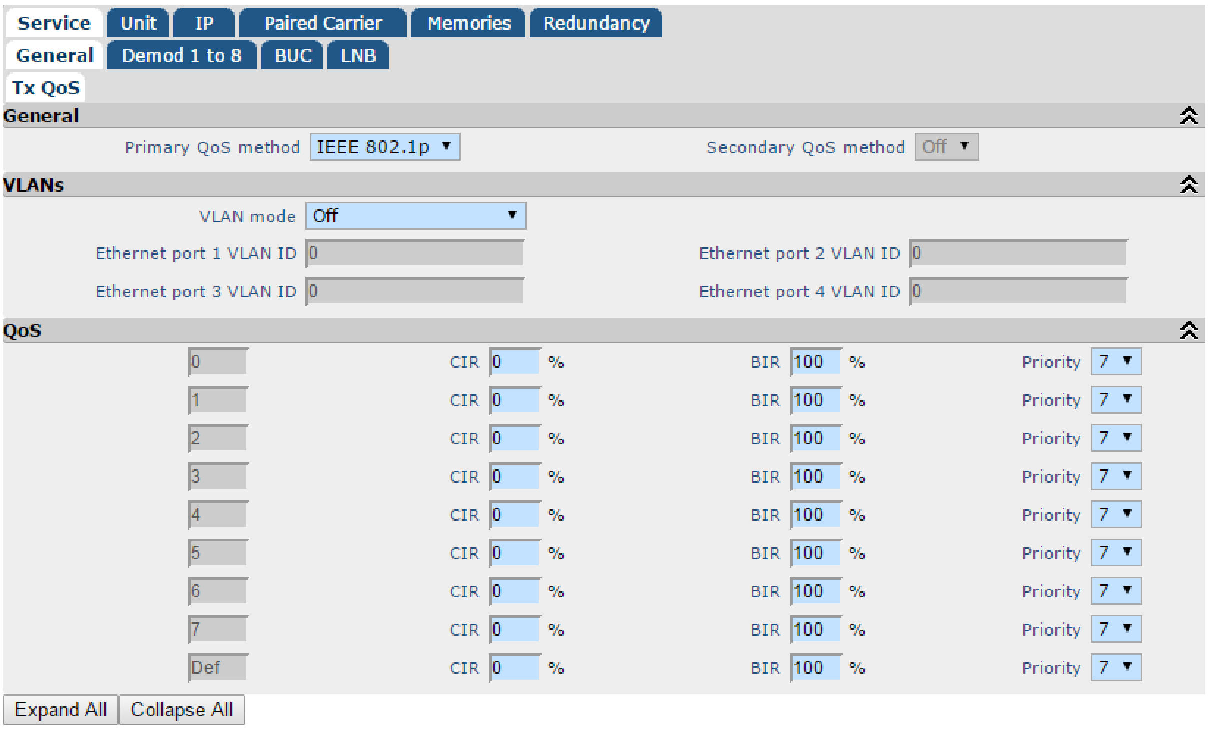


Figure 6-14 Edit->Service->General->Tx QoS Screen for Primary QoS: IEEE 802.1p (Single Stream)

The IEEE 802.1p priority classes (part of the IEEE 802.1Q header) are represented as 0 to 7 in the left hand column. For each QoS rule, the bandwidth to be made available is defined by the CIR and BIR values. A default rule is available to explicitly reserve bandwidth for packets that do not have an IEEE 802.1p priority marking.

6.2.5.1 Screen for Secondary QoS: IP Address

When the secondary QoS method is set to *IP address* then the screen shown in **Figure 6-15** will be displayed.

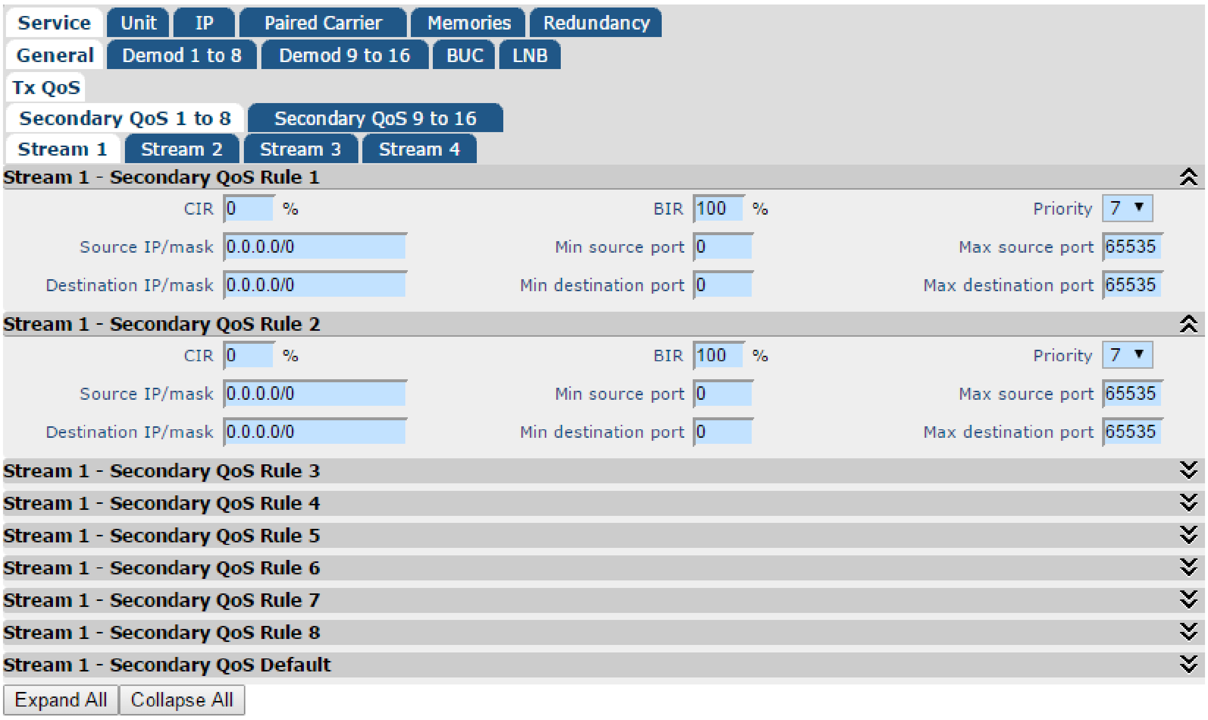


Figure 6-15 Edit->Service->General->Tx QoS Screen for Secondary QoS: IP Address

The number of available streams is determined by the number of demodulators that are enabled.

Any combination of source and destination addresses and range of ports can be used to define the packets that will be governed by each QoS rule. For each QoS rule, the bandwidth to be made available is defined by the CIR and BIR values.

6.2.5.1 Screen for Secondary QoS: Diffserv

When the secondary QoS method is set to *Diffserv* then the screen shown in **Figure 6-16** will be displayed.

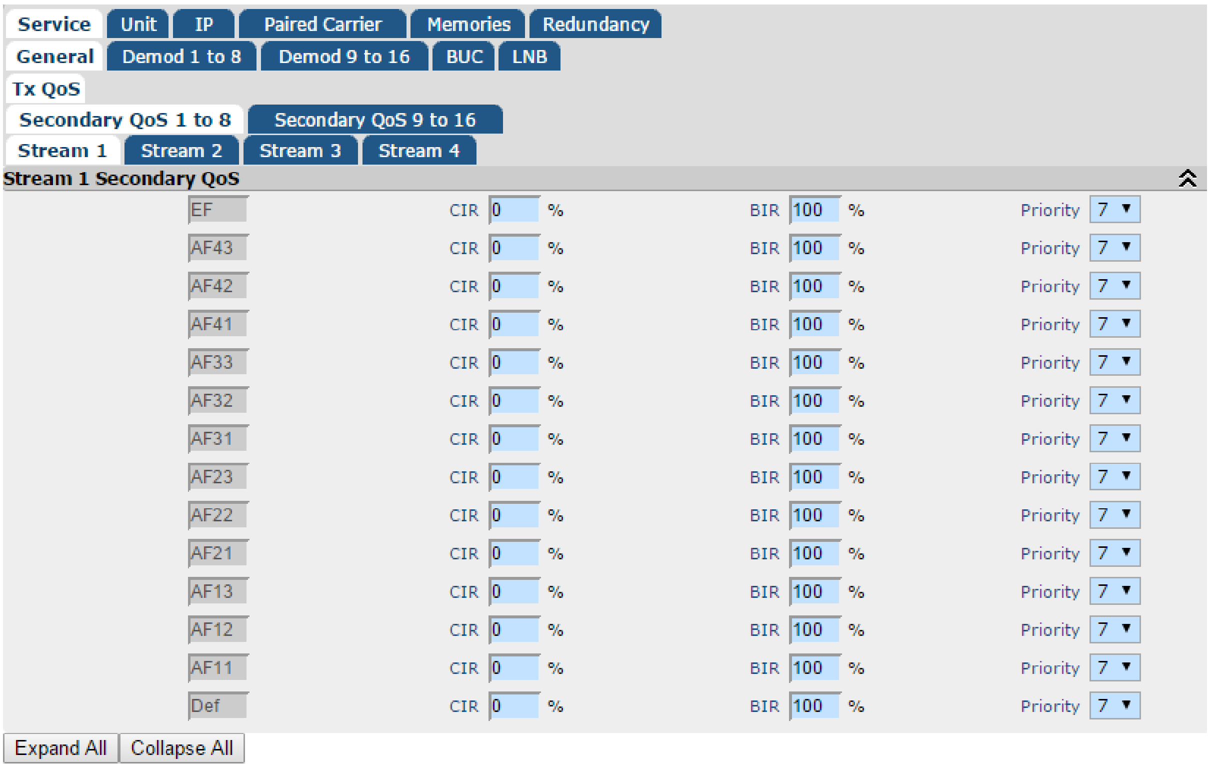


Figure 6-16 Edit->Service->General->Tx QoS Screen for Secondary QoS: Diffserv

The number of available streams is determined by the number of demodulators that are enabled.

The standard Diffserv classes are listed in the lefthand column. A default rule is available to explicitly reserve bandwidth for non-Diffserv packets.

6.2.5.2 Screen for Secondary QoS: IEEE 802.1p

When the secondary QoS method is set to *IEEE 802.1p* then the screen shown in **Figure 6-17** will be displayed.

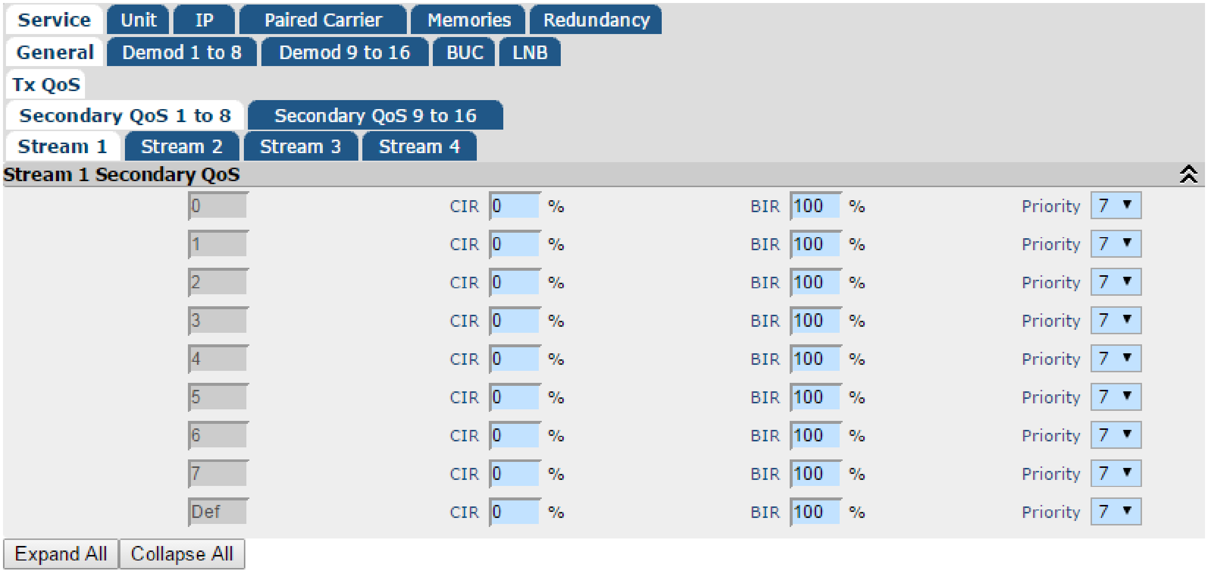


Figure 6-17 Edit->Service->General->Tx QoS Screen for Secondary QoS: IEEE 802.1p

The number of available streams is determined by the number of demodulators that are enabled.

The IEEE 802.1p priority classes (part of the IEEE 802.1Q header) are represented as 0 to 7 in the lefthand column. For each QoS rule, the bandwidth to be made available is defined by the CIR and BIR values. A default rule is available to explicitly reserve bandwidth for packets that do not have an IEEE 802.1p priority marking.

6.2.6 Edit->Service->Demods Screen

The *Edit->Service->Demods* screen is shown in **Figure 6-18**.

Effect of Demodulator Configuration Changes

- ***In order not to interfere with other active demodulators, a demodulator needs to be disabled before its configuration can be changed.***
- ***The receiver covers a 72MHz frequency span and this will be automatically centred based on the lowest and highest centre frequencies of the active demodulators. Configuration changes made to a demodulator will not affect the operation of the active demodulators unless the receiver centre frequency needs to be changed, in which case all demodulators will be briefly interrupted.***

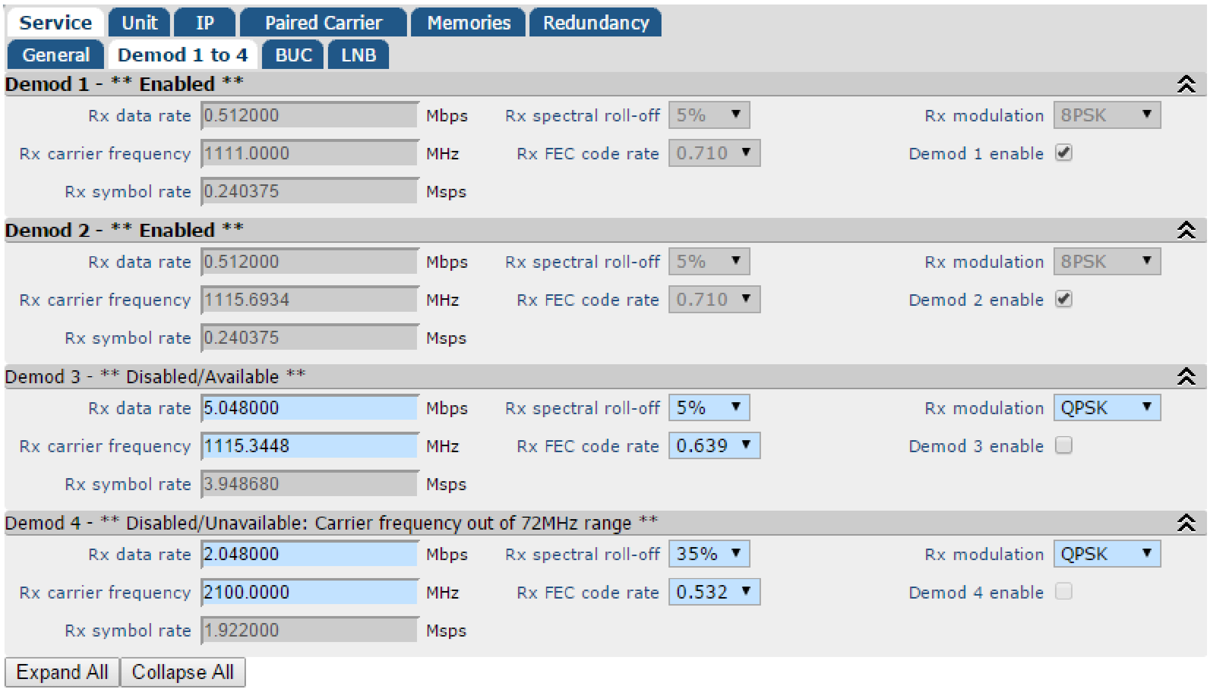


Figure 6-18 Edit->Service->Demods Screen

6.2.6.1 Rx Data Rate

Range:	0.000018Mbps to 100.0Mbps; step size: 0.000001Mbps
Description:	The terrestrial data rate is the maximum number of data bits that the modem will process in relation to the selected terrestrial interface. The terrestrial data rate determines the receive satellite symbol rate, which is displayed for information purposes.

Table 6-22 Rx Data Rate

6.2.6.2 Rx Carrier Frequency

There are various frequency control options, depending on whether IF or L-band has been selected and whether an LNB is fitted that is being controlled by the modem. The frequency control options are presented in **Tables 6-23** through **6-25**.

Range:	50.0MHz to 180.0MHz; step size: 0.0001MHz (i.e. 100Hz)
Description:	This is the IF frequency used in receiving from satellite. Note that values between 90MHz and 100MHz cannot be selected.

Table 6-23 Rx Carrier Frequency (IF)

Range:	950.0MHz to 2150.0MHz; step size: 0.0001MHz (i.e. 100Hz)
Description:	This is the L-band frequency used in receiving from satellite. If the *LNB LO frequency* has been set on the *Edit->Service->LNB* menu then the L-band receive frequency will no longer be available and will be replaced by an LNB carrier frequency option.

Table 6-24 Rx Carrier Frequency (L-band)

Range:	0.0GHz to 99.999GHz; step size: 0.0000001GHz (i.e. 100Hz)
Description:	This is the LNB frequency used to receive from satellite. If the *LNB LO frequency* has been set on the *Edit->Service->LNB* menu then the L-band receive frequencies used by the individual demodulators will no longer be available and will be replaced with an LNB carrier frequency. The LNB carrier frequency is the absolute SHF frequency of the carrier.

Table 6-25 LNB Carrier Frequency

6.2.6.3 Rx Spectral Roll-off

The spectral roll-off determines the slope of the carrier at its edges. The supported roll-off factors are listed in **Table 6-26**.

Range:	5%, 10%, 15%, 20%, 25%, 35%
Description:	All spectral roll-off factors are available for all FECs (with the exception of the 'low-cost' version of DVB-S2, which supports roll-off factors down to and including 15% roll-off). A comparison of the different spectral roll-offs, including their effect on carrier power, is provided in the document '*Saving Satellite Bandwidth by Optimising Spectal Roll-off*'. This is available from the White Papers section of the Paradise web site at http://www.paradisedata.com.

Table 6-26 Rx Spectral Roll-off

6.2.6.4 Rx Modulation

The Rx modulations that are available are listed under FastLink™ in **Table 6-6**.

6.2.6.5 Rx FEC Code Rate

The Rx FEC rates that are available are listed under FastLink™ in **Table 6-6**.

6.2.6.6 Demod Enable/Disable

Each demodulator is controlled by an invidual checkbox that is used to enable or disable the associated demodulator. In order not to interfere with other active demodulators, a demodulator needs to be disabled before its configuration can be changed.

6.2.7 Edit->Service->BUC Screen

The *Edit->Service->BUC* screen is shown in **Figure 6-19**.

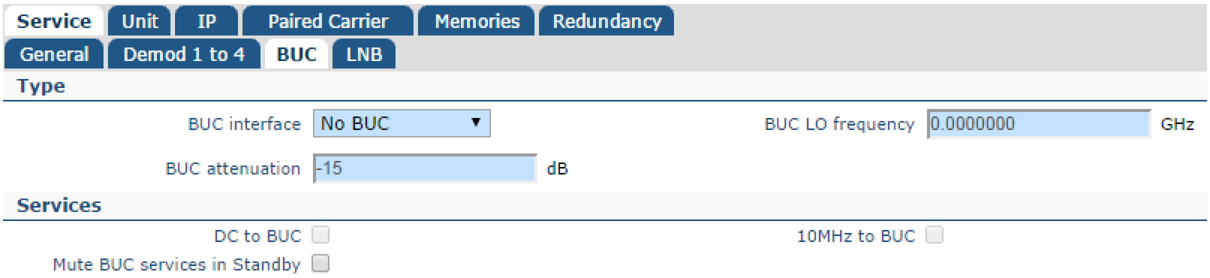


Figure 6-19 Edit->Service->BUC Screen

6.2.7.1 BUC Interface

BUC FSK	This indicates that a BUC is fitted that has FSK communications to the modem.
BUC no comms	This indicates that a BUC is fitted but has no communications to the modem.
No BUC	This indicates that no BUC is fitted.

Table 6-27 BUC Interface

6.2.7.2 BUC LO Frequency

Range:	-99.999GHz to 99.999GHz; step size: 0.0000001GHz
Description:	This is the local oscillator frequency of the BUC.

Table 6-28 BUC LO Frequency

6.2.7.3 BUC Attenuation

Range:	0dB to -15.0dB; step size: 1dB
Description:	This varies the front-end attenuation applied by the the BUC. This is used when there is a low level of signal loss between the modem and BUC in order to prevent the modem output from saturating the BUC.

Table 6-29 BUC Attenuation

6.2.7.4 DC to BUC

This is an On/Off control used to enable and disable the DC power supply from the modem to the BUC.

6.2.7.5 10MHz to BUC

This is an On/Off control used to enable and disable the 10MHz reference from the modem to the BUC.

6.2.7.6 Mute BUC Services in Standby

This is an On/Off control used to enable and disable the transfer of BUC DC and 10MHz services from a failed modem to a backup modem in a 1:1 or 1:N redundancy system. Setting the checkbox causes the services to switch over from the online modem to the backup modem on a failure. Note that FSK communications will always be switched over.

6.2.8 Edit->Service->LNB Screen

The *Edit->Service->LNB* screen is shown in **Figure 6-20**.

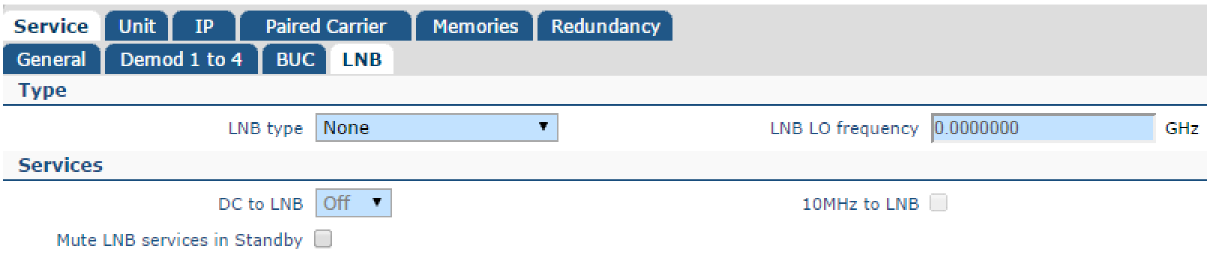


Figure 6-20 Edit->Service->LNB Screen

6.2.8.1 LNB Type

None	This indicates that no LNB is fitted.
Other	This indicates that an LNB is fitted but is not one of the Paradise LNBs listed below.
C 3.635 – 4.200 GHz	This presets the LNB LO frequency to 5150MHz.
Ku 10.95 – 11.45 GHz	This presets the LNB LO frequency to 10000MHz
Ku 11.2 – 11.7 GHz	This presets the LNB LO frequency to 10250MHz
Ku 11.7 – 12.2 GHz	This presets the LNB LO frequency to 10750MHz
Ku 12.25 – 12.75 GHz	This presets the LNB LO frequency to 11300MHz

Table 6-30 LNB Type

6.2.8.2 LNB LO Frequency

Range:	-99.999GHz to 99.999GHz; step size: 0.0000001GHz
Description:	This is the local oscillator frequency of the LNB.

Table 6-31 LNB LO Frequency

6.2.8.3 DC to LNB

This is an On/Off control used to enable and disable the DC power supply from the modem to the LNB.

6.2.8.4 10MHz to LNB

This is an On/Off control used to enable and disable the 10MHz reference from the modem to the LNB.

6.2.8.5 Mute LNB Services in Standby

This is an On/Off control used to enable and disable the transfer of LNB DC and 10MHz services from a failed modem to a backup modem in a 1:1 or 1:N redundancy system. Setting the checkbox causes the services to switch over from the online modem to the backup modem on a failure.

6.2.9 Edit->Unit Screen

The *Edit->Unit* screen contains the following tab menu options:

- *M&C.* This controls remote M&C settings including serial control settings and user passwords.
- *Alarms.* This controls alarm thresholds and actions.
- *SAF.* This allows the entry of Software Activated Feature (SAF) codes that enable modem feature activation in the field.
- *Upgrade.* This allows the modem software to be upgraded.
- *Miscellaneous.* This allows the date and time to be set on the modem, as well as allowing a modem to be reset without having to power it down.
- *Carrier ID.*

6.2.10 Edit->Unit->M&C Screen

The *Edit->Unit->M&C* screen is shown in **Figure 6-21**.

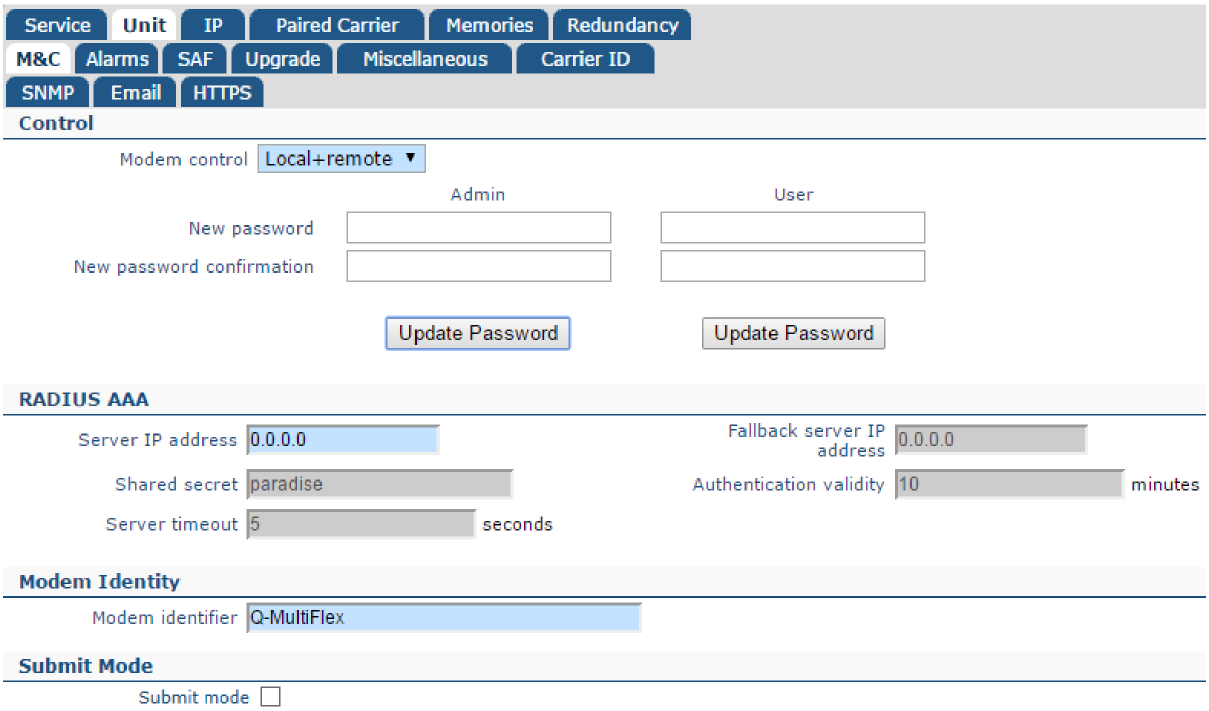


Figure 6-21 Edit->Unit->M&C Screen

The *Edit->Unit->M&C* screen is split into several parts as described in the following sections.

6.2.10.1 Modem Control and Passwords

Table 6-32 shows the *Modem control* options, for user control of the modem.

Local	In *Local* mode only the front panel can be used to control the modem.
Local+remote	In *Local+remote* mode, the modem accepts commands from any user interface at any time.

Table 6-32 Modem Control

Passwords for the administrator (login name *admin*) and user (login name *user*) can be changed (the default password for both is *paradise*). Administrators can both view and control the modem whereas other users can only view modem web pages. Multiple users can be logged on at the same time. When the administrator password is changed then the modem's web user interface will issue an immediate new login request, which needs to be completed using the new password.

6.2.10.2 RADIUS Server IP Address and Fallback Address

The modem supports a RADIUS client that communicates with the server in order to authenticate each user and to provide the authorised level of access (administrator or view-only). This allows users to log in using their personal organization login credentials. All login and configuration change activities are recorded in the modem's log, giving greater visibility and accountability.

Server IP address	This sets the IP address for a network server that supports the RADIUS AAA server to be used for authenticating users' login credentials.
Fallback server IP address	This sets the IP address for a fallback RADIUS network server, to be used in the event that the primary server cannot be contacted. The timeout period is specified by the *Server timeout* value.

Table 6-33 RADIUS Server IP Address and Fallback Address

6.2.10.3 RADIUS Shared Secret

The *Shared secret* is a user-assigned alphanumeric string, which is used as an authentication key (essentially a password) between the RADIUS client in the modem and the RADIUS server on the network.

<u>Note for RADIUS Network Administrators</u>

The modem RADIUS authentication feature will work out-of-the-box, subject to the modem having access to a RADIUS server on the user's network. By default, all authorised users will receive administrator privileges. If you want some users to get administrator access and some view-only access then customisation of the RADIUS server configuration is required as explained below.

The standard RADIUS Access-Accept response from the RADIUS server can have an optional field added to it in order to distinguish between administrator and view-only user login authorisation. This involves the addition of a vendor-specific attribute using an SMI network management private enterprise code of 64534 (to denote Teledyne Paradise Datacom), which is one of a range reserved for private use. A vendor-specific attribute named ‘Access-Level’ is used, where a value of 0 equates to ‘Modem Administrator’ and a value of 1 equates to ‘Modem User’ (view-only). If the modem receives an Access-Accept response with no Access-Level attribute, or with an Access-Level value that is not supported, then the modem will default to administrator access being granted. The full specification of this attribute of the Access-Accept response is as follows:

a. Type: (one byte) value 0x1A - indicates a vendor-specific attribute.
b. Length: (one byte) value 0x09 – indicates the entire vendor-specific attribute field is nine bytes in length.
c. Vendor ID: (four bytes) 0x0000FC16 – indicates Paradise private-use.
d. Vendor type: (one byte) value 0x01 – indicates the vendor-specific attribute is ‘Access-Level’.
e. Vendor length: (one byte) value 0x03 – indicates the remainder of the vendor-specific attribute field following the Vendor ID is three bytes in length.
f. Vendor data: (one byte) value 0=‘Modem Administrator’; value 1=‘Modem User’ – indicates the authorised login access level.

6.2.10.4 RADIUS Authentication Validity

Range:	5 to 60 minutes; step size: 1 minute
Description:	Controls the period between automatic re-authentication of the connection to the RADIUS server. This is done in the background and no user intervention is necessary unless the connection to the RADIUS server has failed, when the user may be prompted to log in again using the fallback RADIUS server (or standard modem log in if no RADIUS server is available).

Table 6-34 RADIUS Authentication Validity

6.2.10.5 RADIUS Server Timeout

Range:	1 to 60 seconds; step size: 1 second
Description:	Controls the timeout when connecting to the RADIUS server. Two attempts will be made before reverting to use the fallback RADIUS server. If the fallback server connection attempts also fail then the user will be presented with the standard (non-RADIUS) login prompt.

Table 6-35 RADIUS Server Timeout

6.2.10.6 Modem Identity

The *Modem identifier* is a user-assigned text string that is typically used to uniquely identify the modem, satellite service or location. It is displayed as the *ID* field on the left-hand-side of every web page.

6.2.10.7 Submit Mode

Submit mode is used when reconfiguring remote modems in order to simplify the process of synchronising configuration changes at both ends of the link in order not to break the link while changing multiple control parameters. When submit mode is active, a Submit button appears on the web user interface as shown in **Figure 6-22**.

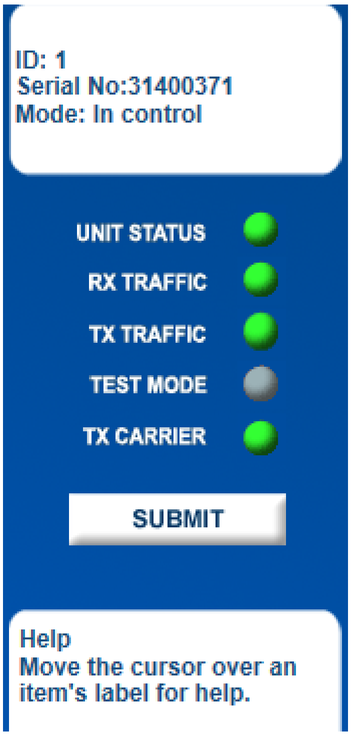


Figure 6-22 Modem Status Summary Screen with Submit Mode Button

In this mode, none of the configuration changes made to the modem will be activated until the Submit button is pressed. This is true even if the control parameters that are being changed are spread over multiple web pages. Once all of the changes have been made, the Submit button should be pressed and this will activate all of the accumulated control changes. This minimises service downtime when making configuration changes. Switching off the submit mode reverts the modem to the mode where each control change is activated instantaneously.

It should be noted that the Q-NET Navigator control application (which can be downloaded freely from the Paradise web site) has the ability to configure hub and remote modems without the user having to be concerned with how the changes are synchronised between the modems, thereby removing this problem entirely.

6.2.11 Edit->Unit->M&C->SNMP Screen

The *Edit->Unit->M&C->SNMP* screen is shown in **Figure 6-23**.

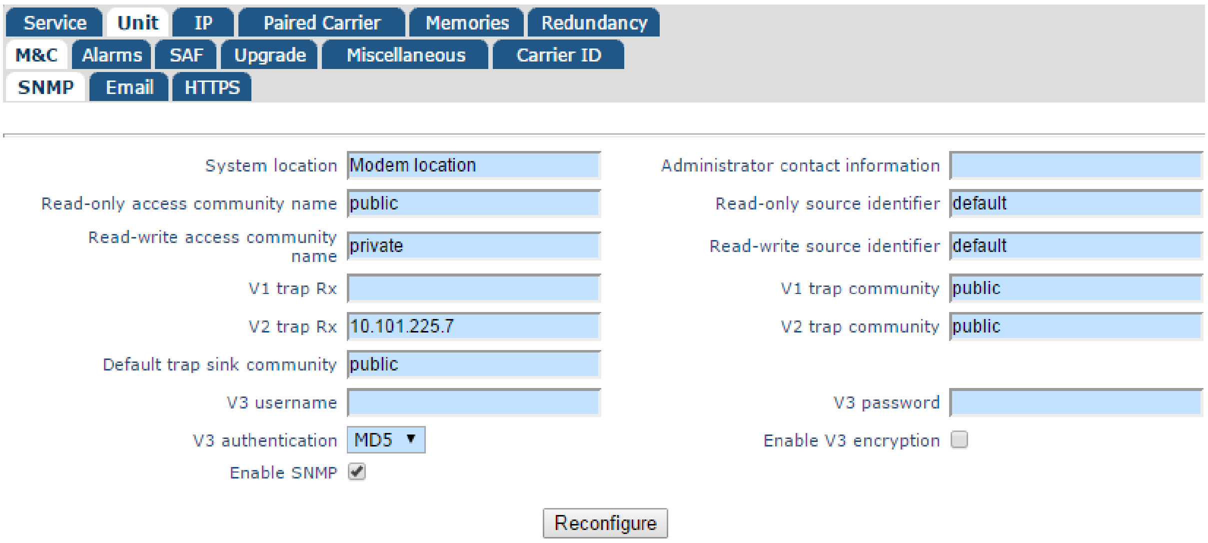


Figure 6-23 Edit->Unit->M&C->SNMP Screen

The Simple Network Management Protocol (SNMP) can be configured for use with SNMP v1, v2c and v3.

The modem's SNMP configuration settings have the standard meanings defined by the relevant SNMP standards and are therefore not described in detail. The community names represent passwords that must be present in each SNMP read or write requests in order for the commands to be executed. The source identifier fields are used to define the source IP addresses that read/write requests will be accepted from. The trap receiver fields are used to define the IP address of a trap server to which trap notifications will be sent when modem alarms arise (and when they disappear).

SNMP can be controlled by the *Enable SNMP* setting. SNMP is switched off by default. The modem does not need to be configured to tell it which version of SNMP is being used and will respond correctly to all SNMP commands regardless of the version.

The modem's SNMP Management Information Bases (MIBs) can be downloaded directly from the modem using the *Download MIB files* hyperlink at the bottom of the screen.

6.2.12 Edit->Unit->M&C->Email Screen

The *Edit->Unit->M&C->Email* screen is shown in **Figure 6-24**.

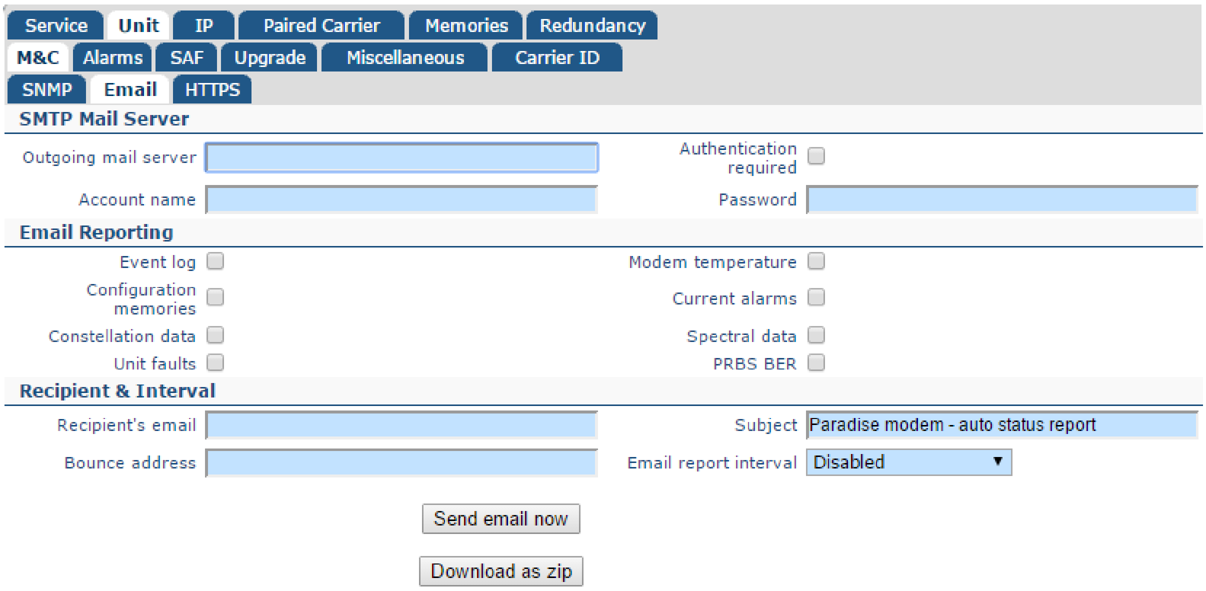


Figure 6-24 Edit->Unit->M&C->Email Screen

From power-up, the modem automatically records modem and satellite link performance information for both online and offline use. This information can be sent by email from the modem to any email address, providing a connection from the modem to an Simple Mail Transfer Protocol (SMTP) mail server is available. This feature is particularly useful when providing Quality of Service reports to satellite-services end users and when investigating unexplained disruptions to the satellite service. It is also possible to fetch performance data over the satellite from a remote modem and then send this by email from the local modem.

The modem has a built-in SMTP mail client. By ticking the required checkboxes, the following information can be sent from the modem, either on demand or at preset intervals:

- Up to a month's worth of logged modem temperature values
- The contents of the modem's event log (i.e. all noteable events that have occurred)
- Current system alarms (i.e. all Unit, Tx and Rx faults and warnings)
- All configuration memories

- Instantaneous spectrum data
- Instantaneous constellation data
- Instantaneous PRBS BER test results

The information is sent in Comma Separated Value (CSV) format, which allows the data to be copied into any spreadsheet from where it can be viewed in a number of formats (e.g. as a graph or a table) and from which reports can be generated.

The relevant data is appended to the email as separate attachments.

The modem needs to know where to send all emails in order for them to be forwarded to individual email accounts. This is the outgoing SMTP mail server name (e.g. smtp.yourmailserver.com). An account name and password may be necessary. The recipient's email address, subject (email title) and email reporting interval should be set as required.

The *Reply to* address field is optional and is the address used to deliver failure notifications in the event that an email cannot be delivered to the recipient's email address.

The following example demonstrates how to graph modem constellation data in a spreadsheet:

- Configure the SMTP mail server and recipient email details.
- Select the *Constellation data* check box and click the *Send email now* button.
- Wait for the email to be received at the recipient's account and open it.
- To import the constellation data into a spreadsheet program (Microsoft Excel is used in this example) double click on the email attachment *constellation.csv* to open it (this should automatically start the spreadsheet application - if not, then save the attachment and open it directly from within the spreadsheed application).
- Within Excel, highlight the A and B columns.
- Select the Chart Wizard from the toolbar (or alternatively select the *Insert* menu followed by *Chart*).
- Select *XY (Scatter)* as the chart type.
- Select the *Scatter* (topmost) sub-chart type.
- Select *Next* and then accept the defaults for *Data Range* and *Series*.
- Add a chart title and X and Y titles as desired.
- Select *Finish* and then resize the resulting graph as desired.

An example of the output is shown in **Figure 6-25**.

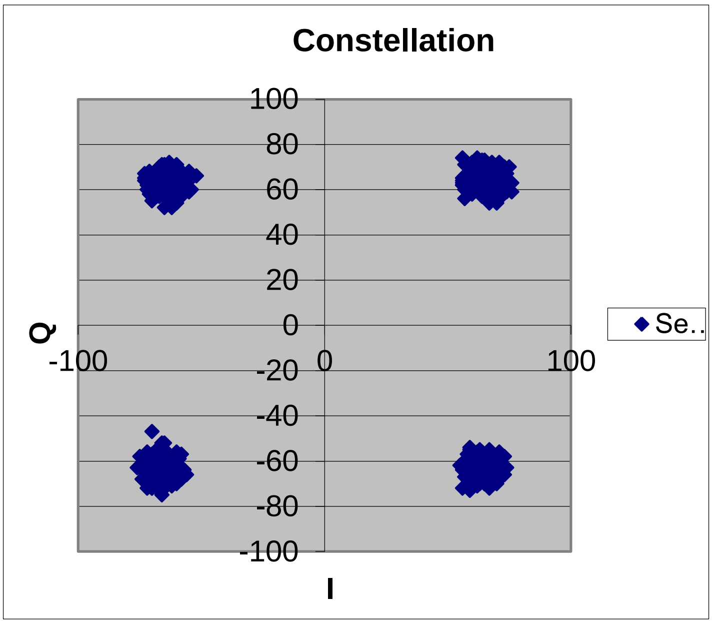


Figure 6-25 Example Constellation Graph (Microsoft Excel)

6.2.13 Edit->Unit->M&C->HTTPS Screen

The *Edit->Unit->M&C->HTTPS* screen is shown in **Figure 6-26**.

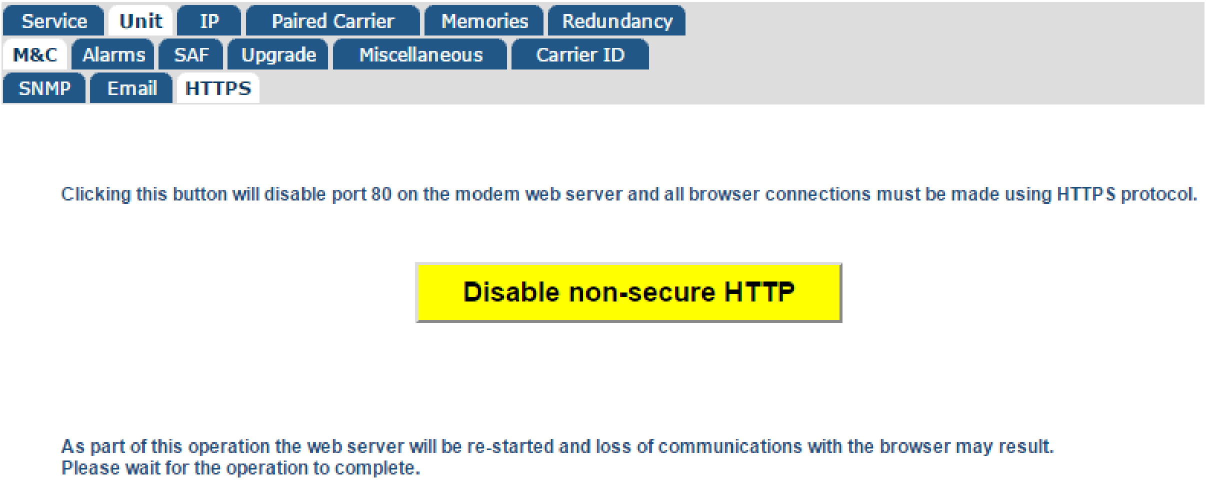


Figure 6-26 Edit->Unit->M&C->HTTPS Screen

Secure HTTPS connections to the modem's web server (on port 443) are always enabled. However, it is possible to disable (and re-enable) standard HTTP requests (on port 80) using this screen.

6.2.14 Edit->Unit->Alarms Screen

The *Edit->Unit->Alarms* screen is shown in **Figure 6-27**.

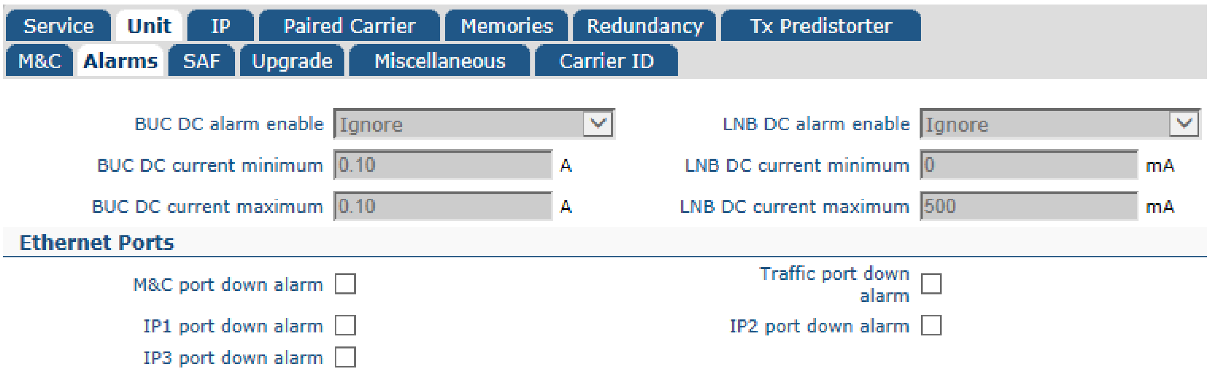


Figure 6-27 Edit->Unit->Alarms Screen

6.2.14.1 BUC DC Current Alarm

Even when there is no communications path between the BUC and modem, it is still possible for the modem to monitor the BUC for under/over current and over temperature conditions that cause the BUC to shut down. **Table 6-36** describes how to set the BUC minimum and maximum DC current levels outside of which a BUC DC current alarm will be raised if *BUC DC alarm enable* is set.

Range:	0.1A to 6.0A; step size: 0.01A
Description:	Sets the trip threshold at which a fault is declared when the current drawn by the Tx ODU is outside the limit. Both a minimum and a maximum current threshold can be set. These set the current thresholds outside of which an alarm will be generated.

Table 6-36 BUC DC Current Minimum/Maximum

6.2.14.2 LNB DC Current Alarm

The modem can also monitor the LNB current. **Table 6-37** describes how to set the LNB minimum and maximum DC current levels outside of which an LNB DC current alarm will be raised if *LNB DC alarm enable* is set.

Range:	0 to 500mA; step size: 1mA
Description:	Sets the trip threshold at which a fault is declared when the current drawn by the Rx LNB is outside the limit. Both a minimum and a maximum current threshold can be set. These set the current thresholds outside of which an alarm will be generated.

Table 6-37 LNB DC Current Minimum/Maximum

6.2.14.3 Ethernet Port Down Alarms

The *Ethernet port down alarm* checkboxes can be used to enable or disable individual alarms associated with each Ethernet port on the modem. These can be used to indicate that a cable has been removed or developed a fault, or that the communicating piece of equipment attached to a particular port has developed a fault.

6.2.15 Edit->Unit->SAF Screen

The *Edit->Unit->SAF* screen is shown in **Figure 6-28**. The concept of Software Activated Features (SAF) is explained in Section 7-4.

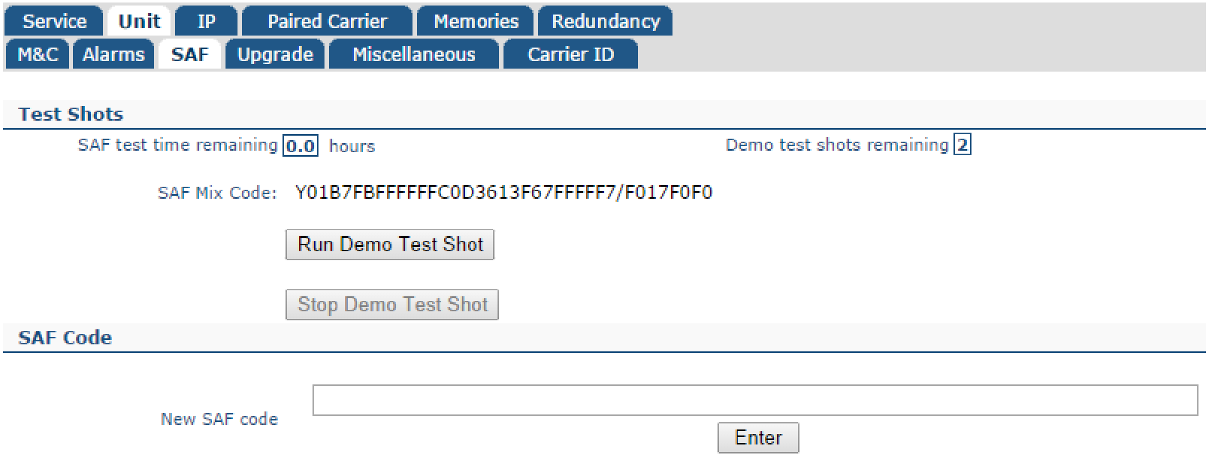


Figure 6-28 Edit->Unit->SAF Screen

This screen displays:

- The remaining time period before any temporarily-enabled SAF features time out.
- The number of unused test shots remaining. A test shot enables all of the modem features for a 10-day period (subject to suitable hardware being fitted and with some exceptions).
- The SAF Mix Code, which is a number that represents all of the features that have been permanently enabled on the modem.

The *Run Demo Test Shot* button is used to start a 10-day activation of the modem's SAF features.

The *Stop Demo Test Shot* button is used to terminate the temporary activation of the modem's SAF features. Any remaining time of the test period is lost.

The *New SAF code* edit box is used to enter a code provided by Paradise that unlocks additional modem features. When unlocked, the features immediately become available. The act of unlocking SAF features will not itself interfere with any services being provided by the modem. Entering a code of '0' will enable a test shot.

6.2.16 Edit->Unit->Upgrade Screen

Upgrade from web user interface

The *Edit->Unit->Upgrade* screen is shown in **Figure 6-29**. This allows the modem's software to be upgraded (and downgraded). This can also be done via the front-panel menus and a USB memory stick.

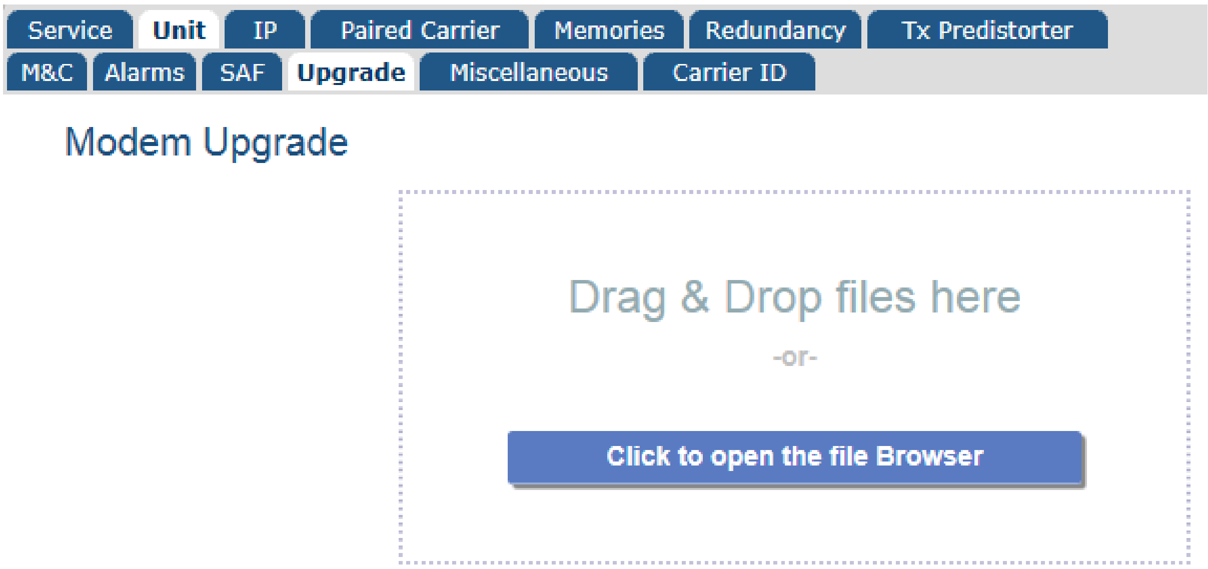


Figure 6-29 Edit->Unit->Upgrade Screen

The latest software can be found under Downloads on the Paradise company web site at http://www.paradisedata.com. The software should be downloaded from the web site to a temporary location that can be accessed by the browser and modem.

The modem should be placed into bridge mode with all advanced IP features (such as TCP acceleration, ACM, routing, etc.) switched off.

Using the *Browse* button, browse to the location of the upgrade file and open the file. During the upgrade process the modem will temporarily drop any traffic service that it was providing.

Feedback on the progress of the upgrade, which typically takes around two minutes, is provided on the screen (**Figure 6-30**). The modem will restart automatically when the upgrade is complete and will resume operation using the same configuration as prior to the upgrade.

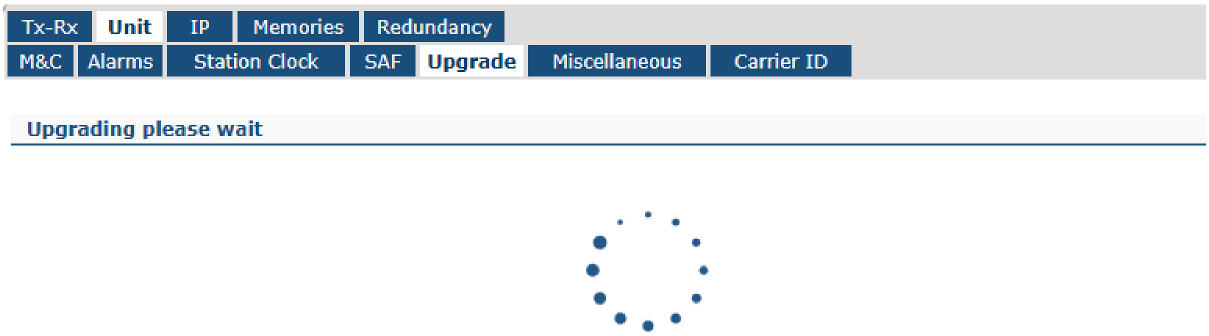


Figure 6-30 Edit->Unit->Upgrade Screen Progress Indication

A remote modem can be upgraded over the satellite link by browsing to the remote modem's IP address and following the same upgrade process. Note that the speed of the upgrade is dependent on the bandwidth available over satellite. An approximate time can be worked out by comparing the size of the upgrade file with the bandwidth available.

In the event that an upgrade is unsuccessful then the modem will revert to a backup version of software. This will normally be the same version as the software that the modem shipped from the factory with. However, it is possible to set the fallback software to any version (please consult Technical Support for further details).

To revert to the backup version of software in the modem, hold down the MAIN key at power-up, then when the menu appears press 5 (this is a hidden menu option). This boots the modem from a backup copy of the software stored when the modem was manufactured. Once the modem has been recovered then the standard upgrade process can be repeated.

Upgrade from USB memory stick

- Create a new folder on the USB memory stick and name it `upgrade`.
- Unzip the contents of the software upgrade zip file 'Q-MultiFlex-x.x.xx.zip' to this folder.
- Three files with the following names should now be present in the upgrade folder as shown in **Figure 6-31**.

Figure 6-31 USB Memory Stick Upgrade Files in Upgrade Folder

- Plug the memory stick into a USB port on the modem.
- On the front panel keypad select **2:Edit**, **4:Unit**, **5:Upgrade**.
- An 'Upgrading!! Do not switch off' message will then be displayed on the front-panel display.
- The modem will reboot automatically and resume normal operation when the upgrade is complete.

If the modem does not recognise the USB memory stick

To be recognised by the modem, the memory stick must have been formatted as 'FAT32'. In Windows, this can be done by right clicking on the USB drive and selecting 'Format' and then selecting 'FAT32'. Note that this will delete the existing contents of the memory stick.

Recovery from a failed upgrade

There are three methods of recovering from a failed upgrade.

Recovery to factory-installed backup software version

To revert to the default backup version of software installed in the modem during the production process, hold down the **MAIN** key at power-up, then when the menu appears press **5** (this is a hidden menu option).

This boots the modem from a backup copy of the software stored when the modem was manufactured. During the boot process the contents of the front-panel display will be incorrect and should be ignored. Once the modem has been recovered then the standard upgrade process can be repeated.

Recovery via the Rescue menu option

It is possible to boot the modem to a basic web server that allows the software upgrade process to be repeated. The basic web server will display a web page that allows you to navigate to the software upgrade file and when this is selected then the software will be upgraded as normal and the modem will reboot automatically at the end of the process.

To initiate the rescue process, hold down the **MAIN** key at power-up, then when the menu appears press **2:Rescue**. The basic web server uses an IP address of 10.0.70.1/16 and uses the IP traffic port on the modem (not the M&C Ethernet port).

Recovery via USB memory stick

- Unzip the contents of the software upgrade zip file 'Q-MultiFlex-x.x.xx.zip' to the root folder for the memory stick (e.g. 'D:\').
-
- Copy the `recimage` file from the following link to the memory stick's root folder:

  ftp://ftp.paradise.chunkyftp.net/Q-Flex/recimage

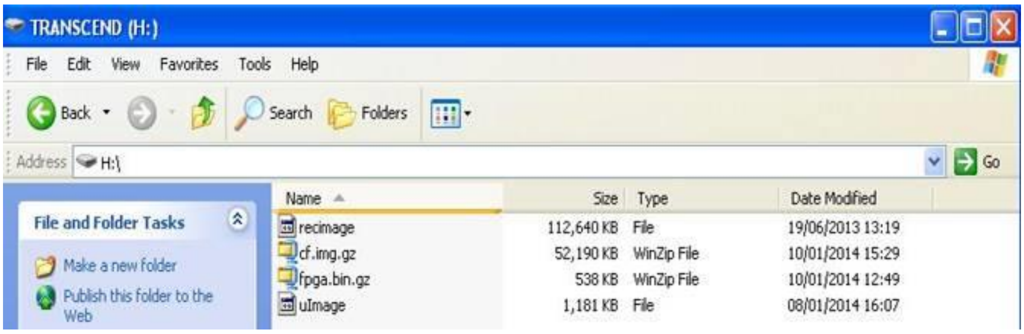


Figure 6-32 USB Memory Stick Root Folder

- There should now be 4 files in the memory stick's root folder as shown in **Figure 6-32**.
- Power up the modem and keep the **MAIN** key pressed down for a few seconds until a menu appears.
- Select **3:USB** from the menu.
- The modem will recover and complete the upgrade process from the memory stick within a few minutes. During the boot process the contents of the front-panel display will be incorrect and should be ignored.

6.2.17 Edit->Unit->Miscellaneous->Time Screen

The *Edit->Unit->Miscellaneous->Time* screen is shown in **Figure 6-33**. This allows the modem's real time clock to be set. The modem incudes a battery and maintains the time even when powered down. The modem will display a dialog box to confirm that the date and time have been changed (however, this will be displayed very briefly and may not be seen in every case).

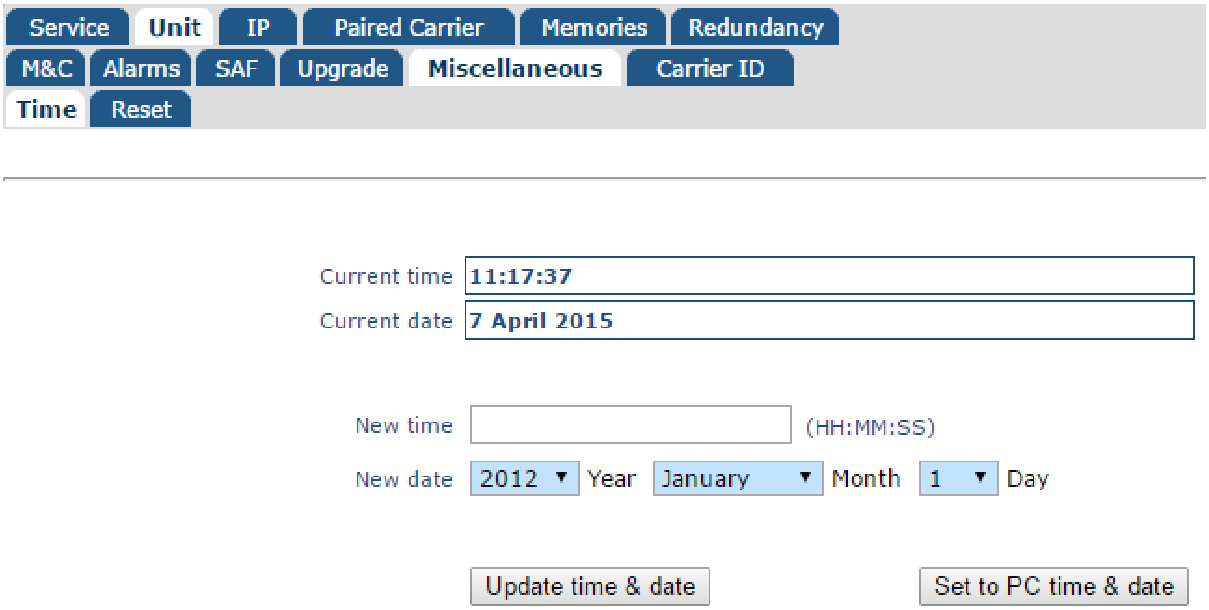


Figure 6-33 Edit->Unit->Miscellaneous->Time Screen

6.2.18 Edit->Unit->Miscellaneous->Reset Screen

The *Edit->Unit->Miscellaneous->Reset* screen is shown in **Figure 6-34**. This allows the modem to be reset, following confirmation.

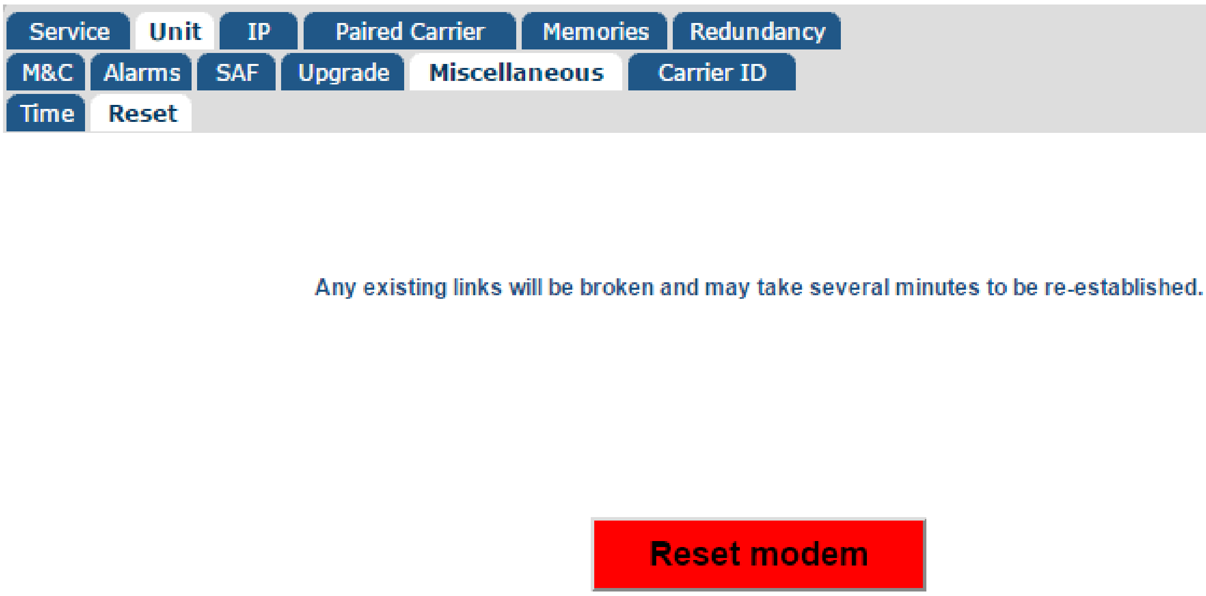


Figure 6-34 Edit->Unit->Miscellaneous->Reset Screen

6.2.19 Edit->Unit->Miscellaneous->NTP Screen

The *Edit->Unit->Miscellaneous->NTP* screen is shown in **Figure 6-35**. This supports using the Network Time Protocol (NTP) to synchronise the modem to the attached computer system. This requires the input of an NTP server IP address (that provides a master source of Coordinated Universal Time (UTC)).

The modem will request the current time from the NTP server on a regular basis.

A time offset can be applied to the modem to account for any regional deviation from UTC.

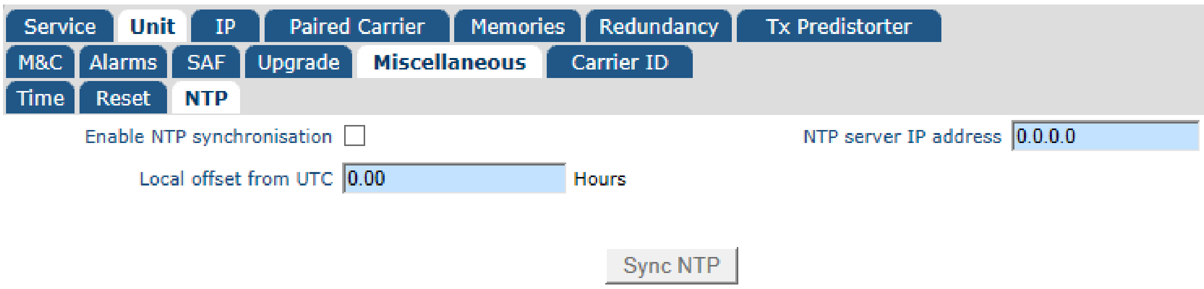


Figure 6-35 Edit->Unit->Miscellaneous->NTP Screen

6.2.1 Edit->Unit->Carrier ID Screen

The *Edit->Unit->Carrier ID* screen is shown in **Figure 6-36**. This allows a low-power spread spectrum signal containing user identification information to be superimposed on the Tx carrier. This works with all types of carriers (not just DVB-S2/S2X). When used with a suitable decoder, the information can be used to identify the source of satellite carriers that are interfering with other satellite services.

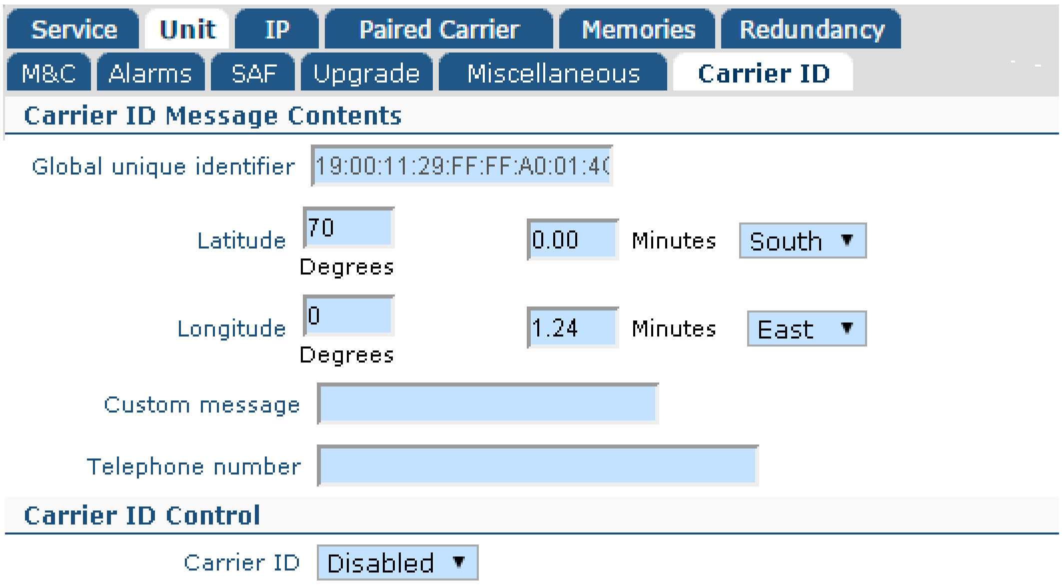


Figure 6-36 Edit->Unit->Carrier ID Screen

6.2.1.1 Carrier ID Global Unique Identifier

The Carrier ID *Global unique identifier* is a unique ID for the modem. Its value is fixed during the manufacturing process and cannot be changed. The unique identifier is transmitted as part of the Carrier ID information allows the modem manufacturer and the specific modem to be traced.

6.2.1.2 Carrier ID Latitude and Longitude

The Carrier ID *Latitude* and *Longitude* fields allow the user to enter the geographic position of the modem. This information is transmitted as part of the Carrier ID and allows a Carrier ID decoder to identify the location from which an interfering carrier is being generated.

6.2.1.3 Carrier ID Custom Message and Telephone Number

The Carrier ID *Custom message* and *Telephone number* fields are optional. If entered, this information will be transmitted as part of the Carrier ID signal and will be available for viewing via a suitable Carrier ID decoder.

6.2.1.4 Carrier ID

This is an *Enabled/Disabled* control that controls the generation of the Carrier ID spread spectrum signal. Carrier ID is an optional feature and can be made available on all Q Series modems via a software upgrade. The Carrier ID feature is not provided as standard and the Carrier ID SAF must therefore be activated on the modem for the feature to be available on the menus.

6.2.2 Edit->IP Screen

The *Edit->IP* screen (shown in **Figure 6-37**) allows the following to be set up:

- Basic and advanced IP modes and features, such as bridging, routing, acceleration and compression.
- The modem's terrestrial and satellite traffic IP addresses.
- Miscellaneous IP features used for specialised modes of operation.
- A further tab allows the setup of static routes.

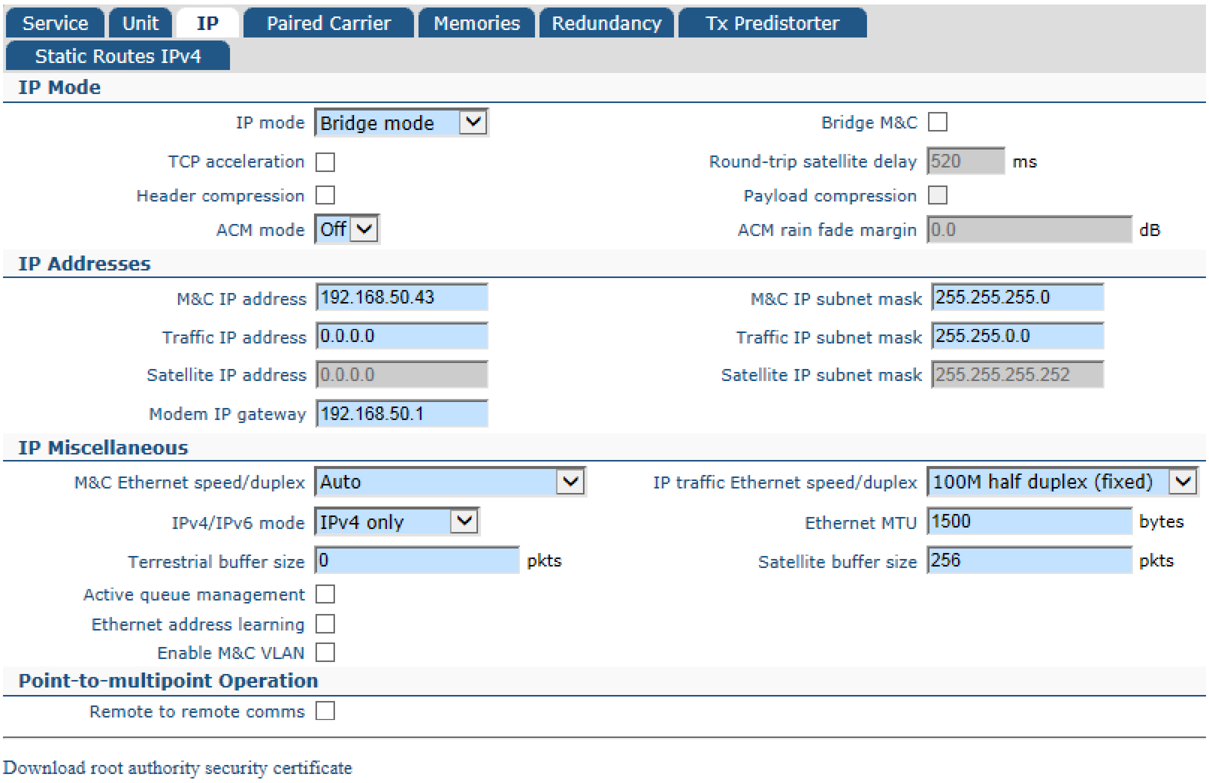


Figure 6-37 Edit->IP Screen

6.2.2.1 IP Mode

Table 6-38 shows the *IP mode* options. The operation of the M&C and IP Traffic Ethernet ports is summarized in **Table 6-38**.

Bridge mode	In this mode the modem acts as an Ethernet bridge, preserving the original Ethernet frames (including additional fields such as VLAN and MPLS headers) over satellite.
Routing mode	In this mode IP packets are forwarded based on the contents of the modem's routing table, which can be configured manually with static routes or controlled dynamically by enabling dynamic routing. Dynamic routing populates the routing table based on information forwarded by other routers in the network. The modem operates as a two-port router in this mode (with separate terrestrial and satellite IP addresses).
Trunking mode	Trunking mode implements a Layer 2 bridge in hardware. This results in a much higher packet handling capability (up to 500,000 packets per second as opposed to a maximum of 150,000 packets per second when in other modes). Because the processor is bypassed in this mode, jitter is also minimised and typically registers as zero when measured with Ethernet test equipment. ACM (and AUPC) can be used in Trunking mode but other IP features such as TCP acceleration cannot be used because they require the packets to be passed through the processor.

Table 6-38 IP Mode

Modem Settings			Ethernet Operation	
Bridging/Routing Mode	**M&C and IP Traffic Ethernet Ports**	**TCP Acceleration**	**Operation of M&C Ethernet Port**	**Operation of IP Traffic Ethernet Port**
Bridging	Bridged	Off	M&C address shared with IP Traffic port; M&C traffic will be bridged over satellite as required	IP Traffic address not used; port is addressed via M&C address; traffic will be bridged over satellite as requried
Bridging	Bridged	On	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Bridging	Not bridged	Off	M&C port has dedicated address; M&C traffic will not be bridged over satellite	IP Traffic port has dedicated address; traffic will be bridged over satellite as required
Bridging	Not bridged	On	M&C port has dedicated address; M&C traffic will not be bridged over satellite; modem gateway is applied to M&C subnet	IP Traffic address not used; IP Traffic port dedicated to satellite traffic only, which will be accelerated and bridged over satellite as required
Routing	Bridged	Off	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Routing	Bridged	On	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Routing	Not bridged	Off	M&C port has dedicated address, which must be on a different subnet to IP Traffic port; M&C traffic will be routed over satellite as required	IP Traffic port has dedicated address; traffic will be routed over satellite as required
			Modem gateway applied to either port as specified by subnet	
Routing	Not bridged	On	M&C port has dedicated address, which must be on a different subnet to IP Traffic port; M&C traffic will be routed and accelerated over satellite as required	IP Traffic port has dedicated address; traffic will be routed and accelerated over satellite as required
			Modem gateway applied to either port as specified by subnet	

Table 6-39 Ethernet Port Operation

6.2.2.2 Bridge M&C

This is an On/Off control that determines whether the two RJ45 Ethernet ports on the base modem are bridged together or whether they have separate IP addresses allocated to them. When multiple IP traffic ports are used (via the 3-port Ethernet extension card) then all IP traffic ports are always bridged together and share one IP address regardless of the IP mode that is selected or the bridge settings.

When the Remote M&C Ethernet port is out of the bridge then satellite IP traffic and M&C traffic are processed separately and therefore the two modem Ethernet connectors are no longer interchangeable. Care should be taken in selecting this mode for a remote modem since if the cables have been incorrectly fitted then it could result in M&C communications with the remote modem being lost.

When the Remote M&C Ethernet port is bridged to the satellite IP Traffic port then the two modem Ethernet ports act as a two-port Ethernet switch.

<u>Remote modem M&C using separate M&C and traffic subnets</u>

While bridging the M&C port to the traffic port(s) gives straightforward M&C access to the remote modems, it precludes the separation of M&C and traffic onto their own distinct subnets, since the ports share a single IP address when bridged.

To overcome this, the Q-MultiFlex™ supports a setting that transmits all M&C destined for the remote modems on a separate VLAN (using VLAN 0). All remote modems will receive the M&C VLAN when VLAN filtering is enabled at the remote modem. To enable this mode on the Q-MultiFlex™, set the Remote M&C VLAN control (under the <u>Edit->Service->General->Tx QoS menu</u>).

6.2.2.3 TCP Accleration

This is an On/Off control that controls point-to-multipoint TCP acceleration.

Packets received by the modem will be either bridged or routed as determined by the *IP mode* setting.

When on, TCP packets are processed by a Performance Enhancing Proxy (PEP) that overcomes performance problems associated with using standard TCP over satellite.

<u>Configuring TCP Acceleration</u>

- ***<u>Bridging Mode</u>***

  In order to make it easier to set up, TCP acceleration does not use an IP address for the IP traffic port when used in bridging mode. The M&C Ethernet port cannot be bridged to the IP Traffic port when using bridged TCP acceleration. M&C control must be provided via a separate subnet to that used for satellite traffic. The modem gateway is applied to the M&C subnet.

- ***Routing Mode***

  In this mode, the M&C Ethernet port and IP Traffic port have dedicated addresses and must be on separate subnets. All packets on both ports will be accelerated and passed over satellite as required. The modem gateway is applied to either the M&C subnet or IP Traffic subnet as specified by the user.

6.2.2.4 Round-trip Satellite Delay

Range:	0ms to 9999ms; step size: 1ms
Description:	This sets a satellite round-trip delay that is used in conjunction with TCP acceleration. It controls the size of the modem's internal packet buffer to match the bandwidth-delay product for the link (i.e. the link's data capacity multiplied by the end-to-end delay). This helps to maintain the throughput at its maximum level when TCP acceleration is on.

Table 6-39 Round-trip Satellite Delay

6.2.2.5 Header Compression

This is an On/Off control that controls header compression.

IP, UDP and RTP header compression is supported in accordance with the Robust Header Compression (ROHC) standard RFC 3095 (profiles 2 and 3). ROHC typically reduces the 40 bytes of IP, UDP and RTP header, which is typically used with Voice over IP data, down to between 1 and 3 bytes. Ethernet header compression is also supported in addition and this reduces 14 bytes of Ethernet frame down to typically 1 byte. Overall savings from compression from both types of compression (e.g. for a G.729 voice stream) can be as high as 60%.

When header compression is on, Ethernet, UDP, TCP, RTP and IP packet headers are compressed in order to save satellite bandwidth. The relative bandwidth saving is greater for smaller packets.

The compressed packets will be either bridged or routed as determined by the *IP mode* setting.

Selective compression of packets can be controlled via the *Edit->IP->Header Compression* screen, which allows routes to be added.

6.2.2.6 Payload Compression

This is an On/Off control that controls header compression.

When payload compression is on, the payload of IP packets are compressed in order to save satellite bandwidth.

The compressed packets will be either bridged or routed as determined by the *IP mode* setting.

6.2.2.7 ACM Mode

Table 6-40 lists the modes available with respect to Adaptive Coding and Modulation (ACM). ACM converts any unused link margin into additional IP throughput.

Off	When using DVB-S2/S2X, this switches ACM off.
On	This switches ACM on. When ACM is on, the choice of modulation and FEC rate (modcod) in the transmit path is dynamically matched to the reported Es/No values from the remote modems. Carrier symbol rate and power remain unchanged but data rate for each remote modem will vary with the choice of modcod. The remote modems will automatically insert regular Es/No information into the return carriers (with no material effect on bandwidth).

Table 6-40 ACM Mode

6.2.2.8 ACM Rain Fade Margin

Range:	0dB to 9.9dB; step size: 0.1dB
Description:	This sets a margin used in the ACM control process when making decisions on what modcod to select based on the current Es/No reading of the remote modem(s). By setting the ACM rain fade margin to a non-zero value, ACM operation will cope with a faster rate of rain fade without losing demodulator lock than would otherwise be the case. Note that the ACM control process has its own non-configurable operating margin built in (which will cope with Es/No changes of up to 1dB/s) and therefore the ACM rain fade margin should be used only on links that have the potential for particularly severe rain fades. Setting an ACM margin that is higher than necessary will reduce the benefits of using ACM since non-optimal modcods may be used due to the need to maintain a larger margin between the actual Es/No and the Es/No required by the dynamically selected modcods.

Table 6-41 ACM Rain Fade Margin

6.2.2.9 M&C IP Address, Subnet Mask & Modem IP Gateway

M&C IP Address Default:	10.0.70.1
Description:	This sets the IP address for remote control. When the M&C and traffic Ethernet ports are bridged together then this address is used for both M&C purposes and satellite traffic. An IP address of 0.0.0.0 causes the modem to request its IP address from a Dynamic Host Control Protocol (DHCP) server on the network, removing the need to allocate static IP addresses to each modem. The allocated IP address can be seen on the *View->Unit* screen. A request to the DHCP server is made every minute until a reply is received. When IPv6 support is selected on the menus then additional address entry options are provided. When changing the IP address, devices communicating with the modem may take several minutes to recognize the new address unless the Address Resolution Protocol (ARP) table on the device is flushed.
M&C IP Subnet Mask Default:	255.255.0.0
Description:	Sets the remote control port IP subnet mask.
Modem IP Gateway Default:	0.0.0.0
Description:	Sets the IP address of a default gateway. The gateway represents the ‘next hop’ destination, which is normally the address of a router, for packets destined for somewhere other than the local network. This is used whenever the *IP mode* is set to *Routing*. An address of 0.0.0.0 means that the gateway is not set.

Table 6-42 M&C IP Address, Subnet Mask & Modem IP Gateway

6.2.2.10 Traffic/Satelite IP Addresses and Subnet Masks

Traffic IP address	This sets the IP address for the modem’s IP Traffic port. (DHCP is not supported for this address and therefore an address must be manually entered.) When IPv6 support is selected on the menus then additional address entry options are provided.

Traffic IP subnet mask	This sets the subnet mask for the modem's IP Traffic port.
Satellite IP address	This sets the IP address for the modem's satellite IP port. This is only used when in routing mode, when the modem acts as a two-port router.
Satellite IP subnet mask	This sets the subnet mask for the modem's satellite IP port.

Table 6-43 Traffic/Satellite IP Address & Subnet Mask

6.2.2.11 M&C and IP Traffic Ethernet Speed/Duplex

Table 6-45 lists the different Ethernet speed and duplex settings for the modem's Ethernet interfaces. The M&C interface and IP traffic interface can be set independently of each other. Changes will be effective immediately but when an auto-negotiated mode is selected then any Ethernet connection will be briefly disconnected while the change takes effect. The *Auto* setting is recommended for normal use but because Ethernet auto-negotiation varies between different manufacturers it may be necessary to fix the speed and duplex in some circumstances. The type of cable (crossover or straight) is always automatically sensed by the modem, which will work with both.

Auto	In this mode the modem will auto-negotiate the Ethernet speed and duplex settings.
10M half duplex	In this mode the modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 10Mbps half duplex as the only option available.
10M full duplex	The modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 10Mbps full duplex as the only option available.
100M half duplex	The modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 100Mbps half duplex as the only option available.
100M full duplex	The modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 100Mbps full duplex as the only option available.
1000M half duplex	The modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 1000Mbps half duplex as the only option available.
1000M full duplex	The modem will auto-negotiate the Ethernet speed and duplex settings but as part of the negotiation will 'advertise' 1000Mbps full duplex as the only option available.

10M half duplex (fixed)	The modem's Ethernet interfaces will be fixed to 10Mbps half duplex operation.
10M full duplex (fixed)	The modem's Ethernet interfaces will be fixed to 10Mbps full duplex operation.
100M half duplex (fixed)	The modem's Ethernet interfaces will be fixed to 100Mbps half duplex operation.
100M full duplex (fixed)	The modem's Ethernet interfaces will be fixed to 100Mbps full duplex operation.
1000M half duplex (fixed)	The modem's Ethernet interfaces will be fixed to 1000Mbps half duplex operation.
1000M full duplex (fixed)	The modem's Ethernet interfaces will be fixed to 1000Mbps full duplex operation.

Table 6-44 Ethernet Speed/Duplex

6.2.2.12 IPv4/IPv6 Mode

IPv4 only	This enables the entry and display of IP addresses in IPv4 format only. The modem will bridge IPv4 and IPv6 packets when in IPv4 mode but will route only IPv4 packets.
IPv4 and IPv6	This enables the entry and display of IP addresses in either IPv4 format or IPv6 format. The modem will bridge and route both IPv4 and IPv6 packets in this mode.

Table 6-45 IPv4/IPv6 Mode

6.2.2.13 Ethernet MTU

Range:	1,500 bytes to 10,240 bytes; step size: 1 byte
Description:	This controls the Ethernet Maximum Transmission Unit (MTU) size, which defines the largest Ethernet frame that can be handled by the modem in bridging mode without fragmentation into smaller frames.

Table 6-46 Ethernet MTU

6.2.2.14 Terrestrial Buffer Size

The terrestrial buffer is used to buffer IP packets coming into the IP terrestrial ports for transmission over satellite. Satellite delay and the quality of the service in general can be controlled by the size of this buffer in conjunction with setting the size of the satellite buffer. The buffer should be set large enough to accommodate bursts of packets being received by the modem. Setting the buffer larger than necessary could result in large packet delays building up should more packets be sent to the modem than can be transmitted.

The optimal size for the buffer depends on the link data rate, the packet sizes, the number of packets and the specific application (some applications being able to tolerate packet loss and/or delays more than others). When the buffer is full then received packets will be dropped until space in the buffer is freed up.

It is generally desirable for the terrestrial buffer to be set so that packets are not dropped unnecessarily before they have been assessed by the traffic shaper as to priority, etc. At the same time, a large buffer could result in stale data being kept, which it might be better to drop by making the buffer smaller so that only the most recent data is kept in an overload situation.

6.2.2.15 Satellite Buffer Size

The satellite buffer is used to buffer IP packets ready for transmission over satellite. The buffer is situated after all internal packet processing has been completed, including traffic shaping and encapsulation. Satellite delay and the quality of the service in general can be controlled by the size of this buffer. The buffer should be set large enough to even out peaks and troughs in throughput that would result from setting an extremely small buffer. Setting the buffer larger than necessary could result in large packet delays building up should more packets be available than can be transmitted. The traffic shaper can be used to ensure that the combined output from all classes of traffic does not exceed the available satellite bandwidth, even when ACM (which dynamically adjusts the data rate) is active.

The optimal size for the buffer depends on the link data rate, the packet sizes, the number of packets and the specific application (some applications being able to tolerate packet loss and/or delays more than others). When the buffer is full then new packets for transmission will be dropped until space in the buffer is freed up. **However, as a general rule, it is recommended that the satellite buffer size is set to 8 for most applications, particularly when TCP acceleration is being used, unless an alternative buffer size is found to give better performance. Setting the buffer too large can cause throughput to oscillate when TCP acceleration is being used.**

6.2.2.16 Active Queue Management

Although the terrestrial and satellite buffers can be tuned to match the specific needs of a particular user application, passive buffer managed has inherent limitations and drawbacks. Active Queue Management (AQM) is an intelligent and pro-active form of TCP/IP queue management that overcomes the potential for inconsistent end-to-end packet delays and the problems of 'buffer bloat'. Buffer bloat is where packet buffers in the system are over-sized in order to try to prevent packet loss. The result is often that performance at the application level suffers due to excessive buffering of packets during periods of congestion, leading to extremely high latency levels with old data being kept almost indefinitely in the hope that extra bandwidth will become available and any overload will ease.

Most buffer management in TCP/IP devices is passive and relies on the user setting internal buffer sizes to be consistent with the needs of the application and its data rates. However, TCP/IP is bursty by nature and if the rate of arrival of packets at the satellite modem exceeds its transmission capabilities then packets start to back up and will eventually get dropped if the overload continues. The problem with this is that the end-to-end packet delay can vary greatly and data becomes increasingly stale as the backlog of packets to be transmitted builds up.

Active Queue Management continually measures the packet delay through the modem and rather than let the backlog of packets build up, it ensures that the delay through the modem is kept constant by dropping packets early if required. (The modem implements a form of active queue management called CoDel, which stands for Constant Delay. The delay has been preset to 5ms, from packet ingress to egress, which is suitable for most applications. It can be changed ‘under the hood’ – please contact Customer Support for details.) The effect of this is that transit times through the network typically continue to be constant even in an overload situation.

The use of AQM can be combined with traffic shaping to ensure that high priority traffic is unaffected when demands on bandwidth are exceeded.

The use of AQM is especially important for latency sensitive applications and where the packet latency over the satellite link is measured to ensure compliance with a Service Level Agreement (SLA). It needs to be enabled on the modems at both ends of the satellite link in order to be effective.

6.2.2.17 Ethernet Address Learning

By default, Ethernet (or MAC) address learning is not enabled on the modem. This helps to protect against the possibility of traffic storms caused by inadvertent loops in the network.

However, when the 4-port Ethernet expansion switch is fitted to the modem then it is strongly recommended that Ethernet address learning is enabled. If address learning is disabled when the 4-port switch is fitted then traffic sent to one port will also be flooded onto all other ports since the modem will be unaware of which devices are connected to which switch port. While a small amount of flooding is acceptable as a means of automatically detecting and adapting to changes in the network, it is undesirable to do it all the time. This problem does not arise when only a single IP traffic port is available on the modem.

6.2.2.18 M&C VLAN

This is an On/Off control that controls whether M&C traffic destined for the remote modems is transmitted in a special VLAN. When the control is checked, all M&C traffic for the remote modems is sent over satellite using VLAN 0. The M&C packets will be received and processed by the remote modems when the *VLAN filtering* control (under the *Edit->IP* menu) is enabled on the remote modem.

This technique for remote control means that the M&C port does not need to be bridged to the traffic port(s) thereby facilitating the use of separate M&C and traffic networks that use different subnets.

6.2.2.19 Remote to Remote Comms

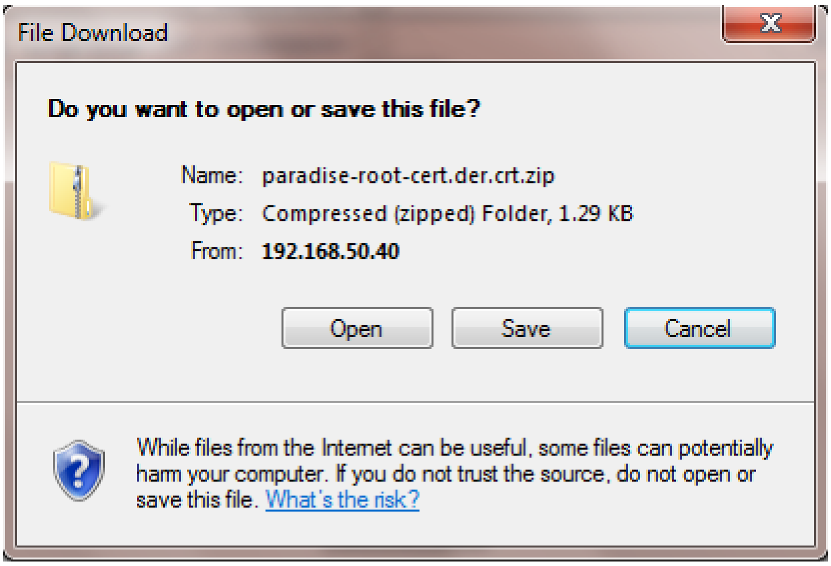
This is an On/Off control that controls whether traffic received from a remote modem is retransmitted over satellite to the other remote modems. By supporting double satellite hops, this enables remote-to-remote communications. Care should be taken with this mode because recirculating packets in this way could confuse intelligent Ethernet switches in the system by giving the appearance that the location of the remote modem has changed, causing switches to reconfigure themselves incorrectly.

6.2.2.20 Download Root Authority Security Certificate

Downloading a security certificate from the modem to your browser will reduce security violations in some circumstances, particularly when using TCP and web acceleration.

The steps involved in storing the security certificate on your computer are described below for Windows and the Chrome browser. The steps may be different for other operating systems and browsers.

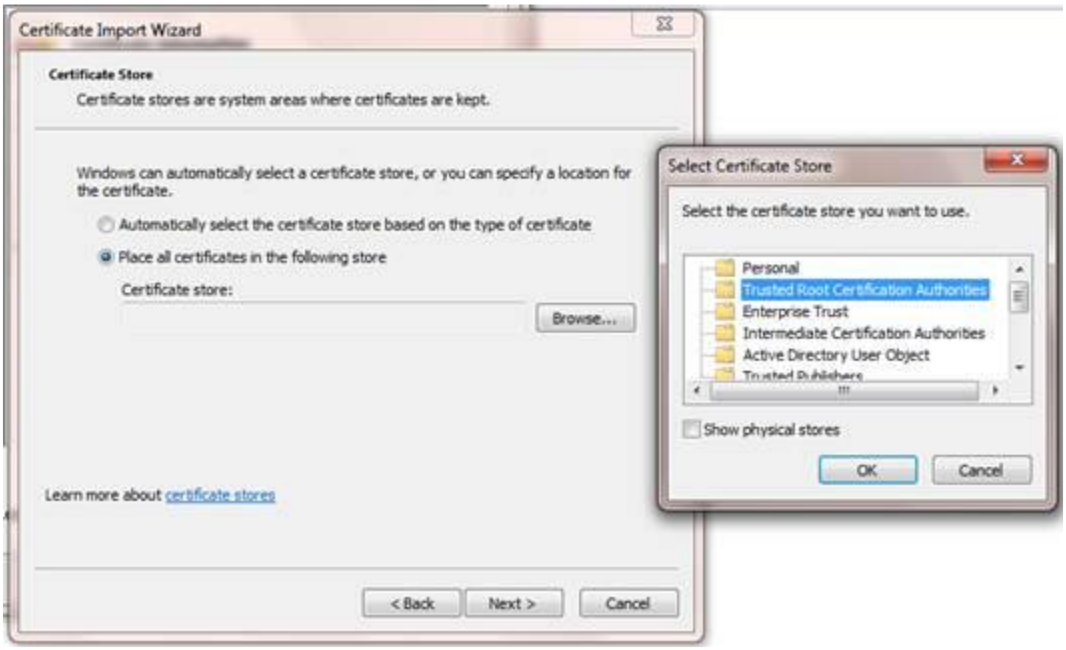
1. Click on the '*Download Root Authority Security Certificate*' hyperlink. This will lead to the following dialog box:



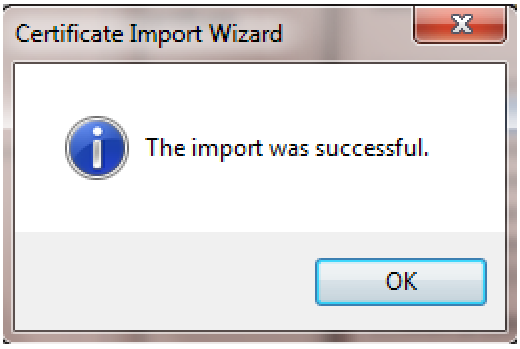
2. Save the file and unzip the 'paradise-root-cert.der.crt.zip.crt' file from the download location. When you double click on the crt file, the following dialog will be displayed:

3. Installing the certificate will lead to the certificate import wizard:

4. This allows the certificate to be placed in a particular location – the Trusted Root Certification Authorities folder should be chosen:



5. You will be asked to confirm the import and when this is done the following will be displayed:



6.2.3 Edit->IP->Static Routes Screen

The *Edit->IP->Static Routes* screen, shown in **Figure 6-40,** allows up to 16 static routes to be added.

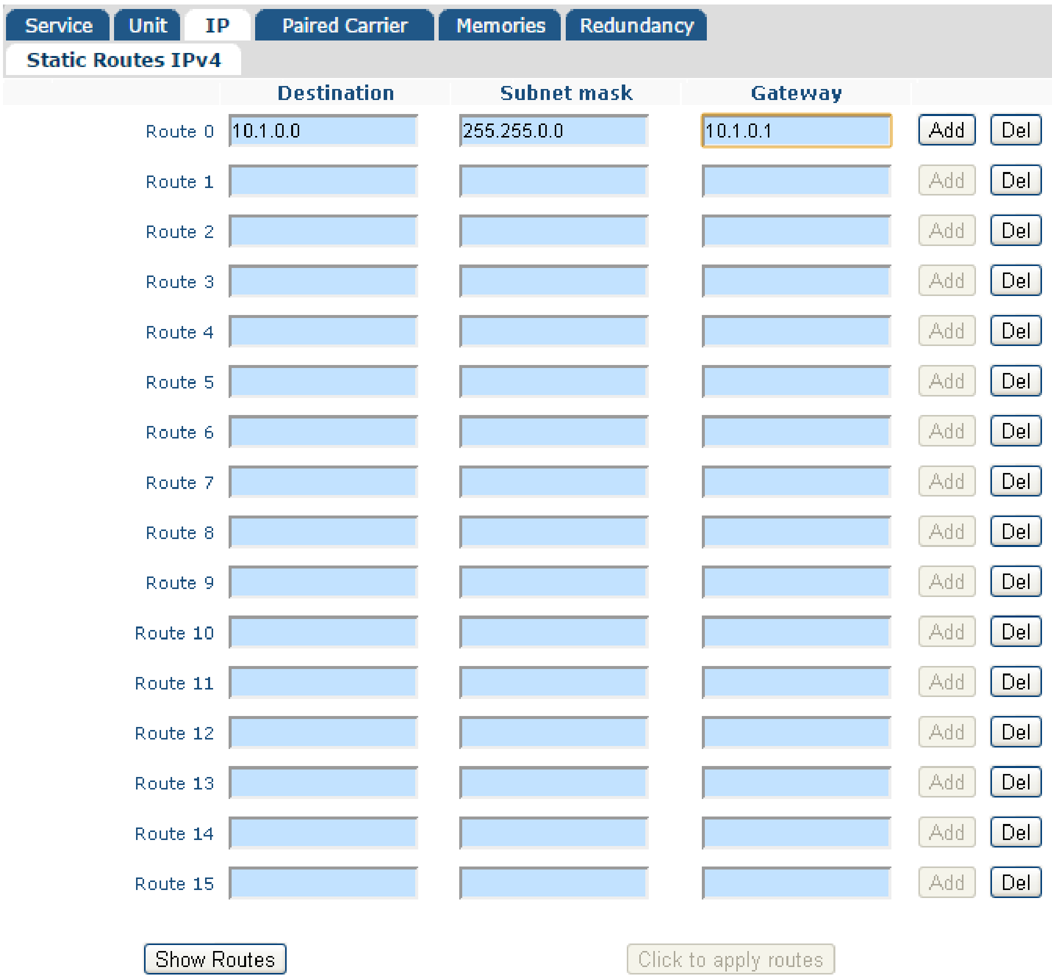


Figure 6-40 Edit->IP->Static Routes Screen

Each route consists of a destination IP address, subnet mask and a gateway address.

The *Add* button must be selected in order to enable each route.

The *Del* button is used to delete individual routes.

The *Click to apply routes* button must be selected to apply the static routes before navigating away from the web page.

The *Show Routes* button can be used to display the underlying operating system 'route add' commands applied to the TCP/IP stack, thereby providing confirmation of the active static routes.

6.2.4 Edit->IP->Header Compression Routes Screen

The *Edit->IP->Header Compression Routes* screen, shown in **Figure 6-41,** allows up to 16 static routes to be added. These determine which packets header compression is applied to. Compression is both transparent and lossless.

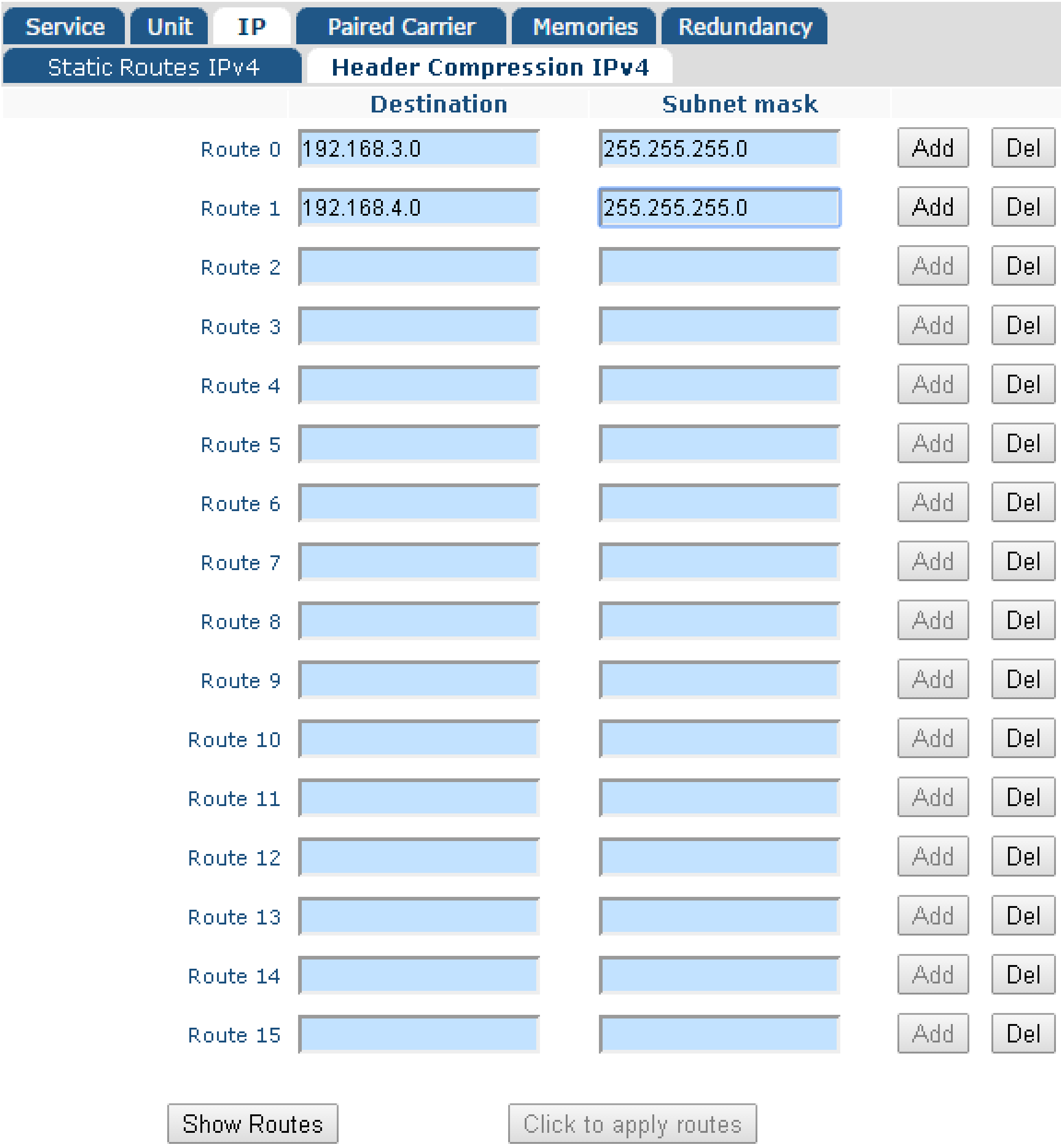


Figure 6-41 Edit->IP->Header Compression Routes Screen

Each route consists of a destination IP address and subnet mask. The *Add* and *Del* buttons enable and disable each route, respectively. Note that routes can be applied even when in bridging mode.

The *Click to apply routes* button must be selected to apply the header compression routes before navigating away from the web page.

The *Show Routes* button can be used to confirm the active header compression routes.

6.2.5 Edit->Memories Screen

The *Edit->Memories* screens shown in this section allow the user to store and recall modem configurations (referred to as configuration memories). These can also be uploaded and downloaded to and from a PC or equivalent to allow configurations to be shared between different modems.

The following operations can be performed on configuration memories:

- *Store.* This allows the current M&C configuration to be stored to a named configuration memory for later use. Up to 20 configuration memories can be created (more may be stored if memory allows). The memories are non-volatile and will persist between successive power-ups of the modem. Configuration memories can be assigned any desired name using the alphanumeric keypad.
- *Recall.* This allows a previously stored configuration to be selected and used in place of the current configuration.
- *Erase.* This allows configuration memories to be deleted.
- *Download.* This is used to download one or more configuration memories from the modem to a PC or equivalent.
- *Upload.* This is used to upload one or more configuration memories to the modem.

A default configuration memory called *LOAD_DEFAULTS* always exists. Recalling it will reset the modem to its factory defaults. When LOAD_DEFAULTS is recalled from the web user interface then the modem's current M&C IP address, netmask, gateway, takeaway control, Modem ID and passwords are all retained whereas when selected from the front panel these go back to their factory defaults. This is done in order not to lose remote control of the modem from the web user interface when using it. *LOAD_DEFAULTS* cannot be erased or overwritten.

Configuration memory names are restricted to alphanumeric characters.

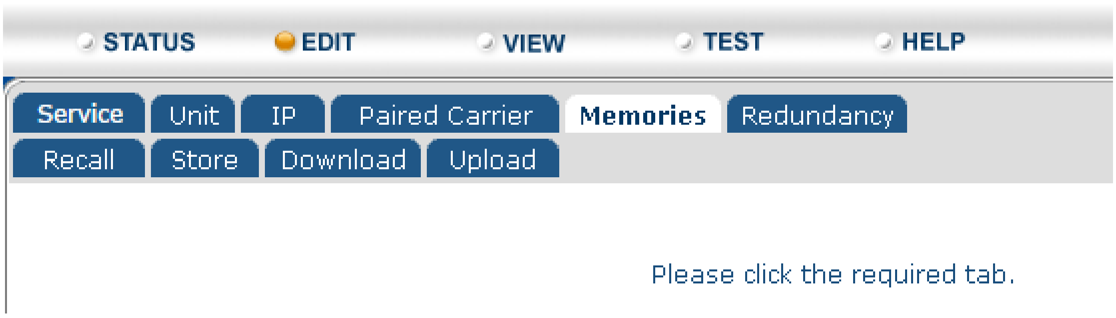


Figure 6-42 Edit->Memories Screen

6.2.5.1 Edit->Memories->Recall Screen

The *Edit->Memories->Recall* screen (shown in **Figure 6-43**) displays all of the configuration memories that are stored on the modem. A specific configuration memory can be made active by selecting the associated *Recall* button. The *Delete* button can be used to delete a configuration memory.

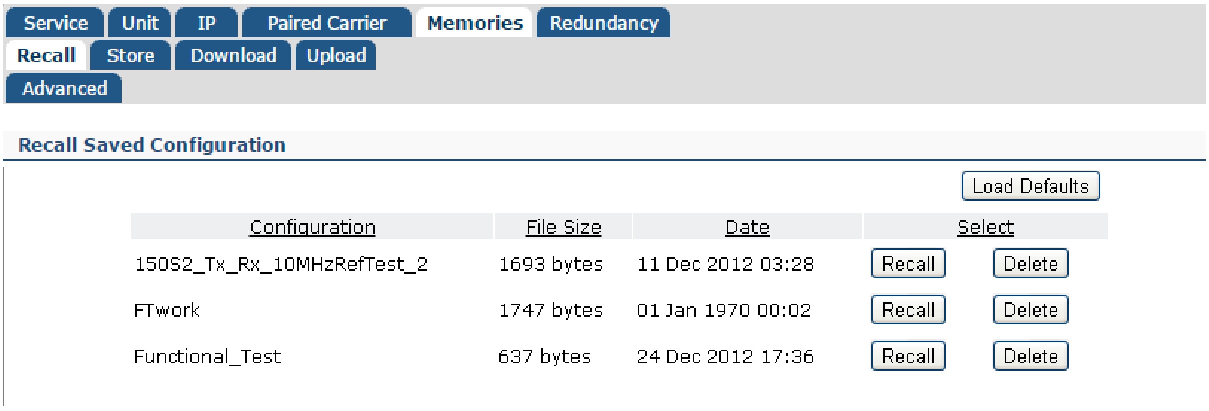


Figure 6-43 Edit->Memories->Recall Screen

6.2.5.2 Edit->Memories->Recall->Advanced Reversionary Control Screen

The *Edit->Memories->Recall->Advanced* screen (shown in **Figure 6-44**) supports a method for recovering a remote modem from a failure during a change to the modem's configuration. In essence, this works in a similar way to the Cisco Reload command, where a known trusted configuration is loaded after a defined timeout period in the event that the reload operation is not cancelled by the operator in a timely manner after completing the necessary configuration changes.

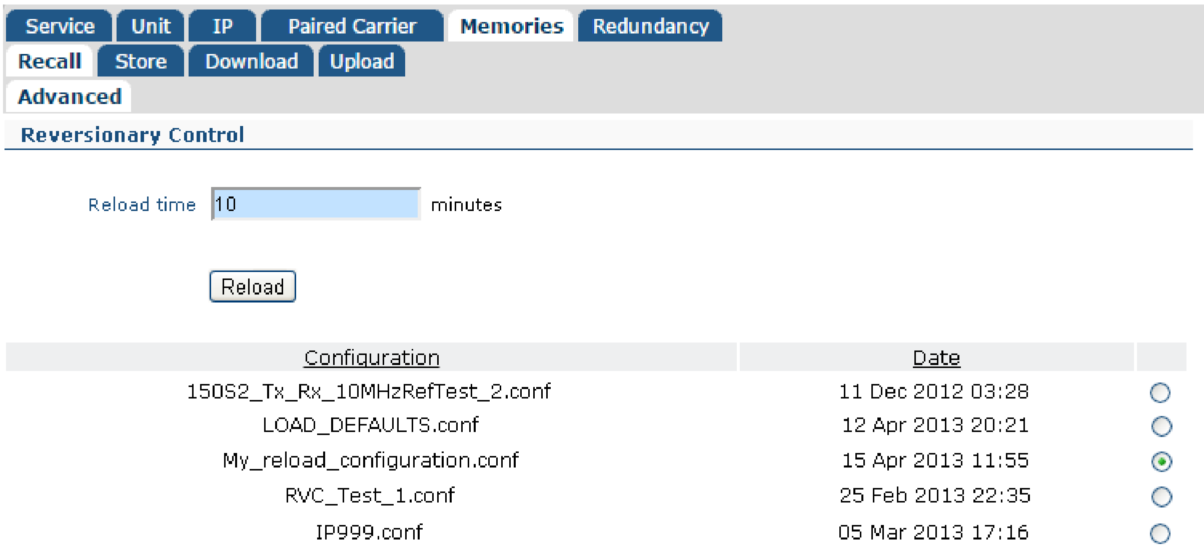


Figure 6-44 Edit->Memories->Advanced Reversionary Control Screen

The procedure for protecting and recovering a remote modem from failure during a configuration change is as follows.

1. Prepare in advance a configuration memory that represents a known ‘safe’ or default configuration for the remote modem. This is the configuration that will be recalled should a manual reconfiguration of the remote modem result in a loss of communications with the modem. Ensure that this configuration memory is stored on the remote modem.
2. Immediately prior to making any manual change to the remote modem, navigate to its *Edit->Memories->Recall->Advanced* screen and select the radio button corresponding to the configuration memory to be reloaded in the event of a failure during the configuration process.
3. Set a reload time. This is the period of time in minutes that the operator has to make all the necessary configuration changes to the remote modem. It represents a timeout period after which the modem will automatically reload the selected configuration memory unless the operator intervenes to cancel the timeout.
4. Click on the *Reload* button to start the timeout period, at which point the screen will change to that shown in **Figure 6-45**, which shows the remaining timeout period along with the name of the configuration memory that will be reloaded. In addition, the *Reload* button changes to a *Cancel* button.
5. Make any necessary changes to the remote modem’s configuration.
6. After completing the configuration changes, navigate back to the *Edit->Memories->Recall->Advanced* screen and cancel the timeout by clicking on the *Cancel* button. The screen will now revert to its original format shown in **Figure 6-44**.

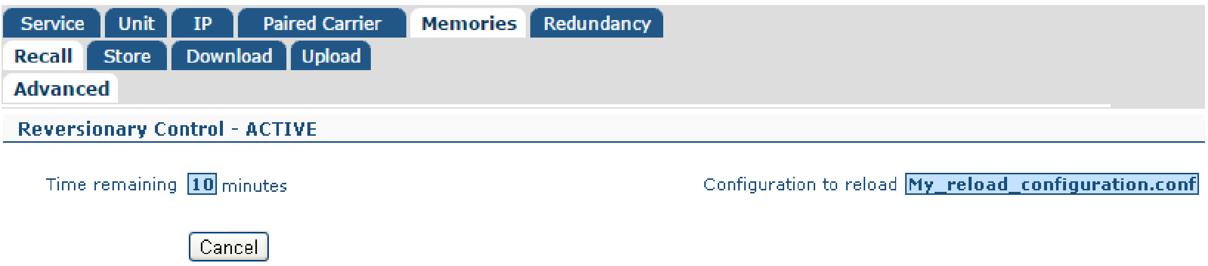


Figure 6-45 Edit->Memories->Advanced Reversionary Control Screen (Active state)

6.2.5.3 Edit->Memories->Store Screen

The *Edit->Memories->Store* screen (shown in **Figure 6-46**) allows the current modem configuration to be stored to a configuration memoriy under a given name. It also displays all of the configurations that are already stored on the modem. The *Delete* button can be used to delete a specific configuration memory.

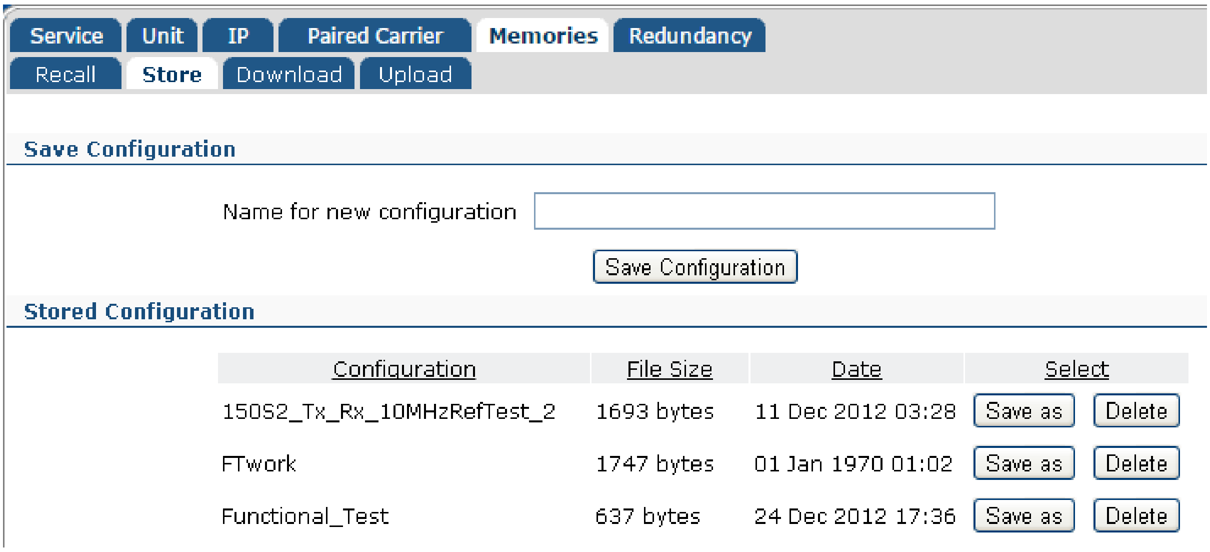


Figure 6-46 Edit->Memories->Store Screen

6.2.5.4 Edit->Memories->Download Screen

The *Edit->Memories->Download* screen (shown in **Figure 6-47**) displays all of the configuration memories that are stored on the modem and can be used to download one or all of the configurations from the modem to the user's browser device (such as a PC).

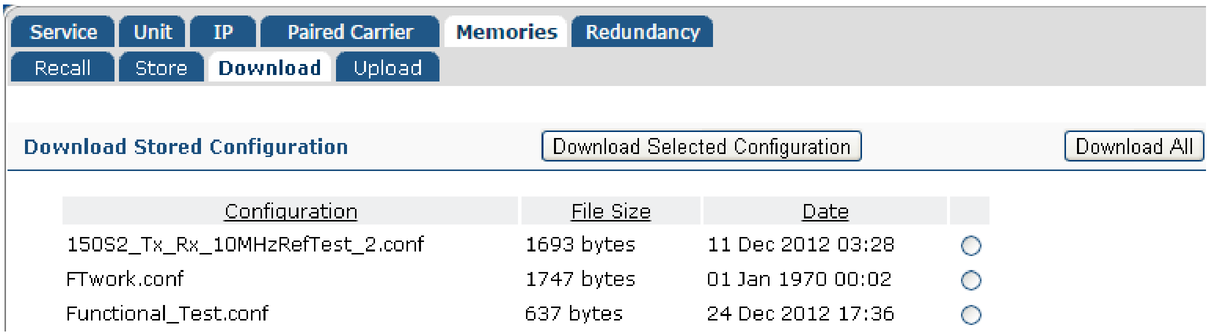


Figure 6-47 Edit->Memories->Download Screen

6.2.5.5 Edit->Memories->Upload Screen

The *Edit->Memories->Upload* screen (shown in **Figure 6-48**) allows the user to browse to a location on their browser device where they have a configuration memory that they want to upload to the modem. After selecting the file, selecting the *Upload Saved Configuration* button causes the configuration to be transferred to the modem.

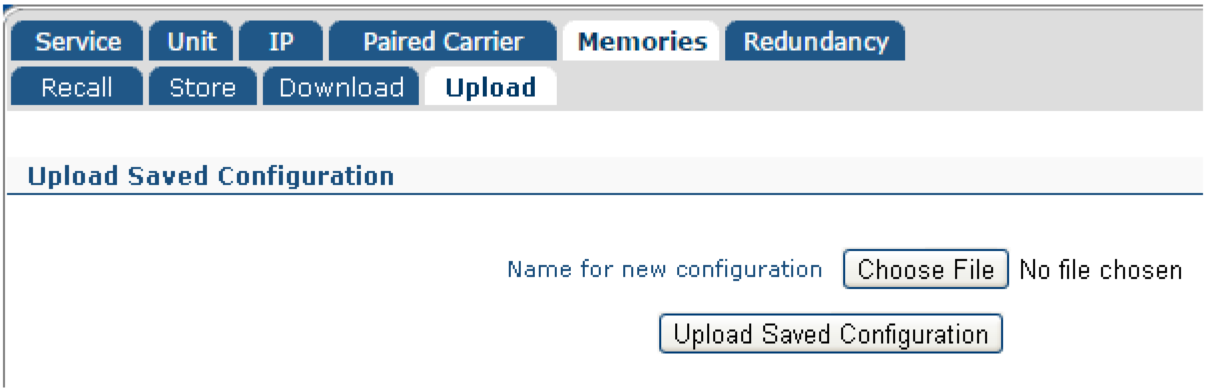


Figure 6-48 Edit->Memories->Upload Screen

6.2.6 Edit->Redundancy Screen

The *Edit->Redundancy->1-for-1* screen (shown in **Figure 6-49**) controls the operation of the modem when in a 1:1 redundancy configuration.

The *Edit->Redundancy->1-for-N* screen and 1:N redundancy in general is documented separately in '*Installation and Operating Handbook for Quantum, Evolution and Q Series Satellite Redundancy Switches',* which is available for download from http://www.paradisedata.com.

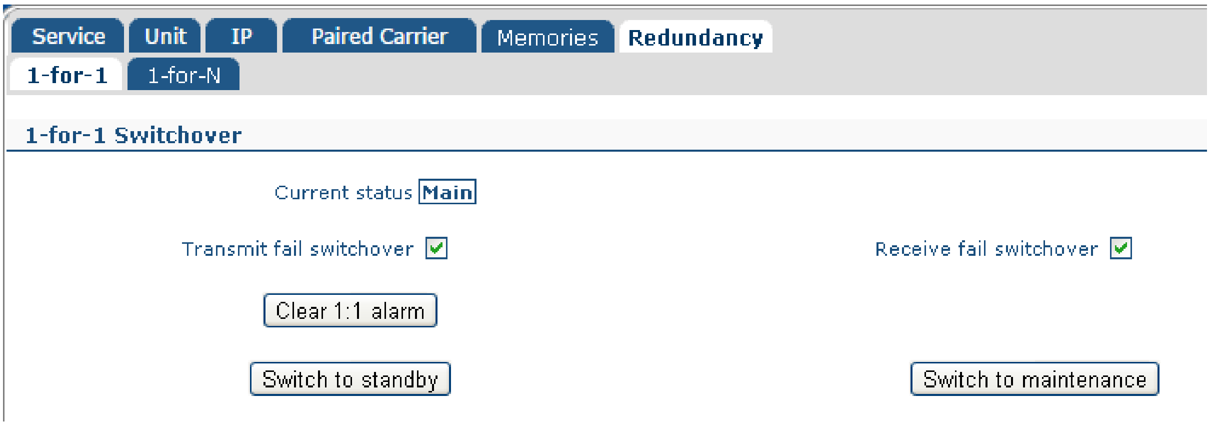


Figure 6-49 Edit->Redundancy->1-for-1 Screen

The *Current status* shows the 1:1 status of the modem. This will be shown as *Main* when the modem is online, *Maintenance* when the modem has been taken out of service, and *Standby* when the modem is offline, ready to switch over on a fault occurring on the online modem.

Transmit fail switchover controls whether a switchover occurs on a transmit alarm. Likewise *Receive fail switchover* controls whether a switchover occurs on a receive alarm. Ticking a checkbox activates the switchover logic, putting it in a state where the modem will switch over when a relevant transmit or receive alarm occurs.

If both transmit and receive fail switchovers are set to off then the 1:1 redundancy system will only switch over on unit faults and all transmit or receive traffic faults will be ignored.

Traffic warnings will never cause a switchover regardless of how the fail switchover settings are configured.

In a 1:1 pair, the *Clear 1:1 alarm* button can be used on the *Standby* modem, when it is exhibiting a fault, to temporarily suppress the fault condition in order to allow the *Standby* modem to be forced online. This is useful when both modems in the 1:1 pair are showing faults but the *Standby* modem is exhibiting a less severe failure than the current online modem, thereby allowing the best possible satellite service to be maintained in the circumstances.

In a 1:1 pair, the *Switch to standby* button forces the modem that is online into *Standby* mode. This is done by momentarily creating a fault condition that forces a switchover to occur.

The *Switch to maintenance* button prevents the modem from being switched online. This facilitates the modem being removed, for example, to be repaired.

Once the modem is in *Maintenance* mode, the *Switch to maintenance* button is replaced with a *Switch to service* button, which can be used to reverse the process by making the modem available to come online.

6.2.7 View Screen

The *View* screen (shown in **Figure 6-50**) allows the following to be viewed:

- *Graphs*. These include spectrum, constellation, throughput and time-based performance graphs. None of these interfere with the service being provided by the modem. Note that when viewing demodulator graphs, such as the constellation, it is necessary to select the specific demodulator to be viewed. Graphs of Tx QoS stream throughput over time are also available and include the stream data rate (in packets per second and bits per second), the number of dropped packets and a count of the errored packets.
- *Alarms*. System alarms and warnings can be viewed.
- *Log*. The system log can be viewed and optionally emptied. The log contains information on all alarms and other noteable events. The log contains space for thousands of entries. The oldest entries are deleted when space is required for new entries.
- *Setup*. This provides a succinct summary of the operational setup of the modem.
- *Unit*. This provides manufacturing information (including the software version number and the hardware fitted), power supply voltage levels, modem temperature indication, loopback status and the IP address of the M&C port (for when this has been set using DHCP).
- *SAF*. This displays all of the SAF features for the modem, indicating whether they are enabled or disabled. It also shows how many test shots remain along with the remaining test time. Information on temporary SAF (such as any temporary licenses) is also available.

- *Tx QoS*. This presents metrics for the shared outbound carrier in terms of total throughput and per-stream throughput, including dropped packet counts and current stream data rates (in packets per second and bits per second).

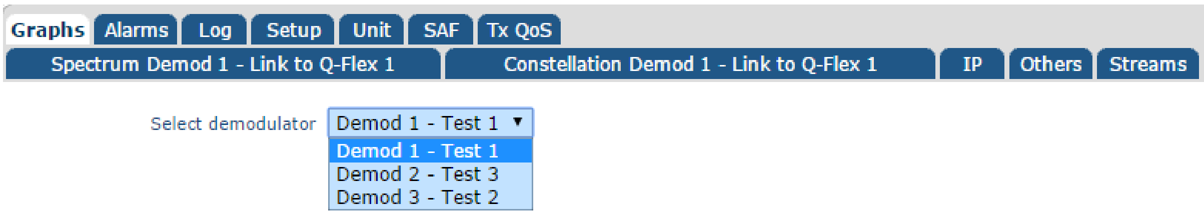


Figure 6-50 View Screen

6.2.7.1 Rx Spectrum Monitor

The Rx Spectrum Monitor shown in **Figure 6-51** is a powerful real-time spectrum analyser within the modem that is used to view the received signal spectrum.

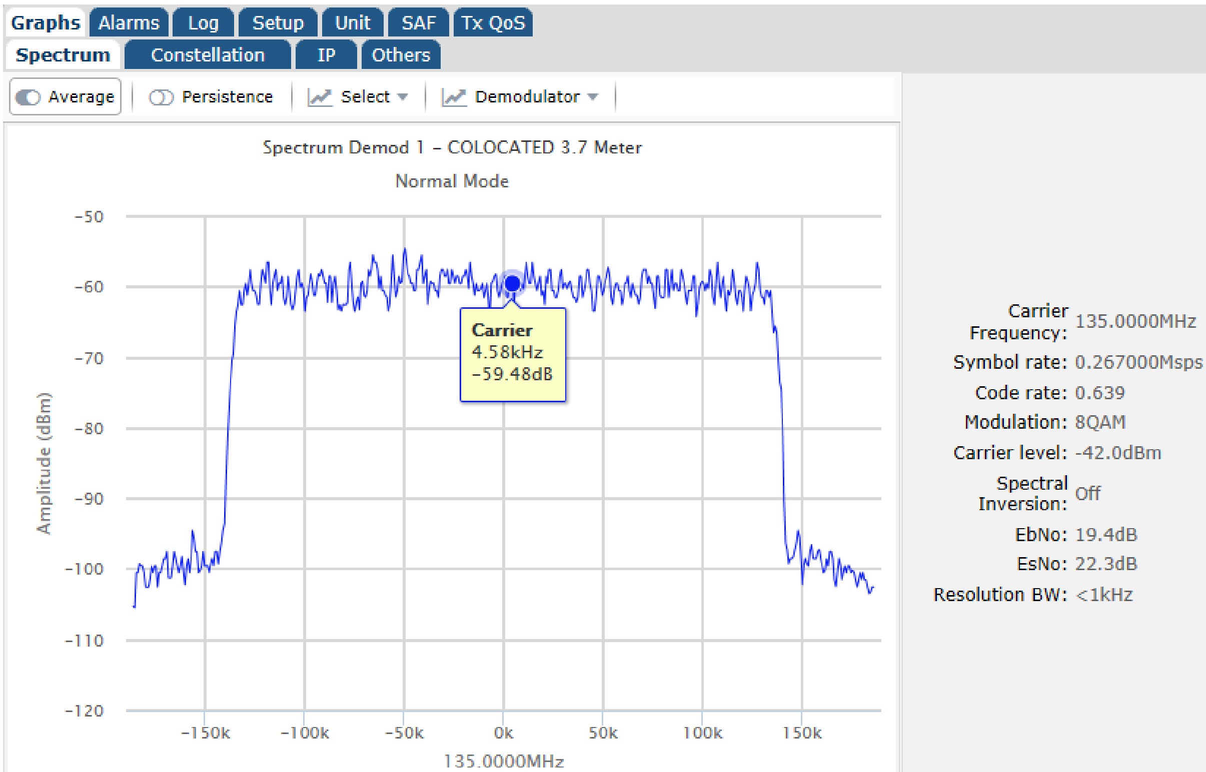


Figure 6-51 Rx Spectrum Monitor

The Rx Spectrum Monitor can be used to check for correct modem operation.

Each demdodulator can be viewed individually or a wideband (*Super Wide*) mode can be selected that shows a 72MHz span of the transponder centred on the inbound carrier centre frequency (subject to the position of the carrier within the 72MHz span of the modem receiver front end).

Setting the *Span* to *Normal* limits the frequency span to that of the carrier.

A zoom control can be activated by moving the mouse over an area of the graph while the mouse button is simultaneously held down. A 'Reset zoom' button appears and can be used to revert to the normal display resolution.

The mouse right click operation can be used to save the spectrum to a file.

Persistence leaves the spectrum to build up over time and is useful for identifying transient signals such as intermittent interference. The *Persistence* button acts as an on/off toggle.

Average increases the number of samples that are used in forming the displayed spectrum. The *Average* button acts as an on/off toggle.

6.2.7.2 Rx Constellaton Monitor

The Rx Constellation Monitor feature shown in **Figure 6-52** allows the modem to be used as a spectrum analyser to view the received signal spectrum.

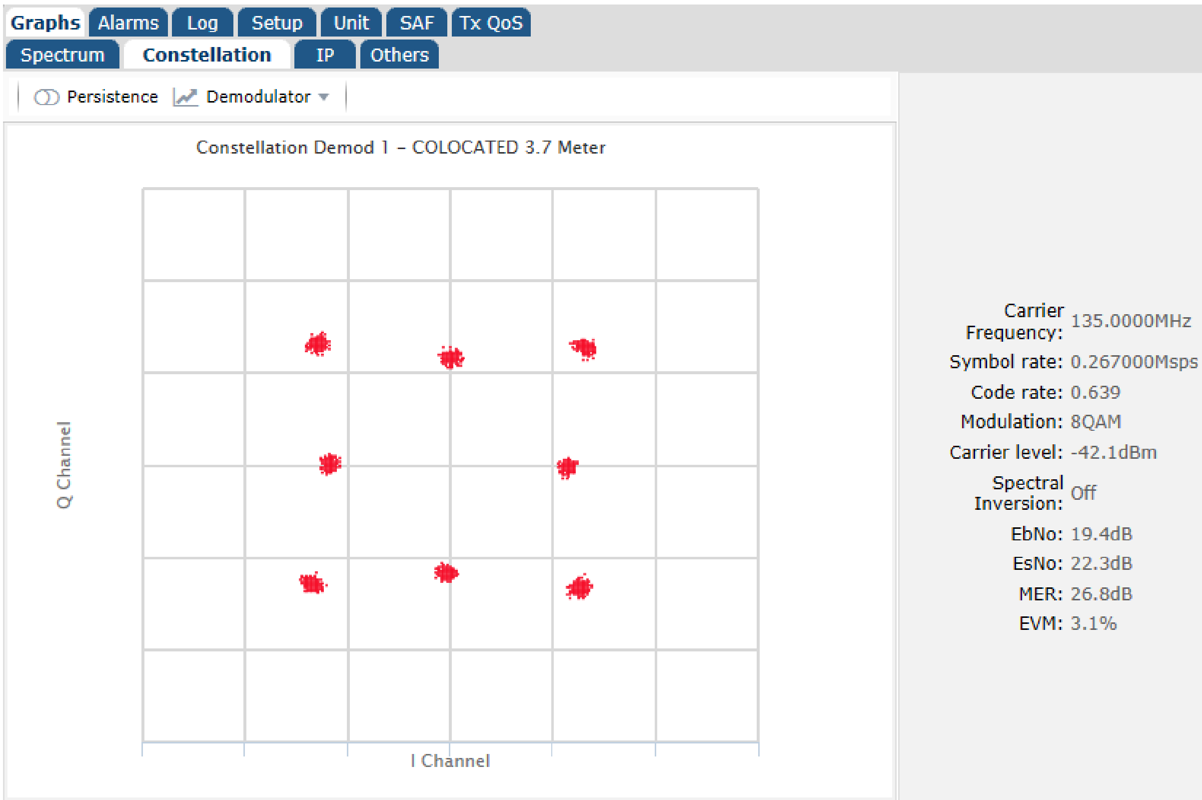


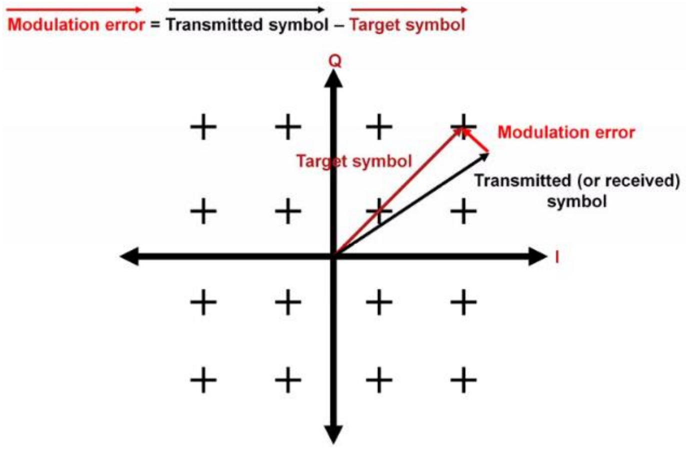
Figure 6-52 Rx Constellation Monitor

The Rx Constellation Monitor can be used to check for correct modem operation including checking for signal distortion and phase noise. The persistence mode is useful for showing any long-term effects due to phase noise and interference. Excessive phase noise can cause cycle skips, seen as unwanted rotations within the constellation.

Note that MER and EVM figures are available on the panel on the right hand side. These concepts are explained in the following information panel.

Modulation Error Ratio (MER) and Error Vector Magnitude (EVM)

MER and EVM (as displayed on the Rx Constellation Monitor) measure how imperfect the received signal is in relation to an ideal signal as in the following example.



They are defined as follows:

- ***MER (dB) =***
  Power of ideal signal
  Power of error signal
- ***EVM (%) =***
  Power of error signal
  Power of ideal signal

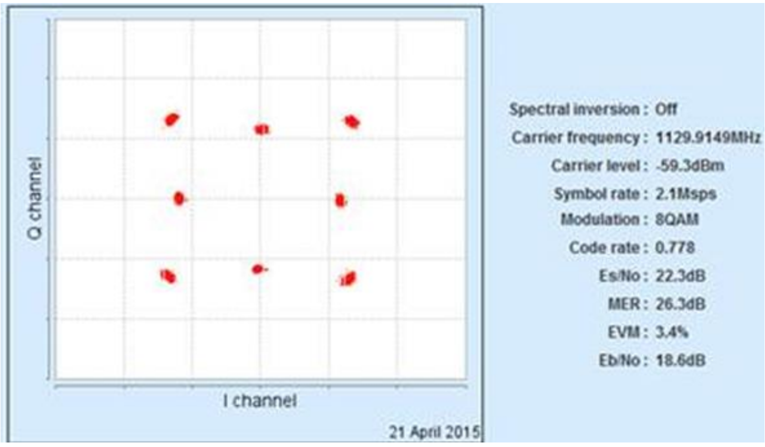
A high MER and low EVM indicate a good signal, whereas a low MER and a high EVM indicate a poor quality signal.

Why are MER and EVM important? Unless you run a BER test then you do not know what the actual BER for the link is. A 'good' Es/No can be misleading since there could be degradation from interference. Modern FECs have steep BER curves, so the difference between quasi-error free (QEF) operation and losing the link can be very small. MER and EVM give an indication of how close to the 'cliff edge' the link is and may allow remedial action to be taken before the link is lost.

It is good practice when deploying a link to measure these two values when the link is running well. Then reduce the power level

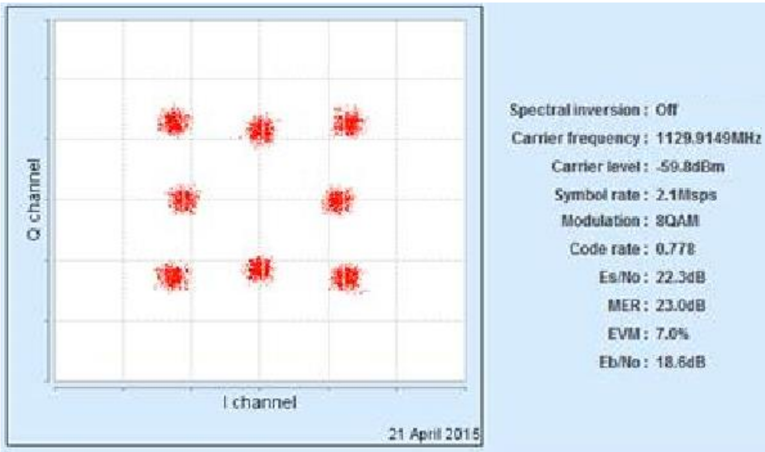
of the carrier(s) and establish the equivalent values just above the point at which the carrier unlocks. This will give a good indication of the range of potential values and can be used to establish an early warning when the link starts to degrade.

The following is an example of a good signal:



where MER=26.3dB and EVM=3.4%.

The following is an example of a poor signal:



where MER=23.0dB and EVM=7.0%.

6.2.7.3 IP Graphs

Figure 6-53 shows an example of an IP throughput graph. IP graphs support the display of throughput (including errored and dropped packets) for transmit and receive in bits per second and packets per second for the terrestrial and satellite ports. The throughput can be viewed in real time and over one day and 30 day time periods. The statistics for each demodulator can be viewed independently.

It is also possible to view the throughput associated with each individual traffic stream as classified by the traffic shaping feature.

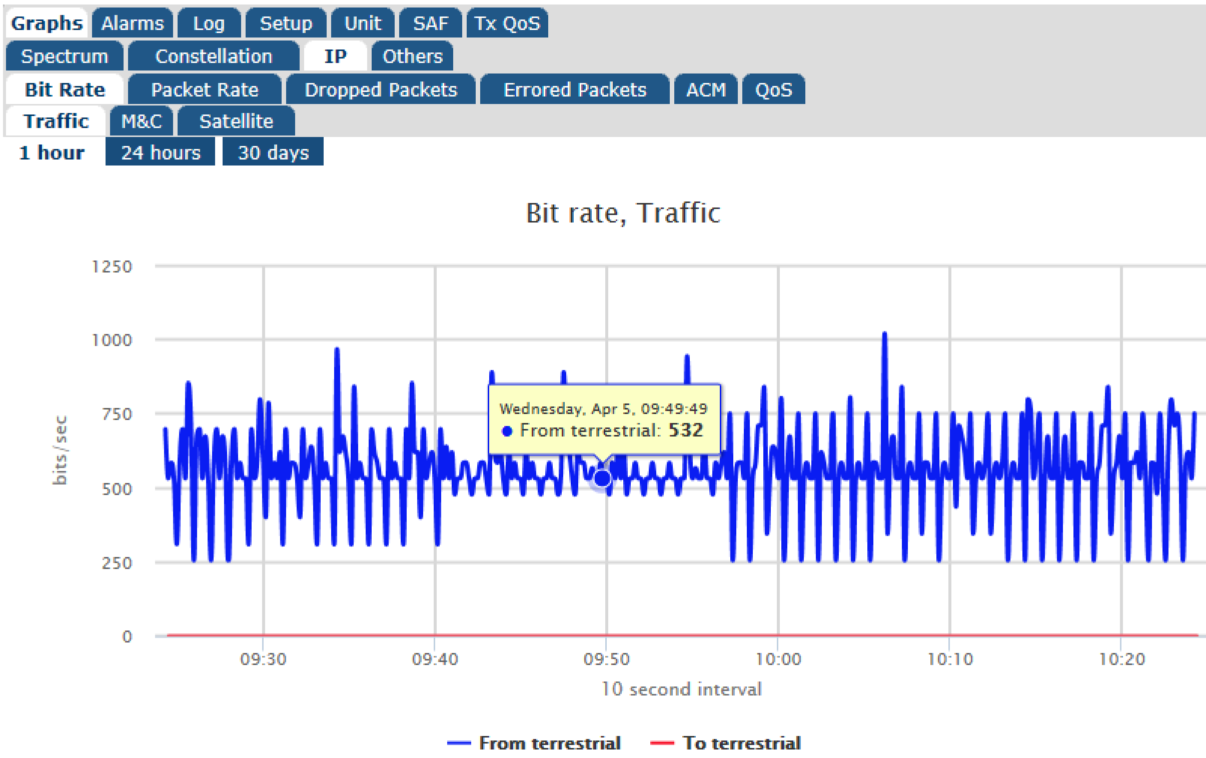


Figure 6-53 IP Throughput Graph

QoS (traffic shaping) graphs are described in Section 7.8.9.

An example ACM graph is shown in **Figure 6-54**. This shows the minimum, average and maximum terrestrial data rate over the selected time period. Note that this graph shows how the terrestrial data rate varies over time in direct relation to dynamic changes of modcod based on a varying Es/No from the remote modem. It does not show actual IP throughput (which is available on the other IP throughput graphs). The ACM graph therefore shows the actual bandwidth available over time, which can be used to determine the benefit of using ACM, particularly when viewed over longer time periods where the effects of short-term fluctuations are removed.

By viewing the ACM graph over a long time period such as a month, an average available bandwidth figure is produced that can be factored into new or revised service level agreements that incorporate the benefits of ACM when compared to the nominal data rate of the link without ACM.

An example of the ACM graph viewed over a shorter time period is shown in **Figure 6-52**.

It is possible to put ACM into a monitor mode where the ACM graph logs what the terrestrial data rate would be for the prevailing conditions, without ever actually changing the modcod. This is useful for assessing the potential benefit of ACM on an existing link without disrupting the current service in any way, or for evaluating ACM in a representative test scenario prior to deployment (see Section 6.2.2.7).

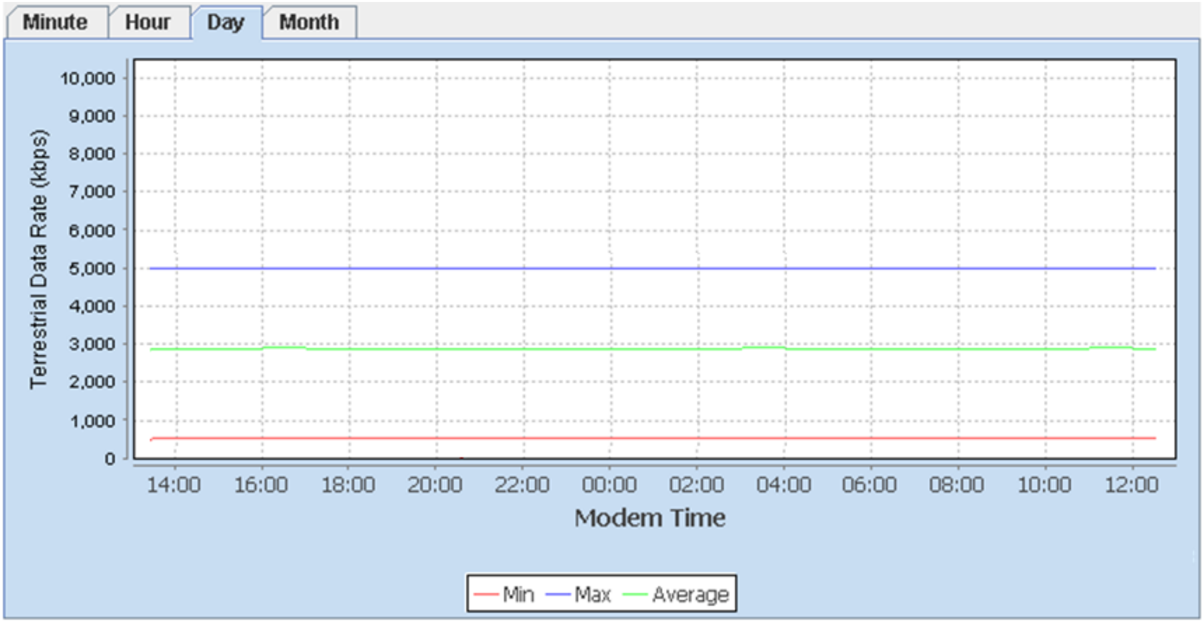


Figure 6-54 ACM Terrestrial Data Rate Graph

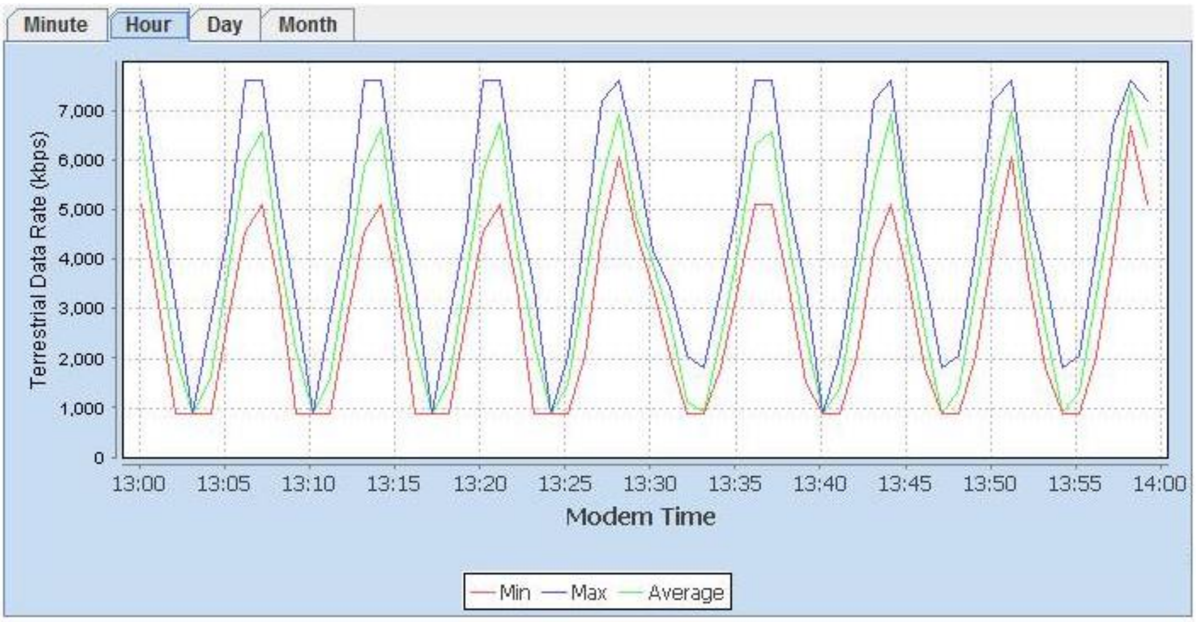


Figure 6-55 ACM Terrestrial Data Rate Graph (Short time period)

6.2.7.4 Other Time-based Graphs

A number of time-based graphs can be displayed. Graphical values are stored for 31 calendar days or until the modem is powered down. The recording of all values occurs automatically at all times once the modem is powered on and is not dependent on whether the graphs are being viewed or not.

The web interface supports display of the following time-based graphs:

- Modem internal temperature.
- The modem received signal Eb/No.
- The modem received power level.
- Receive frequency offset from centre frequency.
- **LinkGuard™** interference power spectral density.
- The Eb/No of the distant modem being controlled via AUPC.
- The transmit power level.
- CPU usage.
- ACM data rate.

An example graph is shown in **Figure 6-56**.

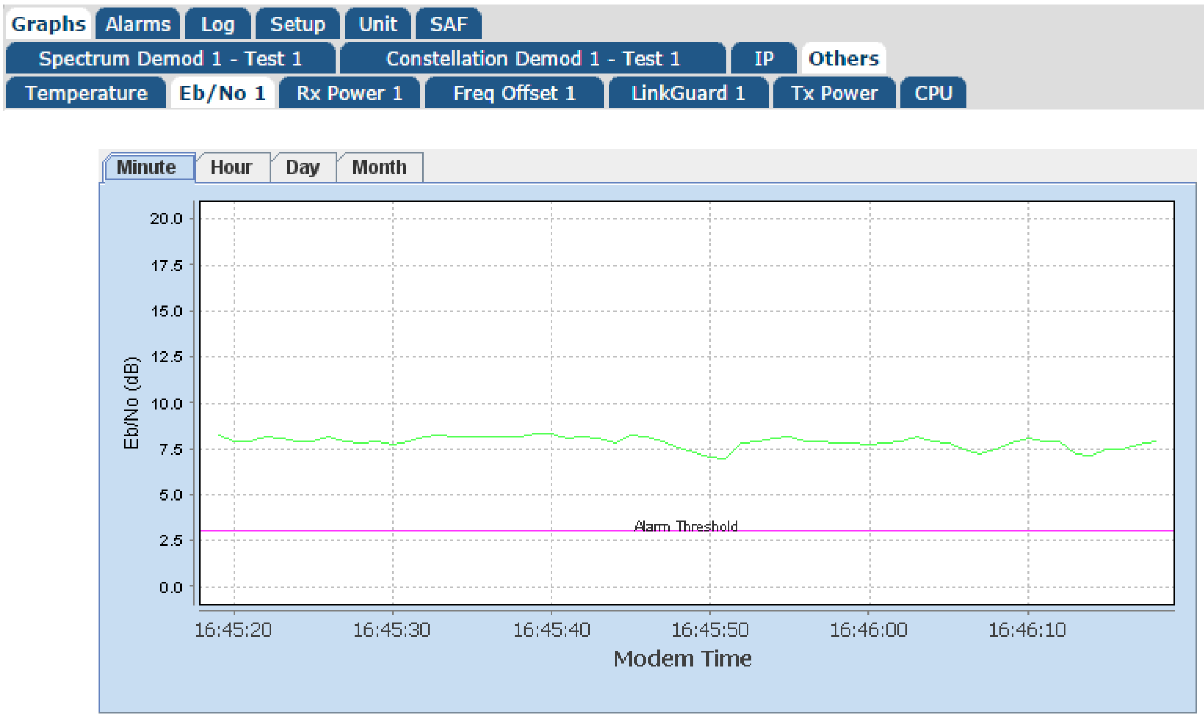


Figure 6-56 Eb/No Graph

6.2.7.5 Stream Graphs

Graphs of the Tx QoS stream throughputs over time are available. These include the stream data rate (in packets per second and bits per second), the number of dropped packets and a count of the errored packets. An example graph is shown in **Figure 6-57**.

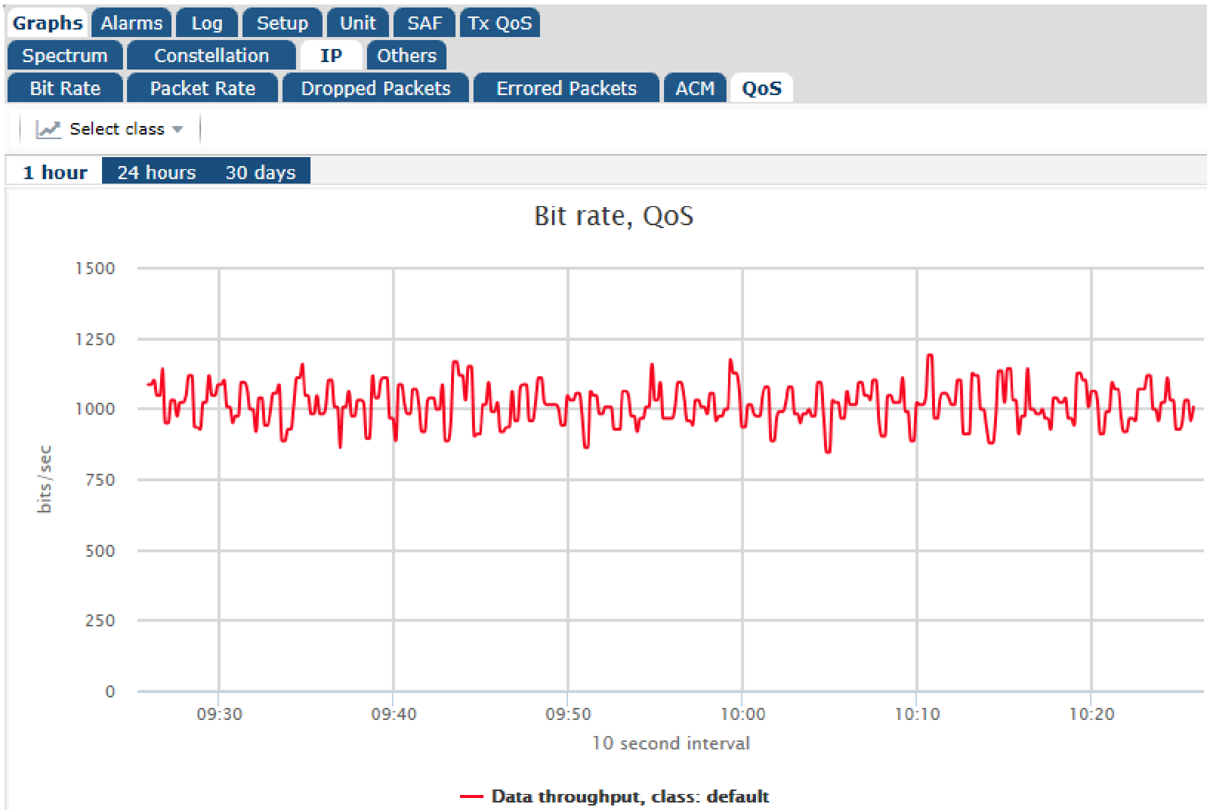


Figure 6-57 Tx QoS Stream Throughput Graph

6.2.7.6 Alarms

System alarms can be viewed using the *View->Alarms* screen shown in **Figure 6-58**. Alarms are latched and their status will be shown as *Off* if they are no longer active. The *Accept* button can be used to delete all of the alarms after which the web page will automatically update and show details of any alarms that are still active.

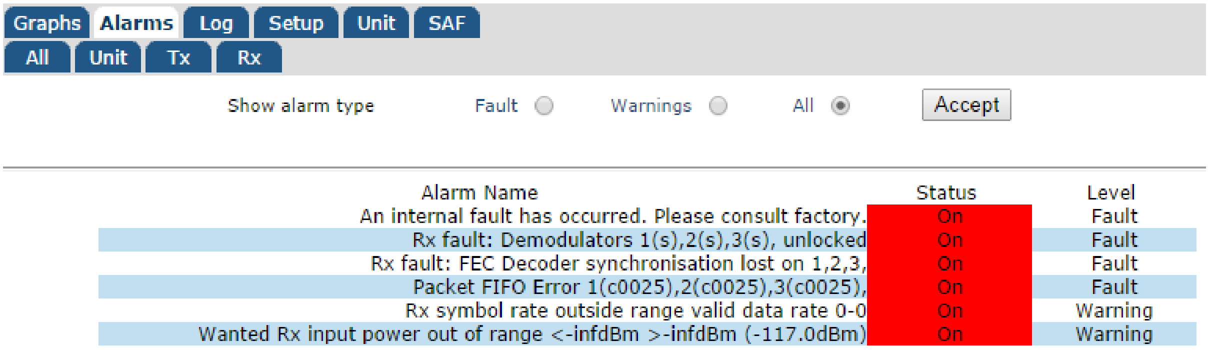


Figure 6-58 System Alarms Screen

6.2.7.7 System Log

The system log can be viewed using the *View->Log* screen shown in **Figure 6-59**. The *Clearc* button can be used to delete all of the entries in the log. The *Download Log file* button can be used to download a text file of the log contents to the browser device.

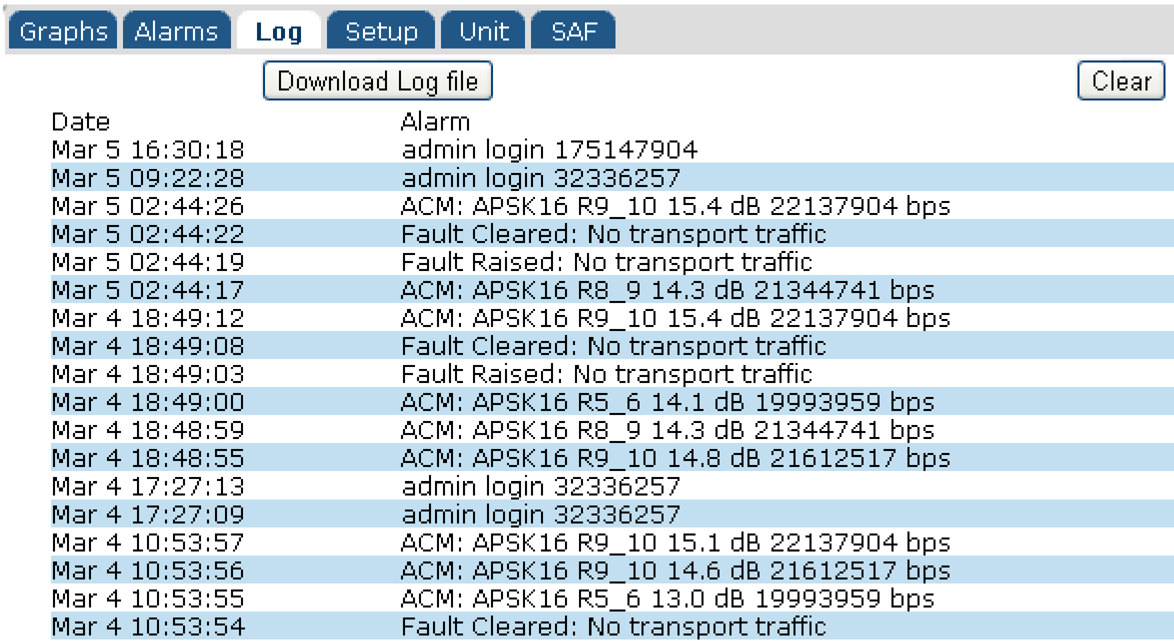


Figure 6-59 System Log Screen

6.2.7.8 View->Setup Screen

The *View->Setup* screen shown in **Figure 6-60** displays the current values of the most important configuration settings.

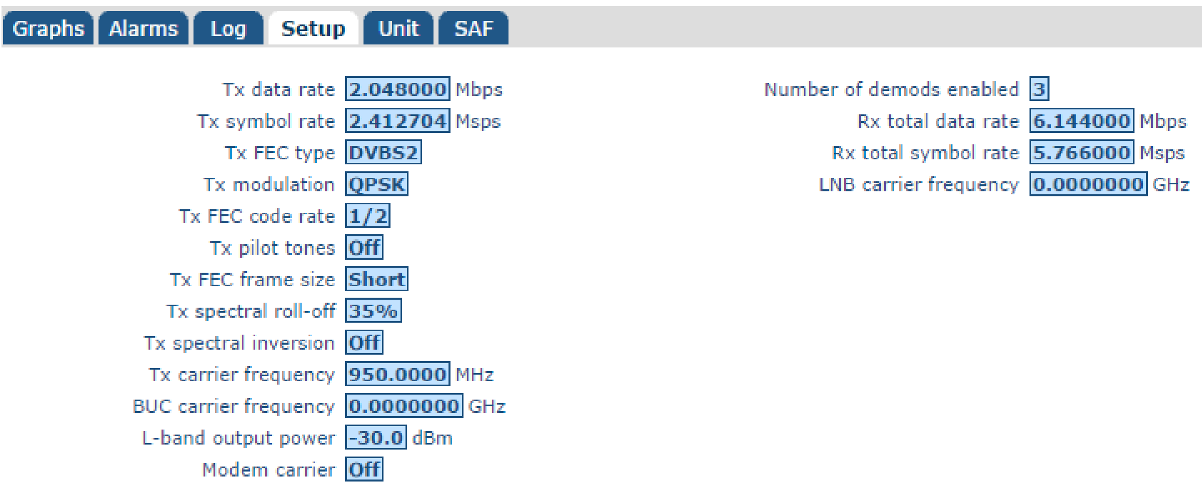


Figure 6-60 View->Setup Screen

6.2.7.9 View->Unit Screen

The *View->Unit* screen shown in **Figure 6-61** displays manufacturing information (including the software version number and the hardware fitted), power supply voltage levels, modem temperature indication, loopback status and the IP address of the M&C port (for when this has been set using DHCP).

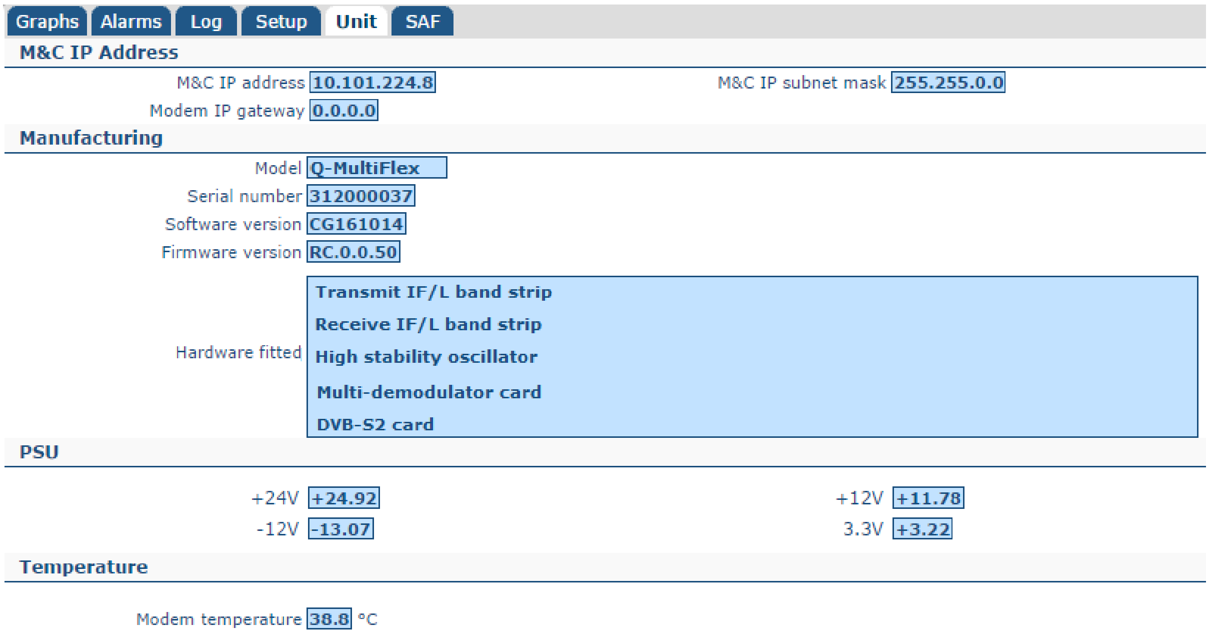


Figure 6-61 View->Unit Screen

6.2.7.10 View->SAF Screen

The *View->SAF* screen shown in **Figure 6-62** displays the status of each modem Software Activated Feature (SAF) indicating whether they are on, off or temporarily enabled. It also shows how many test shots remain along with the remaining test time. Information on temporary SAF (such as any temporary licenses) is also available. The SAF concept is explained in Section 7.4.

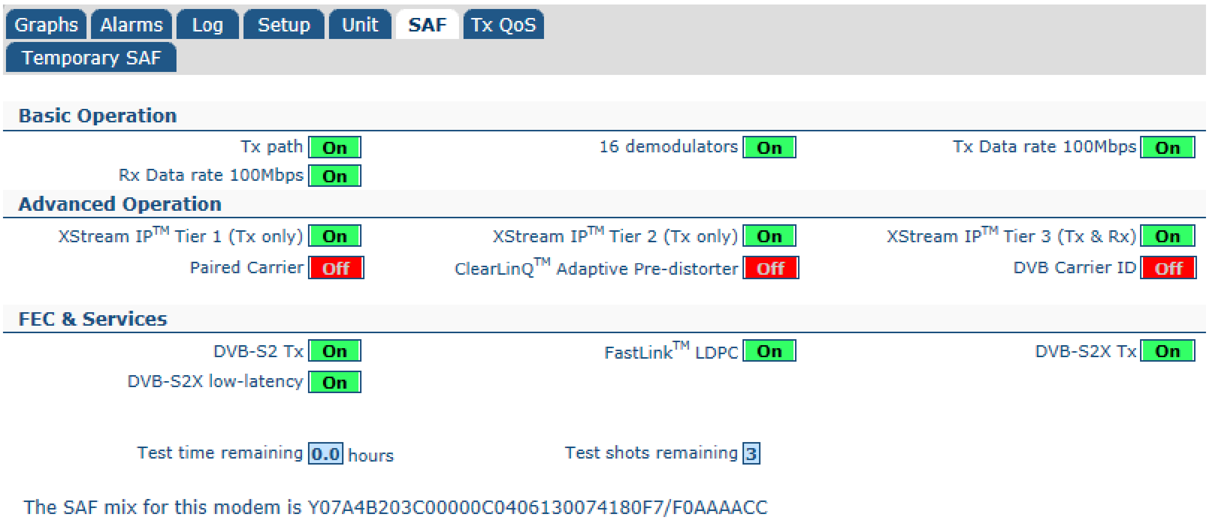


Figure 6-62 View->SAF Screen

6.2.7.11 View->Tx QoS Screen

The *View->Tx QoS* screen shown in **Figure 6-63** displays metrics for the shared outbound carrier in terms of total throughput and per-stream throughput, including dropped packet counts and current stream data rates (in packets per second and bits per second).

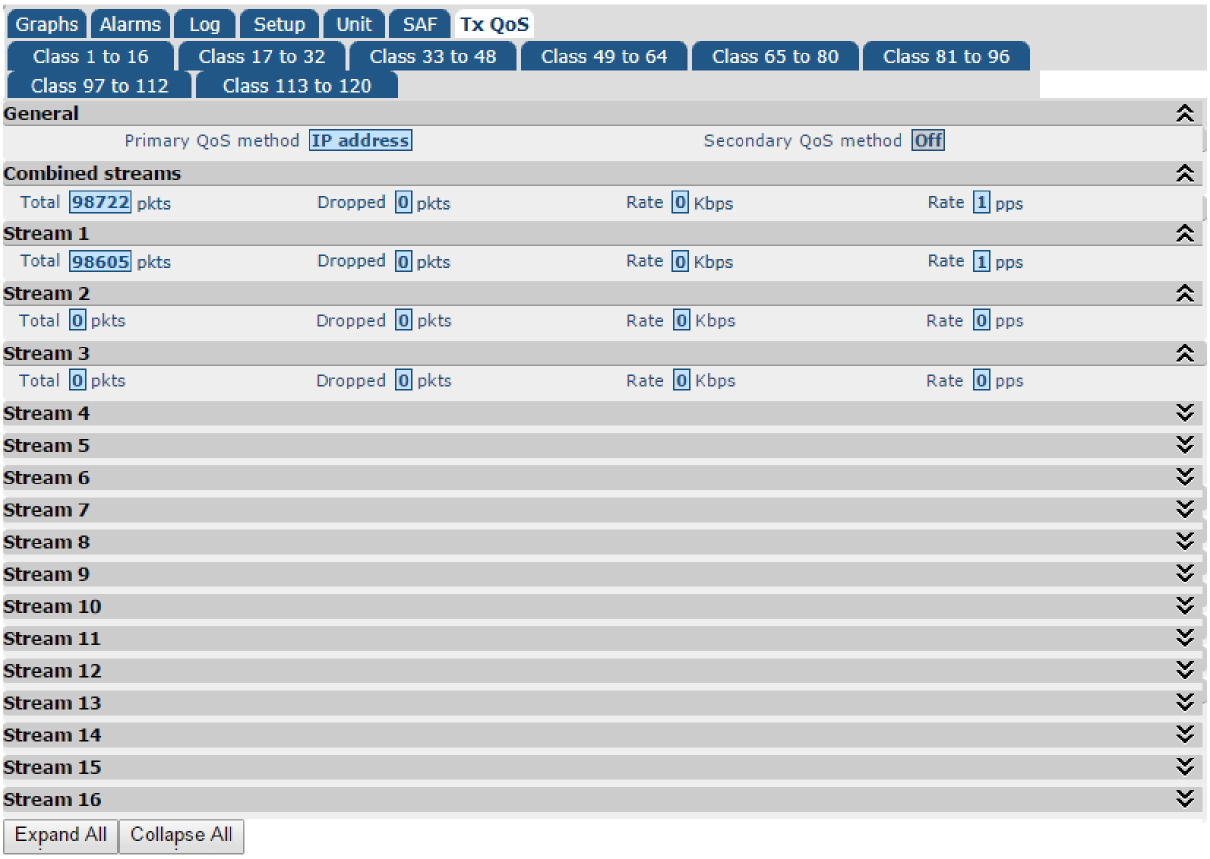


Figure 6-63 View->Tx QoS Overview Screen

Figure 6-64 shows the metrics collected for specific classes.

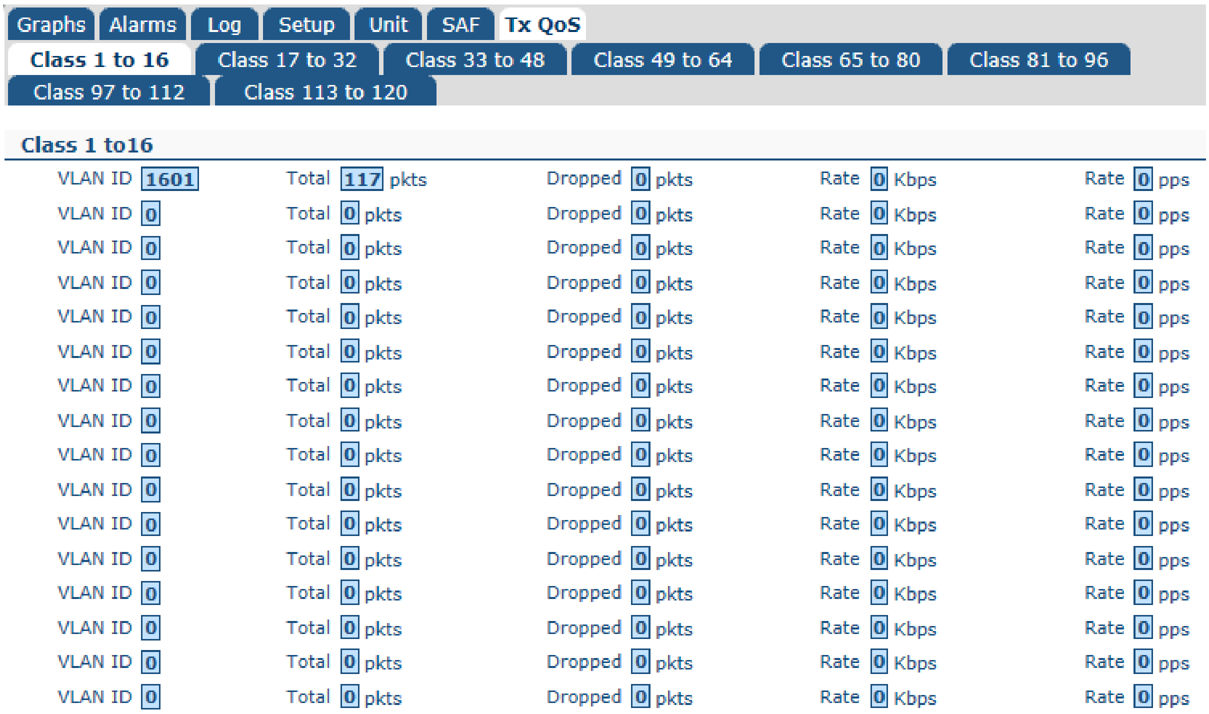


Figure 6-64 View->Tx QoS Class Screen

6.2.8 Test Screen

The *Test* screens support the following test functions:

- *Loopback.* This allows selection of internal loopback between the transmit and receive paths, at different points in the processing chain. This provides a convenient way of checking modem operation in isolation from other equipment. Local loopback refers to returning local signals traveling within the modem in the direction of the satellite, back towards the terrestrial interface. Remote loopback refers to returning remote signals traveling in the direction of the terrestrial interface, back towards the satellite interface.
- *RF Test Modes.* This provides two types of signal – a CW (pure carrier) signal and an alternate 1,0 signal – that can be used to test modem operation.
- *IP Packet Satellite Delay.* This allows a one-way satellite delay (in milliseconds) to be entered. This can be used in modem back-to-back testing to simulate the normal satellite delay. It applies to IP traffic only. It should always be set to 0 when using IP over satellite. Note that the use of this feature is currently incompatible with the use of IP traffic shaping (as the two features compete for the same internal resources).
- *BER test.* This feature provides the ability to inject a test pattern into the modem, through the main traffic channel or via an overhead channel and to monitor the results, using the modem's internal Pseudo-Random-Bit-Sequence (PRBS) Bit Error Rate (BER) Tester.
- *IP packet generator/analyser.* These provide the ability to generate TCP and UDP packets and to measure the throughput, delay and jitter. These allow modem-to-modem

IP communications to be tested (during deployment for example) without the need for any other test equipment.

- *Antenna control.* The modem supports interoperation with antenna control units (ACU) (via a choice of serial or IP protocol).

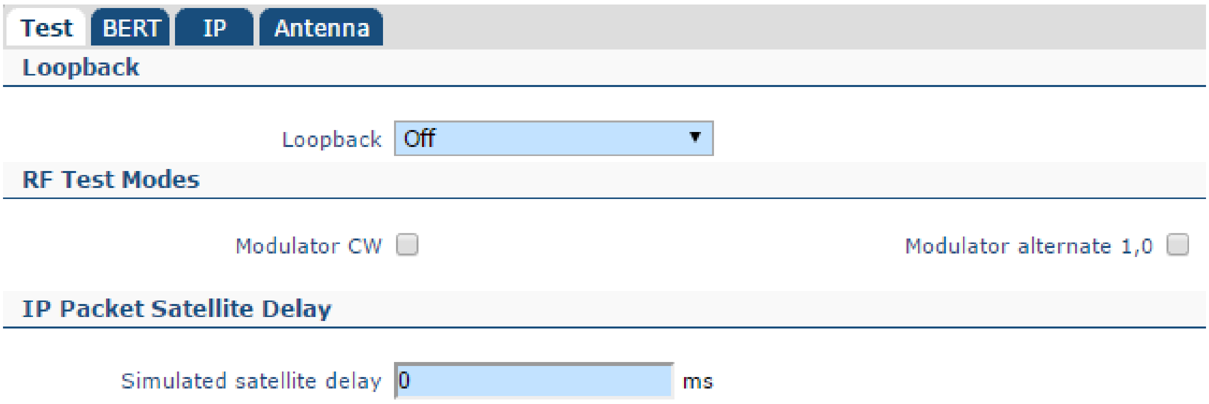


Figure 6-65 Test Screen

With respect to the *RF Test Modes*, selecting Tx CW causes a pure carrier to be transmitted rather than the normal modulated carrier. This is useful for evaluating phase noise and spurious but should not be used over a live satellite link without the operator's permission. Selecting *Modulator alternate 1,0* causes an alternating 1,0,1,0 …… pattern to be fed to the modulator at the symbol rate. This causes two discrete frequencies to be generated, spaced at the symbol rate about the (suppressed) carrier. This is useful for evaluating the carrier suppression of the modulator but should not be used over a live satellite link.

6.2.9 BER Test

The internal PRBS BER Tester shown in **Figure 6-66** allows pseudo-random bit patterns to be injected into the traffic channel and the BER results to be monitored. It can be used when **FastLink™** is selected.

A facility exists to inject errors into the generated PRBS stream and see these reflected within the error count.

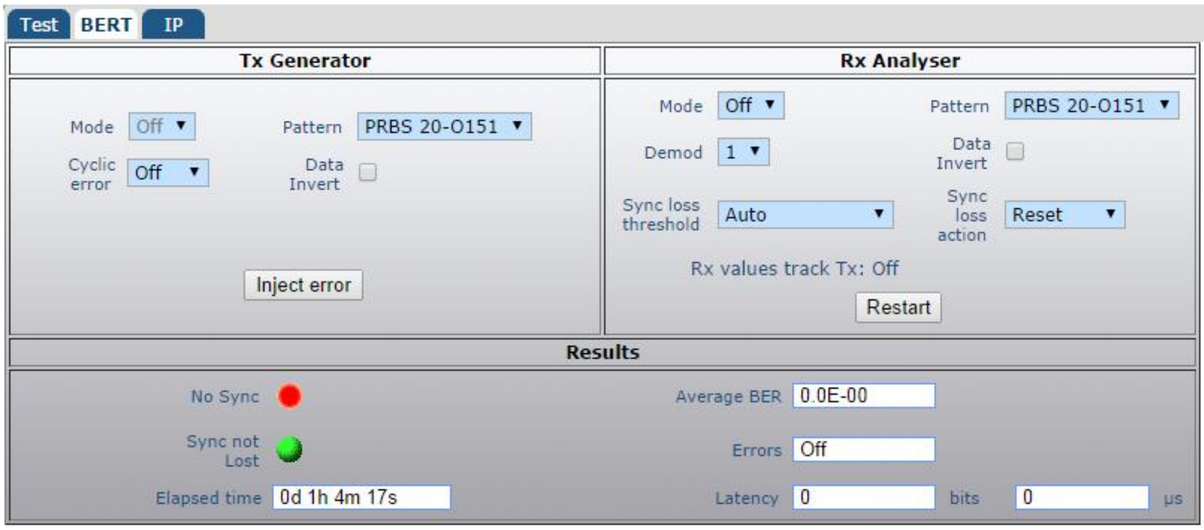


Figure 6-66 BER Test Generator/Analyser Screen

Data Invert allows an inverted data bit stream to be transmitted (or received if selected on the analyser).

The *Inject Error* button can be used to inject a single error into the bit pattern, which should increment the number of bit errors by one.

The *Cyclic Error* forces a single error to be injected periodically. The frequency can be selected from a drop down box (in bits) which appears once the cyclic error is selected.

The *Elapsed Time* indicates the time since the test was started or restarted.

The *Errors* field indicates the total number of error bits detected since the test started.

The *Average BER* field indicates the number of bit errors in relation to the number of bits received.

Latency is shown in terms of both bits and time. The latency is only valid when the Tx signal of the modem is fed back to the Rx input. A long test pattern must be selected in order to make sure that the pattern is unique for longer than the actual latency period, otherwise the latency will be under-reported.

The *Sync OK LED* shows the instantaneous test pattern synchronisation status. When the Rx path is synchronised to the incoming Tx test pattern then the LED will be green and it will be red when synchronisation is lost.

The analyser *Sync Lost Threshold* can be customised or left as *Auto*. The *Counter Action on Sync Loss* can be set to *Reset, Continue* or *Freeze* allowing further customization of the display.

The *Restart* button can be used to start or restart the BER test including clearing all of the error counts.

6.2.10 IP Test Features

TCP and UDP packet generator/analyser tools are available in the modem. These allow the satellite link to be tested without requiring any additional test equipment.

Figure 6-67 shows an example of a modem set up to generate TCP, where the M&C address of the receiving modem is entered.

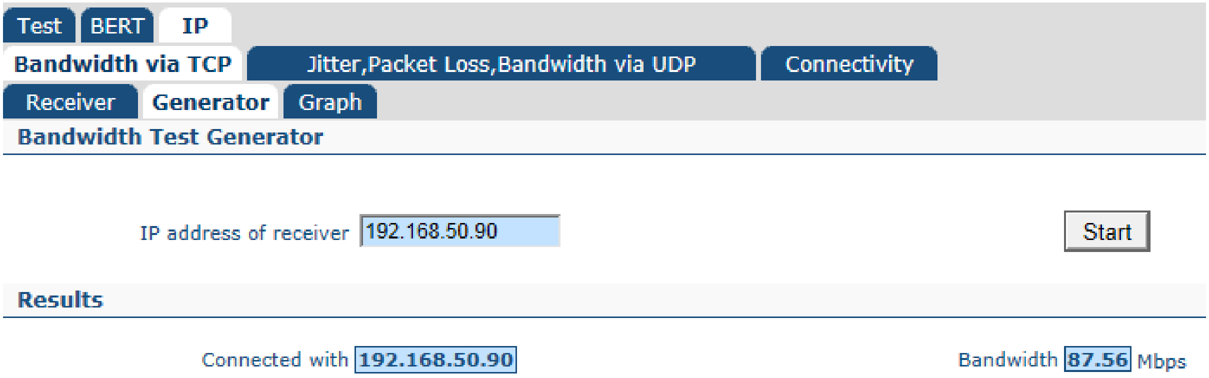


Figure 6-67 IP TCP Packet Generator Screen

Figure 6-68 shows the set up of the receiving modem for the above and **Figure 6-69** shows the bandwidth throughput results for this particular TCP test.

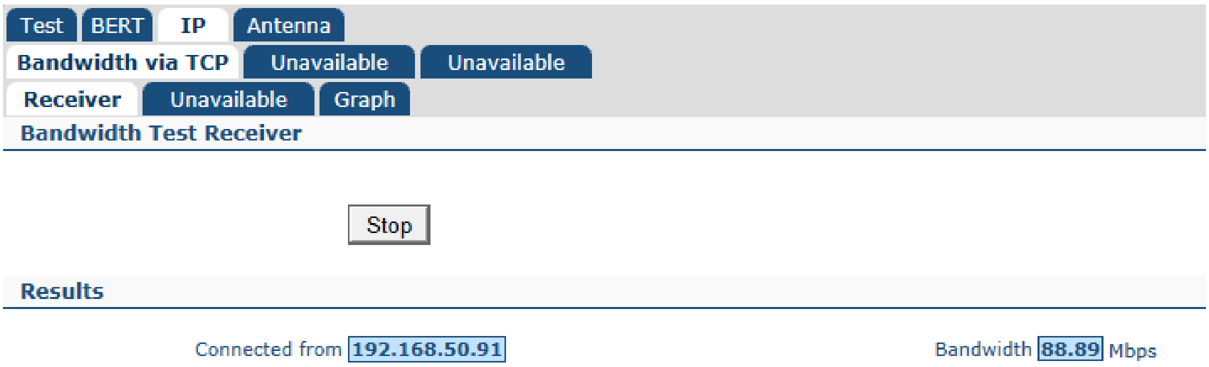


Figure 6-68 IP TCP Packet Receiver Screen

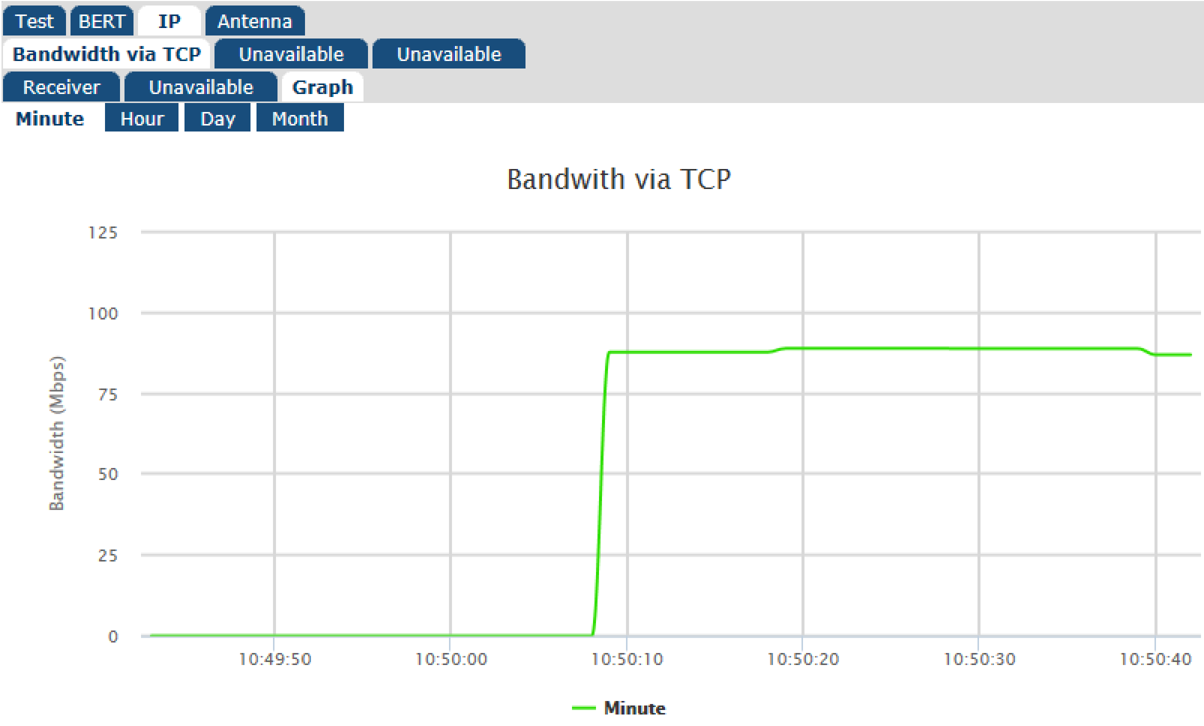


Figure 6-69 IP TCP Test Throughput Screen

Figure 6-70 shows a ping facility built into the modem, which can be used to test connectivity from the modem to other network devices and locations.

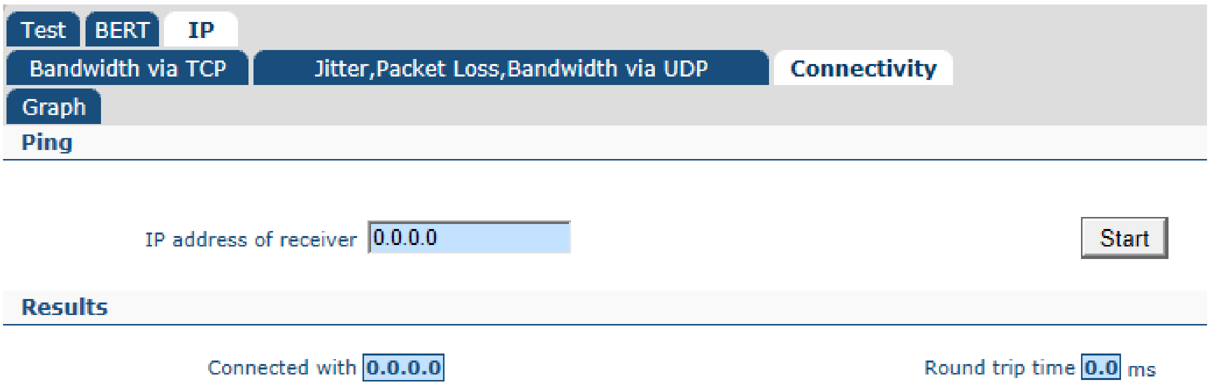


Figure 6-70 IP Connectivity Test Screen

6.2.11 Antenna Control

Two methods of antenna control are provided by the modem:

- A scalable (0 to 10V) AGC output is available via the Alarms & AGC serial connector (the pinout for which is defined in Chapter 10). The AGC output can be set to represent the demodulator AGC level, the Rx composite power level, the Rx wanted signal level or the receive Eb/No level (the last two of which are only available when the demodulator is locked). Other signals on this connector can be used to infer the demodulator lock status and to mute the modem Tx carrier.

- The OpenAMIP protocol is supported.

Both of these options are described in more detail below.

Antenna Serial Control

Serial antenna control is supported under *Test->Antenna* (**Figure 6-71**).

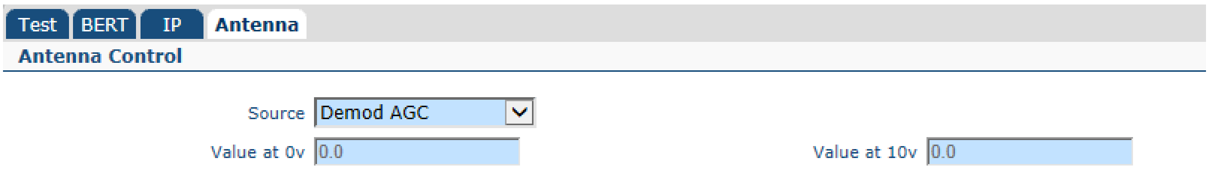


Figure 6-71 Antenna Serial Control AGC Output

The AGC output on the Alarms & AGC connector can be set to be driven by various signals (demodulator AGC, Rx composite power, Rx wanted signal level and Rx Eb/No) as shown in **Figure 6-72**.

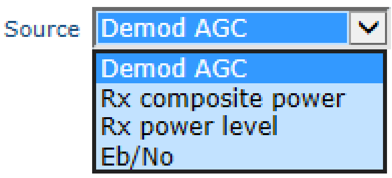


Figure 6-72 Antenna Serial Control Output Source Signal Selection

The AGC output range is 0 to 10V. A scaling factor can be applied to the output. This controls the slope of the output in order to give the desired range of output values for supplying to the antenna controller. For example, if the AGC output is set to represent Eb/No, then a user may decide to set 0V to represent 0dB and 10V to represent 6dB Eb/No (by entering 0 and 6 respectively to represent the 0 and 10V levels). In this case, any Eb/No value over 6dB would be represented by a 10V output also.

In addition to the AGC output on pin 8, there is a Tx Mute control and the Rx Lock status can be obtained on the Alarms & AGC connector as follows:

- Pin 3 provides an indication for Rx traffic faults, the highest priority fault of which is a demodulator unlock (so the alarm output approximately amounts to a demodulator lock/unlock status). Since this is a relay output, the relay common on pin 2 needs to connected to GND (pin 15). A pull-up resistor (if there isn't one already in the ACU) needs to be attached to pin 3 as it is normally open (representing the non-fail state).

- Pin 7 is a Tx Mute input from the ACU. It will inhibit transmission when active.
- GPS is supported by the modem in general but not for beam switching therefore a GPS input is not required in relation to antenna control.

Antenna IP Control

The OpenAMIP protocol is supported for use with antenna control units. This feature is supported in the Antenna IP Control section of the *Test->Antenna* menu (**Figure 6-73**).

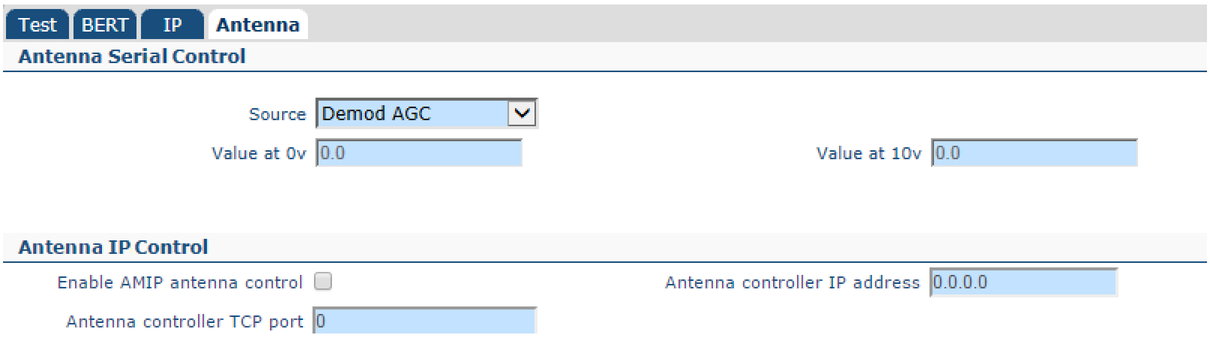


Figure 6-73 Antenna IP Control

Tx Mute control and Rx Lock status are provided via the AMIP protocol. The AMIP control needs to be enabled and the antenna controller IP address and TCP port number need to be entered. Thereafter, all AMIP control is automatic.

6.3 Front-panel Interface

6.3.1 Keypad Operation

6.3.1.1 Cursor

An inverse-video cursor is used to navigate around the LCD display.

6.3.1.2 Navigation Keys

The menu options are arranged into a hierarchy of menus. Navigation is performed using the arrow and *ENTER* keys or by entry of the number associated with each menu option.

Arrow Keys

The *Up* arrow key moves the cursor up one line except when entering a numeric value, when it increments the digit highlighted by the cursor.

The *Up* arrow key is also used to enter a hyphen when a range of values is required (such as for timeslots).

The *Down* arrow key moves the cursor down one line except when entering a numeric value, when it decrements the digit highlighted by the cursor.

The *Down* arrow key is also used to enter a comma when entering a number of values together (such as when entering a list of timeslots).

The *Left* arrow key moves the cursor to the left, both on menus and when entering alphanumeric values. The *Left* arrow key has a special function when viewing the system log, where it is used to move backwards in the log by 100 entries.

The *Right* arrow key moves the cursor to the right, both on menus and when entering alphanumeric values. The *Right* arrow key has a special function when viewing the system log, where it is used to move forwards in the log by 100 entries.

When entrying alphanumeric values, pressing the 0 key and the *Right* arrow key together deletes the character at the cursor.

***MAIN* Key**

The *MAIN* key returns the user to the *MAIN* menu from anywhere in the menu hierarchy.

***ENTER* Key**

On a menu, the *ENTER* key is used to navigate to the submenu highlighted by the cursor. When entering or selecting a new value, the *ENTER* key is used to accept the new value and a further press of the *ENTER* key is (generally) required to move to the next screen

Note that when a new value is accepted, it is applied to the modem hardware immediately.

***BACK* Key**

On a menu, the *BACK* key is used to navigate to the previous screen. When entering or selecting a new value, the *BACK* key is used to cancel any change to the current value and move backwards to the previous screen.

6.3.1.3 Alphanumeric Keys

The alphanumeric keys provide numeric entry. Where it is valid to enter alphabetic characters, repeated pressing of a numeric key will cause the key to cycle through its associated lower-case and then upper-case alphabetic characters.

6.3.1.4 Special Function Keys

Help

Help information can be displayed for any M&C control by holding down the 0 key and pressing the *Left* arrow key together while the screen containing the M&C control is displayed. This brings up scrollable text that explains the M&C control's function. Pressing the 0 key and *Left* arrow key together for a second time removes the Help text and reverts the display back to its previous contents.

Keyboard Lock

The keypad can be locked against inadvertent use by holding down the 0 key and pressing the *MAIN* key together at the same time. Pressing the two keys again at the same time unlocks the keypad.

LCD Contrast

The contrast of the LCD display can be adjusted by holding down the 0 key and pressing the *Up* (or *Down*) arrow key together at the same time. The *Up* arrow key increases the contrast and the *Down* arrow key decreases the contrast.

LCD Backlight

The LCD backlight can be dimmed or brightened by holding down the 0 key and pressing the *Up* or *Down* arrow key together at the same time.

Log/Alarm Clear

The system log and system alarms can be cleared by pressing the 0 key when on the front-panel *View->Log* and *View->Alarms* screens.

6.3.2 LCD Screen Layout

The front panel user interface uses a menu system to present choices to the user. These in turn allow either the selection of a value from a list of options or require the setting of a new value. Examples of these types of screen are shown below.

```
Station clock source: [None]
     1:None      2:BNC
     3:RS422
```

Screen Type 1: Menu Selection from Pre-defined List

```
IF carrier freq:50 to 90, 100 to 180MHz
   [070.0000] Step 100Hz
New:  070.0000
```

Screen Type 2: Entry of New Value

Features that are not available appear on the display are preceded by a '#'. There are several reasons why a feature may not be available:

- ***The feature is a Software Activated Feature (SAF) and the appropriate SAF code has not been enabled. Please contact Paradise Sales who can issue a SAF key to unlock the feature.***
- ***The feature is available but its use is precluded by the current operational modem settings.***

6.3.3 Front Panel Menu Structure

The front-panel menu hierarchy broadly follows the same structure as the web user interface starting with the *MAIN* menu shown below.

```
        [London-New York]
1:Status          2:Edit
3:View            4:Test
```

The *Main* menu can be accessed from any display by pressing the *MAIN* key. It is from this menu that all functions are selected.

It contains the following sub-menus:

Status Displays modem operational status summary information.

Edit Allows modification of the modem configurable properties.

View Displays detailed operational status and read-only configurable property values.

Test Controls the selection of test modes.

Please refer to the equivalent web user interface menus for further information on the front-panel menu options. Note that complex, advanced features of the web user interface such as graphs, static routes and traffic shaping are not supported via the front panel. All basic modem status and setup, as well as many advanced features, can however be accessed via the front panel.

Chapter 7 Modem Concepts

7.1 Automatic Uplink Power Control

Authorisation from the satellite operator should be sought before AUPC is activated.

7.1.1 Introduction

Automatic Uplink Power Control (AUPC) provides a mechanism to counteract changes in atmospheric conditions, such as rain, that degrade the performance of satellite links. It does this by monitoring the remote-end signal-to-noise ratio (Eb/No) and automatically adjusting the local power output of the satellite link in order to maintain the specified remote-end Eb/No. Note that if the rain is falling at the local end of the link then the power seen at the satellite will be unchanged. However, if the rain is falling at the remote end of the link then the power seen by the satellite will increase, which if not controlled carefully has the potential to affect other carriers or saturate the transponder. Carrier power must be kept to the levels agreed with the satellite operator.

Remote Eb/No monitoring is performed by sending messages through the asynchronous ESC channel (which is carried over the satellite multiplexed with the main data channel). When using DVB-S2, which does not have an inherent ESC channel, Eb/No information is injected, at a low rate with extremely low overhead, into the return channel.

An asynchronous ESC channel is available in Closed Network Plus ESC, IBS and IDR modes. AUPC can share the ESC channel with other traffic, such as remote M&C commands.

The modem can be set to simply monitor the remote Eb/No, or to maintain it at a specified level. A deferred alarm can be set to activate if the remote Eb/No falls below a user-set threshold.

A target Eb/No level has to be set along with a maximum transmit power level for the local end. The transmit power is adjusted to keep the remote Eb/No at the target value. If the satellite link is lost, then the transmit power can be frozen at its current level until the link is restored, or it can be returned to its nominal value.

7.1.2 Configuring AUPC

To use the AUPC function, the following procedure should be followed:

1. Prior to switching on AUPC, configure the modems at both ends of the link and ensure the satellite link is operating correctly.

2. Set the transmit power to achieve the remote Eb/No expected under clear-sky conditions.
3. To receive an indication of when the remote Eb/No falls below a defined threshold, set a target Eb/No minimum threshold (which will cause a backward alarm to be generated under these conditions).
4. Set the AUPC mode to monitor the remote Eb/No in order to determine if it is working correctly. If the remote-end Eb/No is not available on the *Status* screen then the modems are not configured correctly.
5. Record the remote Eb/No under clear-sky conditions and then set the AUPC mode to maintain the remote Eb/No.
6. Set a target Eb/No and set the maximum power level.
7. Review the remote Eb/No to confirm that it is being maintained correctly under different atmospheric conditions. The web user interface remote Eb/No and power graphs can be used to review AUPC performance.

7.2 1:1 Redundancy Operation

7.2.1 Overview

Two modems can operate as a 1:1 redundant pair using a single interconnecting lead, two power splitters/combiners and cable forms to parallel up the terrestrial interfaces of both units. Both modems operate normally with respect to incoming data and IF signals, but only one modem enables its satellite and terrestrial outputs at any point in time.

Figure 7-1 illustrates how a 1:1 redundant Hub may be configured for a point to Multipoint star system, incorporating up to 16 remote sites. However, every system could have a different level of complexity, perhaps with a larger number of remote sites or additional 1:N Rx only modems, so please consult the team at Paradise Datacom for any specific requirements.

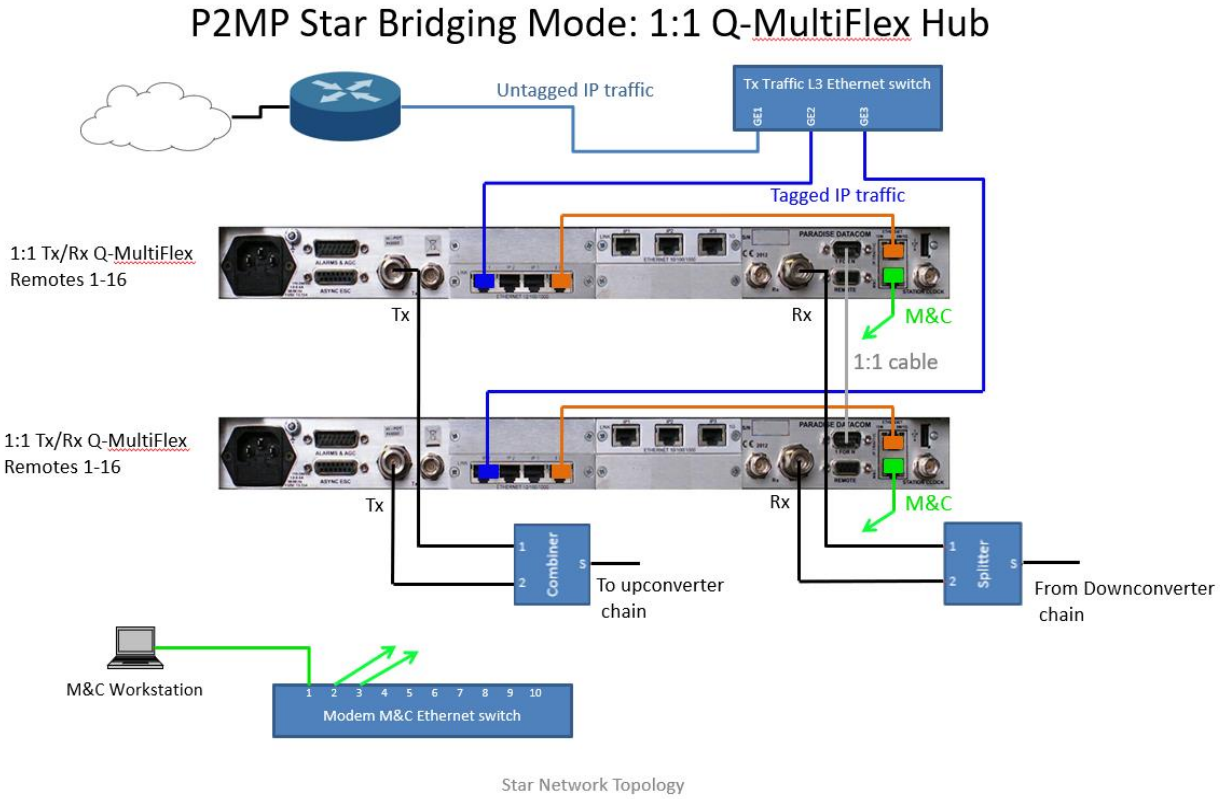


Figure 7-1 Modem 1:1 Redundancy System

It is possible to replace the offline modem in a 1:1 pair without interrupting traffic.

7.2.2 Switching Operation

If a particular modem is required to be the online modem then this should be powered up first. Alternatively, a manual switchover should be invoked once the modems have powered up. This is achieved by selecting the *Switch to standby* control on the *Edit->Redundancy->1:1* menu, which momentarily simulates a failure in the operational unit.

The Standby modem monitors its own status and the status of the online modem continually and will switch over to become the online modem automatically in the event that a fault occurs with respect to the online modem. The types of faults that will cause a switchover are configurable. Both unit and traffic faults can cause a switchover. Traffic faults that are external to the equipment that affect both units simultaneously do not result in any switchover. L-band services can be configured to switch with the modem or to remain with the online modem after it has failed.

In order to minimize unnecessary switchovers, a modem that experiences a failure will remain offline even if it returns to its normal working state. If it does return to a normal state then it will act as the Standby unit.

7.2.3 Setup Procedure

A 1:1 redundant modem pair is set up as follows:

1. Ensure that both modems are running the same software version and are configured identically. See Section 7.3.4 for details of how to configure IP addresses in modem redundancy configurations.
2. Connect a suitable cable between the 9-way 1:1 connectors on the two modems.
3. Connect the terrestrial data interfaces for the two modems in parallel.
4. nd configure the two units alike. Suitable adapter cables are available from Teledyne Paradise Datacom.
5. If the Ethernet traffic port is used on the modem, then the two traffic ports may be connected to a hub or other multi-port LAN device using RJ45 crossover cables.
6. Connect the two transmit IF ports to the input ports of a suitable splitter/combiner of the correct impedance (50Ω or 75Ω) and the appropriate frequency range. The combined output is fed to the up-conversion equipment. Note that only one output is active at a time. Because of the signal loss associated with splitters/combiners, the power level at the output of each modem needs to be increased by approximately 3.5dB.
7. Connect the two receive IF ports to the two output ports of a suitable powersplitter/combiner of the correct impedance (50Ω or 75Ω) and the appropriate frequency range. Both demodulators will receive an identical signal from the down-conversion equipment via the splitter/combiner. Because of the wide dynamic range of the modem AGC circuitry there should be no need to modify signal levels.
8. Check correct operation by performing a manual switch between the units (via the *Unit-Advanced-Operation* menu). The pair will not switch over unless the Standby unit is fully operational. (Note that the pair can be tested in loopback mode but this requires the IF signals to be split and combined and looped back to the other unit. Looping the output of one unit back to its self will not work, since the Standby unit output is muted and it will therefore not detect any carrier.)

7.2.4 IP Addressing and Operation in Redundancy Configurations

7.2.4.1 1:1 IP Operation

The following rules should be observed when using 1:1 redundancy for IP.

1. In 1:1 mode, the M&C IP addresses need to be different for each modem.
2. In 1:1 mode, the IP traffic addresses also need to be different for each modem. In bridging modes the IP traffic address is not used but it is required for routing mode.
3. The M&C Ethernet port must not be bridged to the IP traffic port (this is controlled via the *Bridge M&C* control on the *Edit->IP* screen).
4. The M&C IP address and the traffic IP address should be on different subnets. The modem defines one default gateway. If the second subnet also requires a gateway then a static route should be added that defines a gateway for that subnet.

On the 1:1 Standby modem, the carrier is muted, as is the satellite receive port (in order to ensure that no received data is passed out of the terrestrial port). The M&C port and the terrestrial IP traffic port are not muted.

If a switchover occurs when in bridging mode, the Standby modem will automatically learn to bridge the traffic as necessary, once it comes on line.

If dynamic routing is being used when a switchover occurs then the route through the newly online modem will be learned automatically.

If static routing is being used then the M&C system will need to detect that a switchover has occurred and update the routes accordingly for the new IP address associated with the online modem. Some network devices support route failover, which automates this process. In this case the M&C system router that supports route failover should be configured to include another route in the routing table with a higher 'metric' or 'distance' for the route that uses the Standby modem's IP traffic address. The switchover to using the Standby modem will then be automatic when it detects the path through the primary modem is no longer available.

7.2.4.2 1:N IP Operation

The following rules should be observed when using 1:N redundancy for IP.

5. In 1:N mode, the M&C IP addresses need to be different for each modem.
6. In 1:N mode, the IP traffic addresses should be set to be the same in both modems. The IP traffic port on the Standby modem is physically isolated from the network via a relay contact, which ensures that having identical IP addresses does not cause any problems.
7. The M&C Ethernet port must not be bridged to the IP traffic port (this is controlled via the *Bridge M&C* control on the *Edit->IP* screen).
8. The M&C IP address and the traffic IP address should be on different subnets. The modem defines one default gateway. If the second subnet also requires a gateway then a static route should be added that defines a gateway for that subnet.

On the 1:N Standby modem, the carrier is muted. The IP traffic port remains active but is physically isolated from the network. The M&C port is not muted, allowing the M&C system to control the Standby modem at all times.

The switchover operation in relation to bridging and routing is similar to that for 1:1 operation.

7.3 Software Activated Features

While some modem functions are available as plug-in option cards, the majority of additional functions are made available through Software Activated Feature (SAF) support. As the name implies, these are modem features that can be enabled by entering a feature code via any of the modem's user interfaces. Feature codes are encrypted codes issued by Teledyne Paradise Datacom, uniquely associated with individual modems.

To allow evaluation of modem features, all of the SAF features of the modem that it is capable of supporting can be activated for a 10-day period by entering a feature code of 0. This is referred to as Demonstration Mode. Demonstration Mode can be activated up to three times after which any further attempts to use it will be rejected. Note that it is not necessary to wait for Demonstration Mode to time out before reactivating it: it can be activated twice to give a 20-day demonstration period and three times to give 30 days. The user will be alerted shortly before the demonstration period times out. As well as allowing feature evaluation, Demonstration Mode can be used to test compatibility with other equipment and allows rapid substitution of equipment in a crisis.

To enable one or more features permanently (referred to as Permanent Mode), a modem-specific feature code needs to be obtained from Teledyne Paradise Datacom. The code is tied to the modem serial number (available via the user interfaces and on the back panel).

The features that have been temporarily enabled on a modem can be viewed along with the time remaining before they become disabled, as can the features that have been permanently enabled and those that can potentially be enabled.

The SAF function keeps the initial cost of a modem to the minimum and allows simple field upgrading at a later date, as required.

7.4 Software Upgrading

It is possible to update the software and firmware within the modem via the Remote M&C Ethernet connection web user interface and via the front or rear panel USB connectors. The software upgrade process is described in Section 6.2.13.

7.5 LinkGuard™ Interference Detection and Carrier Relocation

LinkGuard™ is a Paradise patented technology for detecting in-band interference underneath satellite carriers while remaining on traffic. A visual indication of any unwanted interference is provided through a signal-under-carrier spectrum web graph showing the wanted carrier along with any unwanted interference. The graph includes a 'persistence' mode to show even intermittent interference.

In addition, **LinkGuard™** now supports the ability to optionally automatically relocate a carrier to a new user-selected frequency when significant levels of interference are experienced. The user can set an interference threshold and an associated time period. When interference is experienced above the threshold for the defined time period then the carrier frequency will be changed at both ends of the link using Paradise's Reversionary Control feature (which allows the distant modem's configuration to be changed automatically).

Figure 7-2 shows a 32APSK carrier (in blue) initially with no interference (shown in red) and then with interference caused by another modulated carrier. Note that the interference is sufficient to reduce the Es/No of the carrier by around 4dB but is not obvious by looking only at the received carrier spectrum. The modem I/Q constellation graph is also shown.

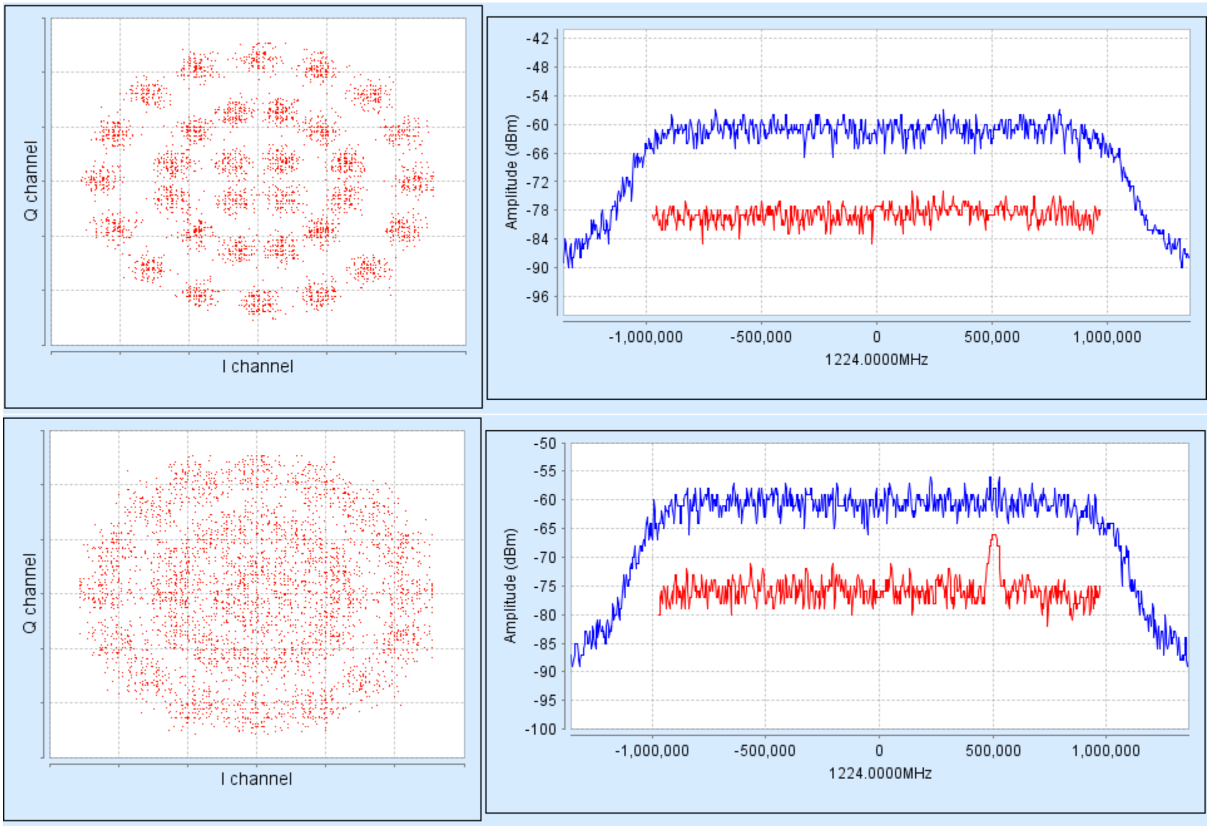


Figure 7-2 Example LinkGuard™ Web Screenshots without/with Interference

LinkGuard™ provides a menu option for setting a power spectral density threshold, above which the modem will automatically alarm to indicate that a significant source of interference has been detected. The **LinkGuard™** Rx traffic warning alarm is displayed locally on the modem and can be accessed remotely via the modem's web server, SNMP traps and physical contact relays. Automated 24x7 interference detection is therefore provided without the need for an operator to be present.

LinkGuard™ detects various forms of interference including tonal interferers (such as CW), radars, Wi-MAX, jammers and other modulated carriers including adjacent interfering carriers. If there is more than one source of interference then it will detect and display all of them.

For existing links, even ones that do not use Paradise modems, a **LinkGuard™**-capable modem can be set up to receive the same Rx signal in order to simply monitor the link for interference (so long as it can lock to the carrier). This is a useful and convenient way of quickly confirming suspected cases of interference while keeping the service running.

Note that even when the level of interference is severe enough to prevent the demodulator(s) from locking, the spectrum graph will continue to show the interference along with the wanted signal (although it will not be able to differentiate between them at this point and will show a single composite spectrum).

LinkGuard™ does not necessarily replace other interference detection equipment but it does provide a useful new first line of defense. It works with all carriers including DVB-S2/S2X.

7.6 FastLink Low-latency LDPC

FEC design is a trade-off between good BER performance and low latency. TPC has low latency but BER performance can be 1dB or more worse than conventional LDPC. (For example, TPC 8QAM ¾ at 5e-8 BER has an Eb/No of 6.4dB compared to LDPC at 5.5dB.) Conventional LDPC latency can be many times that of TPC. (For example, LDPC 16QAM ¾ at 64kbps has a latency of 395ms compared to TPC latency of 47ms, which is a factor of over eight different.)

With satellite delay in addition, LDPC can exhibit over ½ second one-way delay for very low data rates. Low-latency LDPC FECs are becoming available that provide comparable BER performance to LDPC with latency nearer to TPC. FastLink low-latency LDPC from Paradise does precisely this. FastLink also offers an extensive range of modulations ranging from BPSK to 64QAM (including both 8PSK and 8QAM, 16APSK and 16QAM and 32APSK).

One of the key advantages of FastLink is its flexibility. As mentioned, FECs offer a trade-off between BER performance and latency. While the default settings for FastLink achieve this balance, two other modes are also available. The first mode optimises performance for particularly low latency, at the cost of a slight increase in Eb/No required to achieve a specific BER. The second mode optimises BER performance and is suitable when latency is not an issue (e.g. when higher data rates are being used). This flexibility means that FastLink LDPC has now superseded Paradise's conventional LDPC offering. This flexibility also means that FastLink can be used in a wide range of demanding applications, allowing a single FEC to potentially replace the use of multiple existing FECs.

FastLink is available on all Paradise SCPC modems at all data rates up to 100Mbps. FastLink does not interoperate with any other LDPC.

FastLink BER performance is defined on our modem datasheets.

7.7 IP Functionality

7.7.1 Base Modem IP

As shown in **Figure 7-3**, the modem has one RJ45 auto-sensing Gigabit Ethernet port for M&C and one for sending and receiving satellite IP traffic. (A 4-port Gigabit Ethernet switch is available as an option.)

Figure 7-3 Modem Ethernet Ports

Both of the Ethernet connections by default form part of an Ethernet bridge and share an IP address. Essentially, the bridge makes the modem disappear from the network in relation to passing IP traffic over a satellite. Consequently, for simple point-to-point communications, little or no user set up is required to pass IP traffic over satellite. If both Ethernet ports are configured to be part of the bridge then a single Ethernet connection to the modem can be used for both IP traffic and modem M&C control (using either of the two RJ45 connectors). If the M&C port is configured to be outside the bridge then one Ethernet port is dedicated to IP traffic and the other to M&C control (as labeled on the connectors).

To communicate with the modem itself for M&C purposes, an IP address and subnet mask must be set. Note that setting an IP address to 0.0.0.0 causes the modem to request an IP address from a Dynamic Host Control Porotocol (DHCP) server on the network. Static routes are supported allowing routing decisions to be made based on a set of explicit routing rules that can be entered via the web user interface. Dynamic routing is also supported.

The use of a default gateway IP address is supported. When a gateway is specified then it provides a next-hop IP address for all destinations that are not on the local subnet. This is usually the address of a router that has been set up to forward packets to the correct network.

The bridge maintains information on how to forward frames based on replies that are received from each device in the network.

The M&C port can be taken out of the bridge (via the '*Bridge M&C port*' menu option) in which case each port has its own IP address.

7.7.2 IP Addressing

The two ports on the IP card are bridged together, acting as a two-port switch. This is true regardless of what bridging or routing mode is selected. In bridging mode, IP addresses are not used so there is no restriction on what subnets are off the two traffic card ports. In routing mode, since the IP traffic card has a single address covering both ports, there can only ever be one direct subnet off the two ports.

- With an IP card fitted and the base modem M&C port out of the bridge then the base modem IP traffic port is not addressable.
- With an IP card fitted and the two base modem ports bridged then base modem access can be used for M&C only – no base modem data will be passed over satellite.
- If no IP traffic card is fitted and the M&C port is out of the bridge (i.e. the traffic port has its own IP address) then the IP traffic port and M&C port *must* be on different subnets because otherwise the modem does not know which of the two ports to respond out of.

7.7.2.1 Gateways

There is a single gateway address for the modem.

7.7.3 Throughput Performance

Actual throughput performance depends on a number of factors including one way/two way traffic, packet size, data rates and the mixture of IP features switched on. There are endless combinations and therefore it is strongly recommended that empirical testing is undertaken prior to deployment to ensure that the required level of service can be provided.

The modem can process up to 150,000 packets per second. (In Trunking mode this increases to 500,000 packets to second.) It is good practice to put a switch (or router) between the modem and local network in order to minimize the number of packets the modem has to process, as incidental network traffic (not intended for satellite) has the potential to push the modem over it packet processing limit.

TCP acceleration works to the maximum data rate of the modem.

Header compression on the IP Traffic card works to 58,000 packets per second one way, 29,000 two way.

7.7.4 Jumbo Ethernet Frame Support

The modem supports Ethernet frames up to 10k bytes in length. For optical Ethernet, this is increased to 16k bytes.

7.7.5 IP Interoperability

The **Q-MultiFlex™** interoperates with **Q-Flex™** and **Q-Lite™** remote modems. All **Q-MultiFlex™** IP features have been adapted to work point-to-multipoint.

7.7.6 IP Connectivity Modes

The modem software supports unidirectional and bidirectional point-to-point IP operation.

7.7.7 TCP Acceleration

TCP traffic, as opposed to UDP, requires acknowledgements to be returned to the sender as part of the protocol flow control process. TCP was never intended for systems with long delays (such as satellite). With no acceleration, TCP traffic over satellite would limit itself to a few hundred kbit/s (depending on the PC TCP window size), *regardless of the actual traffic bandwidth available over satellite.* Because the satellite delay is taken as evidence of link congestion, TCP throttles back the amount of data it sends. Acceleration allows approx 90% utilisation of whatever the available traffic bandwidth is over satellite. Acceleration can be used in point-to-point and point-to-multipoint bridging modes, as well as in routing mode.

When acceleration is used in bridging mode, all UDP packets are bridged. VPN packets, although they use TCP, cannot be accelerated because acceleration relies on making changes to the addresses in the original IP packet which is encrypted by the VPN as the payload of a new IP packet (tunnel mode). Even in transport mode, where only the IP packet payload is encrypted, authentication will detect when the modem alters any IP address and reject the packet at the end point.

Acceleration works by the modem spoofing TCP acknowledgements back to the local originating device as if they come from the remote end point, eliminating the satellite delay. Since there is no significant delay, the originating PC assumes there is no congestion in the link and will therefore ramp up the level of TCP output to fill the available bandwidth.

Note that when TCP acceleration is used in both directions then the TCP acknowledgements going in each direction compete with the data in each direction. Since TCP will attempt to completely fill the data pipeline, there is a possibility that there will not be sufficient bandwidth available for the acknowledgements, which could drastically reduce the throughput level (typically in one direction). The Paradise software attempts to prioritise TCP acknowledgements in this situation to prevent this from happening. However, a better solution is to use the IP traffic shaping feature to guarantee sufficient bandwidth for the acknowledgements.

7.7.8 Traffic Shaping

Traffic shaping provides control over the management of data within the modem. Specifically it provides a guaranteed quality of service for defined IP data streams. It is aligned with all of the major quality of service schemes and can be used to extend terrestrial services over satellite to create fully provisioned end-to-end services, thereby providing direct support for the implementation of customer service level agreements. Key time-based performance metrics are gathered continuously by the modem and can be extracted in order to be assimilated into customer quality of service reports.

This section provides an overview of the traffic shaping feature, including definitions of terms and worked examples. For a detailed description of the actual traffic shaping menus, please see Edit->Service->General->Tx QoS Screen.

A satellite modem in general normally acts as a transparent pipe for data, so the data that is finally received at the destination on the terrestrial network at the far end of the link is identical to that which has been supplied to the local modem for transmission over satellite. This is not necessarily true for IP data. Being packet based, IP naturally supports multiplexing of different data streams. These streams often have different inherent priority levels and competing demands for bandwidth. What is transmitted over satellite often requires careful management, both in terms of what is actually sent (versus what is filtered out) and in relation to the order in which packets from different streams are sent (i.e. the relative priority levels of packets from different streams and the effect this has on packet jitter).

Traffic shaping essentially controls these two key aspects of traffic management, namely, access to satellite bandwidth and the level of delay and jitter that is experienced.

The Paradise traffic shaping feature is controlled via the modem web user interface under *Edit->Service->General->Tx QoS*.

7.7.8.1 Guaranteed Bandwidth

The allocation of bandwidth to a classified data stream can be controlled.

The **Commited Information Rate (CIR)** is the guaranteed bandwidth that will be allocated to the specified data stream. This is the level of bandwidth that is guaranteed under all normal circumstances where the equipment is operating correctly.

The sum of all CIRs for all classified data streams cannot be more than 100% (of the transmission data rate of the modem).

7.7.8.2 Maximum Bandwidth

If excess bandwidth becomes available at any point (i.e. one or more streams do not require their allocated bandwidth), or some of the overall bandwidth has not been allocated to any particular stream, then it can be allocated in a controlled manner between potentially competing streams.

This setting is called the **Burst Information Rate (BIR)**. It defines the maximum amount of bandwidth, beyond the guaranteed bandwidth, that a stream should be allocated, should spare bandwidth become available. Each BIR can be set up to 100% (of the transmission data rate of the modem).

7.7.8.3 Priority

What happens when excess bandwidth does become available (i.e. all guaranteed bandwidths are being met and there is spare capacity) in the situation where several streams have BIRs set (meaning that they are all potentially competing for the same excess bandwidth)? This is determined by the stream *Priority* setting.

In this case, the allocation of the spare bandwidth between competing schemes will be done based on the priority level allocated to each stream. This is done on an absolute basis: if 256kbps of bandwidth is spare and two streams both want an additional 256kbps then all 256kbps will be allocated to the stream with the higher priority.

The priority setting also controls latency and jitter. In the situation where the transmit modem has several packets in different priority queues for transmission over satellite, then the packets will be sent based on their priority, with the packets from the highest priority queue being sent first.

The priority value ranges from zero to seven, with zero being the highest priority (note that this is the opposite order of prioritization to IEEE 802.1p priority tagging where seven is the highest priority).

A default data stream exists for any packets not explicitly part of a defined data stream. These get assigned the lowest available priority, namely, seven.

7.7.8.4 Stream Classification

How does the modem know which packets belong to which streams? Streams can be classified using the following methods (potentially in combination with each other):

- The source and/or the destination address in the IP packet along with the source and/or the destination port number of the TCP or UDP header in the packet. Any or all of these can be used in any combination at the same time, including using a range of port numbers.
- The 6-bit Differentiated Services Code Point (DSCP) value in the IP packet header.
- The 3-bit Priority Code Point field of an IEEE 802.1Q VLAN tag (also referred to as an IEEE 802.1p Priority Tag).
- The VLAN ID in an IEEE 802.1Q VLAN tag.

The key classifiers are described in the following sections. The result is that each incoming packet is assigned to one of a number of QoS classes. Data will be classified as belonging to the first class in the list for which a match is found starting from the top. If no match is found then the packet is assigned a default class that corresponds to a priority level of seven (lowest). The default data stream gets a BIR value assigned to of 100% (equal to the transmit data rate of the modem).

In addition to the stream classification, each stream can be associated with a particular DVB-S2/S2X modcod when transmitted as part of the shared outbound carrier, with the modcod being matched to the satellite signal strength being received by a particular remote modem. When multiple streams are disabled then all packets will be transmitted using the same modcod.

7.7.8.4.1 IP Address

A data stream can be classified based on either the source and/or the destination addresses in the IP packet as well as by a range for the source and/or the destination port numbers in the TCP or UDP header in the packet.

The example in **Figure 7-4** shows a traffic shaping scheme based on matching on source and destination addresses and port numbers. In this example the shared outbound consists of a single modcod (not shown).

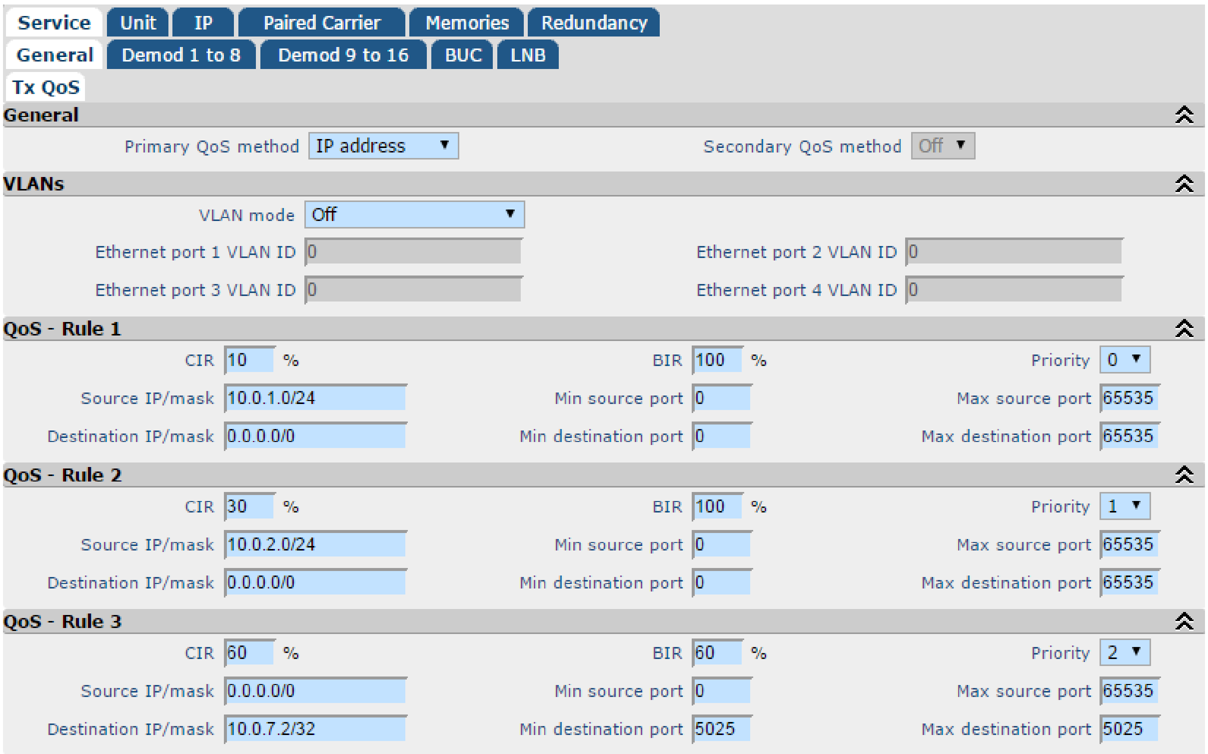


Figure 7-4 Traffic Shaping using IP Addresses

As can be seen, Rule 1 guarantees 10% of the available bandwidth to IP packets from subnet 10.0.1.0/24, which is allowed to burst up to 100% of the bandwidth should it become available. The packets have the highest priority (0).

Rule 2 guarantees 30% of the available bandwidth to IP packets from subnet 10.0.2.0/24, which is also allowed to burst up to 100% of the bandwidth. The packets have a lower priority (1) than Rule 1 and therefore associated packets will only receive BIR bandwidth if it is not required for Rule 1.

Rule 3 guarantees 60% of the available bandwidth to IP packets going to IP address 10.0.7.2/32. Since the BIR value equals the CIR value then no excess bandwidth will be allocated beyond the guaranteed level.

Since the combined CIR values of the three rules equals 100% then potentially no bandwidth will be available for any other traffic.

7.7.8.4.2 VLAN ID

Data stream classification can be based on VLAN ID. VLAN tags can be added externally or by the modem.

The example in **Figure 7-5** shows a set of traffic shaping rules based on VLAN ID.

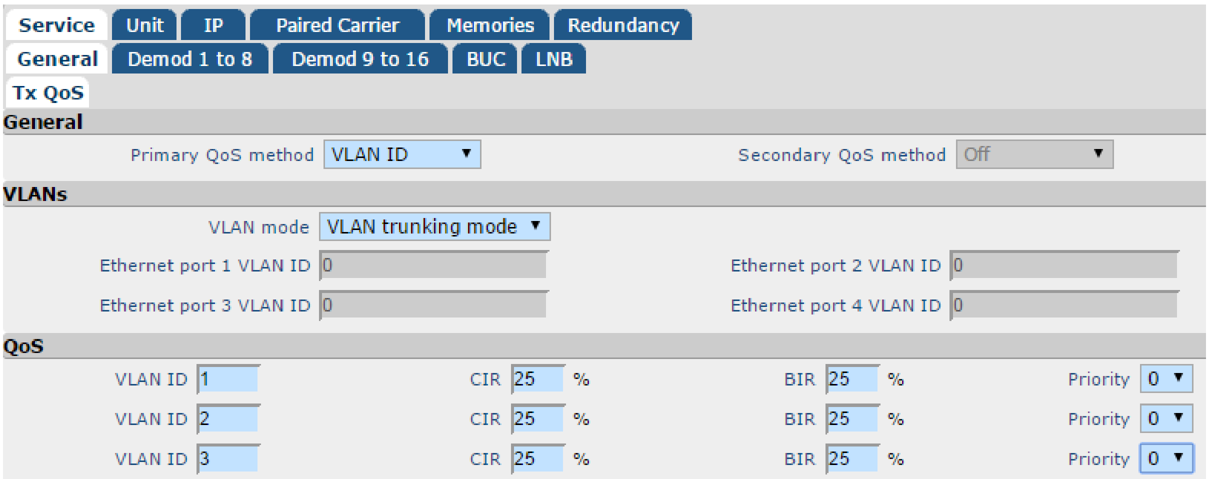


Figure 7-5 Traffic Shaping using VLAN ID

In this example, three VLANs (1, 2 and 3) are all guaranteed 25% each of the available bandwidth but none of them are allowed to exceed this. Each has the same priority, which should ensure that all of these VLANs experience similar levels of jitter. 25% of the available bandwidth will be available for other traffic, although this will increase if the three VLANs do not use their allocated bandwidth.

7.7.8.4.3 Diffserv DSCP Class

Data stream classification can be based on the six-bit Differentiated Services Code Point (DSCP) value in the IP packet header. All of the standard DSCP classes are supported.

An example of traffic shaping based on DSCP classification is shown in **Figure 7-6**.

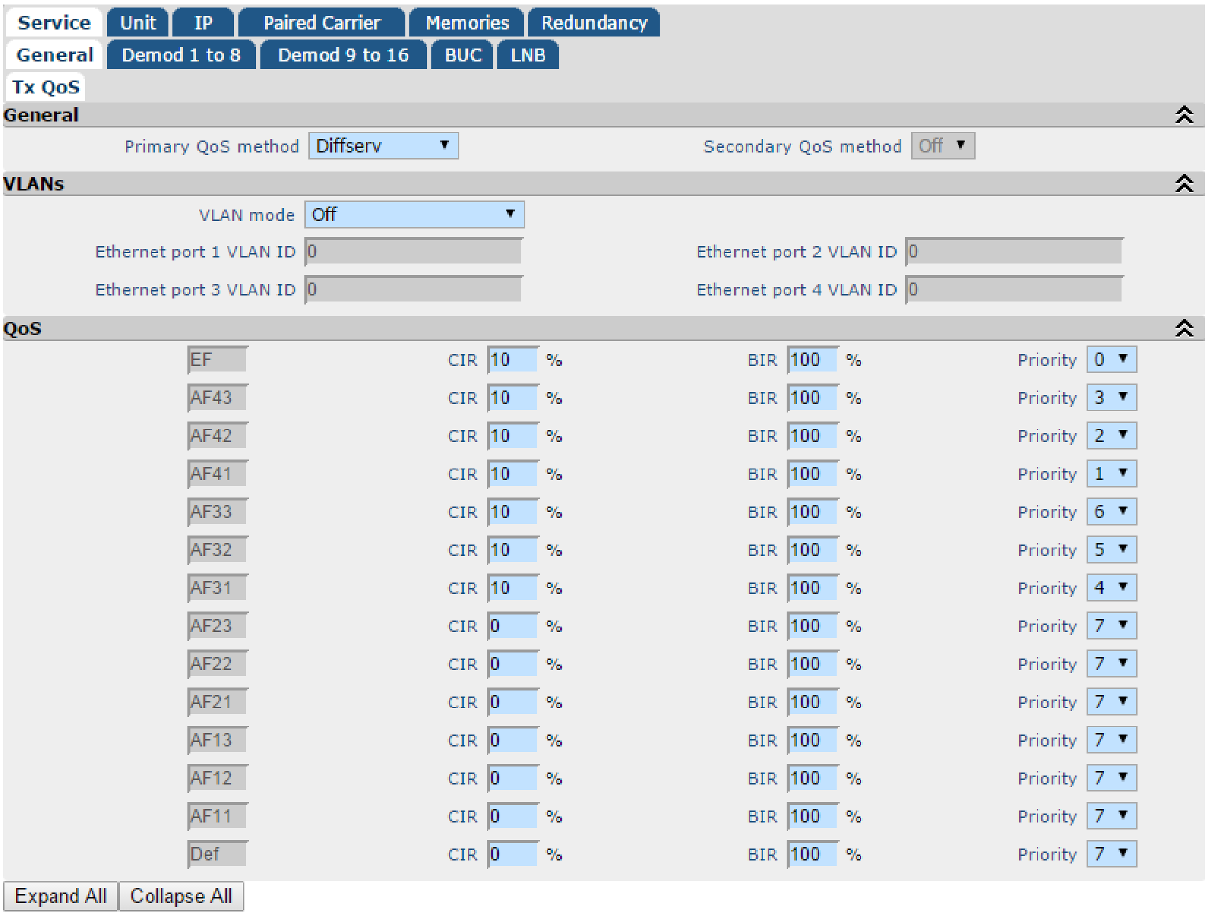


Figure 7-6 Traffic Shaping using DSCP

In this example, the Expedited Forwarding (EF) class is given the highest priority (0) and is guaranteed 10% of the available bandwidth. Two Assured Forwarding classes (3 and 4) are guaranteed 10% of the available bandwidth for each drop probability (1, 2 and 3). Each AF class is given the appropriate level of priority corresponding to its precedence and drop probability. All classes are allowed to burst up to 100% of the available bandwidth in this example. All other traffic is given lower priority. No explicit bandwidth reservations are made for any other DSCP class in this particular case.

The default class (*Def*) corresponds to the 'best effort' DSCP class 000000.

7.7.8.4.4 IEEE 802.1p Priority Tag

Classification may be done on the 3-bit Priority Code Point field of an IEEE 802.1q VLAN tag (also referred to as an IEEE 802.1p Priority Tag). This is part of a 32-bit field inserted into an Ethernet frame between the MAC address and length field.

The priority tag has eight possible values, each of which maps directly to an equivalent internal class within the modem (for which a BIR, CIR, etc. can be set). Each packet passed to the modem must have this field set to the appropriate value in order for the modem to recognize the different data streams.

The example shown in **Figure 7-7** shows traffic shaping based on priority tagging.

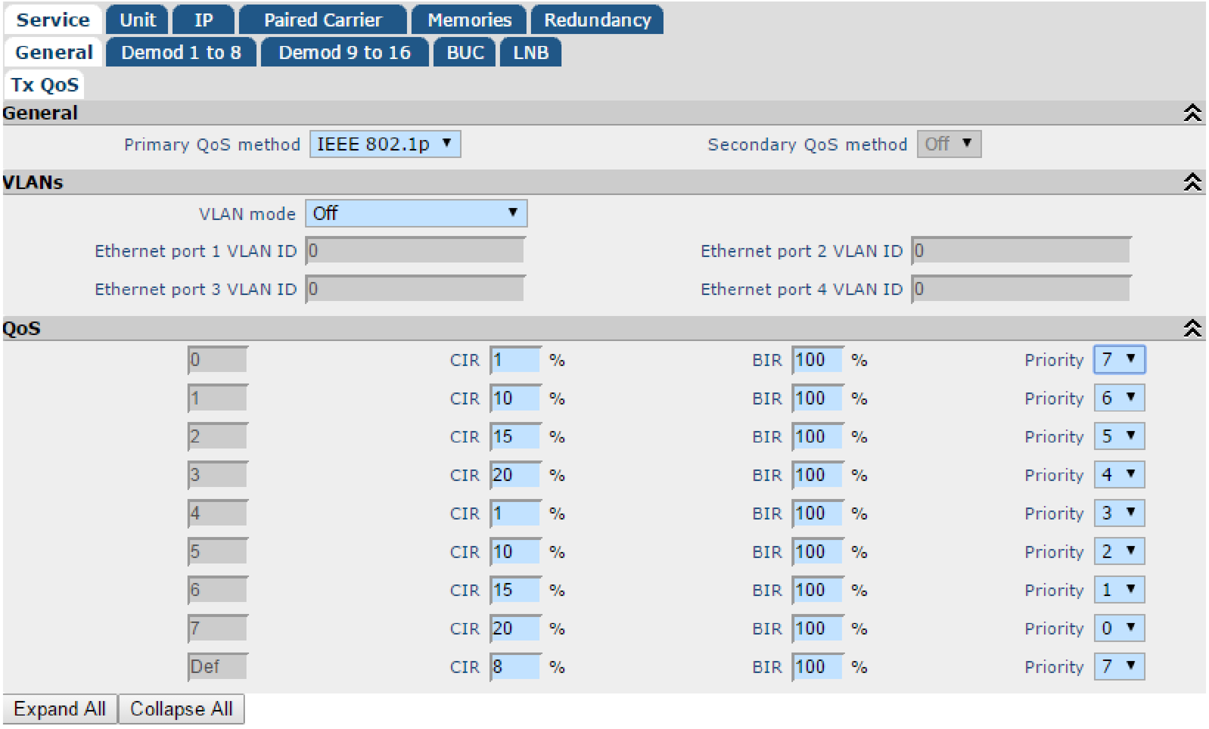


Figure 7-7 Traffic Shaping using IEEE 802.1p Priority Tags

In this example, the IEEE 802.1p priority classes are shown in the left hand column. Each is assigned varying amounts of guaranteed bandwidth and each is allowed to burst up to the maximum bandwidth. IEEE 802.1p priorities (with 7 being the highest) are inverted in relation to those in the modem's queing mechanism (where 0 is highest). The right hand column shows the modem queing priority level. Although there is a straightforward one-to-one priority mapping between IEEE 802.1p priorities and those of the modem, explicit control of this allows priorities to be changed if required.

The default class (*Def*), allows bandwidth to be explicitly reserved for traffic that does not have an IEEE 802.1Q header attached.

7.7.8.5 Traffic Shaping Graphs

A web graphing facility exists that shows a line graph of throughput (in terms of bps) over time for each QoS class. The data for each class is not superimposed, instead it is necessary to select the particular class to be monitored graphically from a dropdown box. It is easy to switch between graphs for the different classes in order to check that the level of throughput is in line with expectations.

Graphs are time based and are shown in minute, hour, day and month formats. It is intended to add diagnostic graphs per class in the future for errored packets and dropped packets.

7.7.9 Static and Dynamic Routing

The modem can be operated as a two-port static router, one port being the terrestrial interface and the other port being the satellite interface. Static routing is useful for small networks that do not require dynamic routing – it can be activated by selecting routing mode but not enabling any dynamic routing protocols (static routing is provided as a free feature).

Each route comprises a *Destination IP Address, Subnet Mask* and a *Gateway Address.* If the destination address of a packet fails to match any entries in the routing table, and the packet has a destination address outside of the local network, the packet will be sent to the default gateway, if specified, otherwise the packet will be discarded. (Static routes can also be entered, and the whole routing table displayed, via the telnet interface to Zebra within the Quagga Router when in Routing Mode The Zebra interface is not dissimilar to Cisco's command line interface and is described in the Quagga user manual available from http://www.quagga.net/docs/quagga.pdf.)

Dynamic routing in the modem offers support for RIP V1 and V2, OSPF V2 and V3 and BGP V4. Note that the 64 static routes have precedence over dynamic routes.

When dynamic routing is on, traffic will be automatically routed across satellite correctly by automatic exchange of routing information with other routers. The routing information exchange uses satellite bandwidth and is therefore an overhead. The amount of bandwidth required depends on the size of the routing tables that are exchanged and the frequency with which they are exchanged.

Dynamic routing is supported via the Quagga software package. Itan only be used on point-to-point links. It is possible to enable routing, TCP acceleration and traffic shaping together at the same time (but routing is incompatible with the header compression feature).

Configuration of dynamic routing protocols can be complex and for this reason the modem provides only a default configuration for the RIP and OSPF protocols that can be enabled from the user interfaces. These will be all that is required in many cases. Further configuration of all routing protocols is available for expert users, via a telnet interface to the Quagga software (the Quagga user manual available from http://www.quagga.net/docs/quagga.pdf). You can telnet into a different command line interpreter for setting up each routing protocol and one that can be used for basic-level setup of all routing protocols. These provide 'Cisco IOS-like' commands that will be familiar to users of Cisco equipment.

When using telnet to login to the Quagga (the default password is 'paradise') various port numbers are used to access the routing protocol to be configured, as follows:

- RIP: port 2602
- OSPF: port 2604
- BGP: port 2605
- Zebra: port 2601

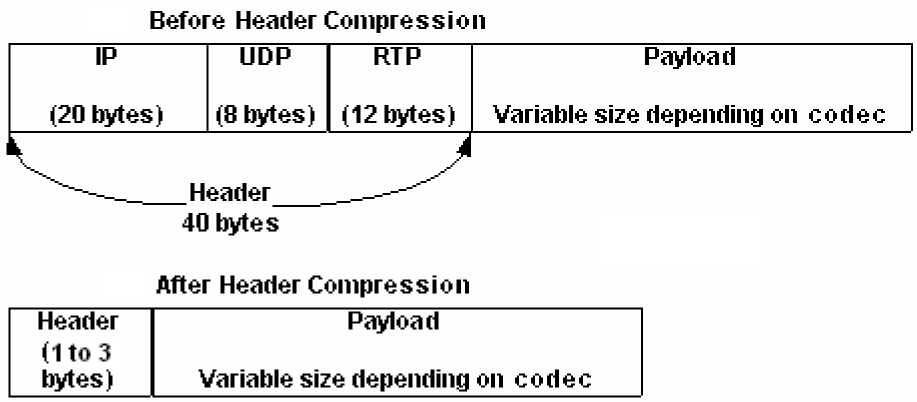
7.7.10 Header Compression

The modem supports RObust Header Compression (ROHC) of:

- IP + UDP headers
- IP + UDP + RTP headers
- IP + TCP headers
- All Ethernet headers

The 40 bytes of IP, UDP and RTP headers are typically compressed to between one to three bytes.

Ethernet header compression is also supported. The 14 bytes of Ethernet frame (the Ethernet CRC is not sent over satellite even when compression is off) are typically reduced to one byte.



Example: G.729 packet with 20ms (20 bytes) of payload:

- Original size = 40 byte header (IP+UDP+RTP) + 14 bytes Ethernet + 20 bytes payload + 5 bytes HDLC

= 79 bytes

- Following compression = 1 byte header (IP+UDP+RTP) + 1 byte Ethernet + 20 bytes payload + 5 bytes HDLC

= 27 bytes (best case)

This represents more than a 60% bandwidth reduction.

There is support for ‘per route’ configuration control, where you can specify up to 32 source or destination IP addresses – only packets with one of these addresses get directed through the compressor.

Header compression runs up to 29000 packets per second one-way, 22000 packets per second two-way on the IP Traffic card.

7.7.11 VLAN Operation

A VLAN allows virtual networks to be created as opposed to being limited to purely physical segments. Benefits include creating a restricted broadcast domain so not everyone sees all traffic, plus added security.

Both VLAN trunking and VLAN access modes are supported. VLANs can be tagged externally to the modem or can be tagged ‘per port’ within the modem itself. VLAN filtering can be used at the remote modems to filter on just the required traffic.

7.7.12 Adaptive Coding and Modulation (ACM)

Adaptive Coding and Modulation (ACM) uses feedback from the receiver to the transmitter to respond to changes in channel conditions to optimise throughput, by providing only the level of error protection that is required.

Deployed links have reported throughput gains of up to 100%.

ACM works on the shared outbound carrier in conjunction with DVB-S2/S2X.

By varying the error correction strength to match atmospheric conditions, link margin is converted into useful bandwidth. Modulation and FEC rate (modcod) is dynamically matched to the current Es/No returned from the remote modem. Symbol rate is kept constant, changing the terrestrial data rate up or down with Es/No. ACM operation automatically accounts for all other link impairments including antenna alignment error, inclined orbit, phase noise and other degradations.

ACM can be used on point-to-point IP links. ACM must be on in Tx on the transmitting modem and Rx in the receiving modem. It must be on in both Tx and Rx in both modems if ACM is to be actively used for both outbound and inbound carriers. It requires a satellite return channel (either DVB-S2 or SCPC). The return channel can be used for user data as well and no special set up is required – the modem will automatically ensure Es/No information is returned to the transmitting modem with no material impact on bandwidth.

In terms of configuration, the link is set up as normal, using a nominal data rate, modulation and FEC rate that gives the required symbol rate. The *only* other step is switching ACM on!

The modcod selected by the user on the forward path represents the maximum modcod to be used when ACM is active. This allows higher order modcods that cause non-linear distortion in the RF chain to be avoided. ACM will use all modcods up to and including the modcod set by the user. It is easier to set up an ACM link as normal rather than being forced to adapt to an alternative such as setting a fixed symbol rate. Uniquely for any ACM implementation, other than switching ACM on, no other ACM-specific controls are necessary.

Paradise ACM works at true QEF points. All DVB-S2 modcods from QPSK ¼ to 16APSK 9/10 are available and both short block and normal block sizes are supported. Each modcod operates over a defined range in relation to carrier-to-noise level, providing true quasi-error-free operation. Rapid fading is countered by using predictive tracking to estimate what the remote Es/No will do before it happens, which prevents link loss even in sudden deep fades. Should the link be lost then the minimum modcod is automatically selected in order to re-establish the link. The transmitter can switch between any two modcods – it does not have to go through them in sequence. Since ACM can work all the way down to a negative Es/No, i.e. below what the link was designed for, it effectively gives 100% link availability (albeit at a reduced data rate).

Note that with DVB-S2 ACM, pilots are automatically switched on at operating points where their use achieves the maximum throughput for a particular Es/No. For example, for an available Es/No of 6.5dB, it is better to use short-block 8PSK 3/5 with pilots on (spectral efficiency 1.69bits/s/Hz) than to use the most suitable short-block modcod with pilots off, i.e. QPSK 5/6 (spectral efficiency 1.6bits/s/Hz). Pilots are sometimes viewed as causing an undesirable increase in overhead but it should be remembered that they also reduce the Es/No at which the modem can lock – this trade-off means that optimal throughput is sometimes achieved only with the active use of pilots.

Note that ACM can be used with AUPC at the same time (providing automatic uplink power control helps maintain the remote Eb/No at the target level).

Modcod changes are totally transparent at the receiver - it does not involve the demodulator having to reacquire the signal. Modcod changes can be made instantly whenever required, maximising throughput at all times.

Because the symbol rate is kept constant, any change in modcod will change the terrestrial data rate. An increase in data rate does not need to be explicitly signalled to the terrestrial network. A decrease does, because it could result in a buffer overflow in the transmit modem if it receives more data than it can transmit. Upstream buffer control is achieved by sending Ethernet Pause frames that define a period of time for which transmission should be suspended. In principle, Pause frames are supported only for full-duplex links and support for them in vendor equipment is optional, therefore the modem auto-negotiates this capability with the attached equipment.

Paradise ACM is intrinsically tied to an IP traffic shaper and TCP accelerator, allowing data grooming to match data priority to the available bandwidth. Without this, there would be no effective data management of a dynamically varying channel, which would become a free-for-all where you would not be sure which packets will be passed over satellite and which will be dropped. Note that an external traffic shaper cannot be aware of the instantaneous data rate in the modem and is therefore restricted to shaping for the nominal data rate of the link (i.e. for a fixed modcod). (The Ethernet Pause frame does not help in any way with external traffic shaping – its purpose is purely to minimize any packet loss at the point in time when a modcod change occurs. It is therefore strongly recommended to use the modem's internal traffic shaping feature in conjunction with ACM.)

ACM controls are on the *Edit->IP* screen. ACM status can be viewed from the *Status* screen.

ACM is built into the modem and does not require the use of a separate controller box.

ACM is compatible with the use of Paradise's *Paired Carrier*, allowing both carriers to use the same space segment, further reducing bandwidth requirements.

Chapter 8 Network Implementation Guide

This document describes how to design, implement and deploy Q-NET™ networks.

The Q-NET™ satellite network solution is a highly flexible and scalable satellite network solution designed for a broad range of markets, applications and business models. Its unique selling points directly enable operators to dramatically cut costs and generate additional revenue. Its defining characteristics are extreme flexibility, low hardware costs and low operational running costs.

Teledyne Paradise Datacom introduced the Q-MultiFlex™ modulator/multi-demodulator unit for point-to-multipoint operation. A variant of our flagship Q-Flex™ satellite modem, it combines a highly efficient DVB-S2X shared outbound carrier with support for multiple low-latency inbound carriers.

Q-NET™ supports both Layer 2 bridging and Layer 3 routing. Q-NET™ can therefore act as a transparent bridge for all protocols, or can be used to provide explicit packet forwarding, as required. VLANs are fully supported (including VLAN access and trunking modes and when applying traffic shaping rules).

All Paradise equipment and other network devices can be controlled from Q-NET™ Navigator, a client-side Windows application that supports a shared network database for all operators. It provides full control over all modem and multi-demodulator functions using an easy-to-navigate site map, which also displays the real-time alarm status of each modem. It takes care of automatically synchronizing all changes in the network when shared outbounds or inbounds need to be reconfigured.

Q-NET™ Bandwidth Manager provides multi-transponder/satellite carrier planning, system status monitoring, custom report generation and traffic analytics. It runs on standard network server hardware and is accessed via web browser client sessions. It complements the hands-on control provided by *Navigator*. The two applications can be used separately or in conjunction with each other.

8.1 Network Topologies

Star, mesh and hybrid star/mesh networks are all supported and can be combined as required.

8.1.1 Point-to-Multipoint Star Network

A star network topology is shown in **Figure 8-1**.

In this scenario, a Q-MultiFlex™ generates a shared outbound from the hub to the remotes, which have Q-Flex™ modems for receiving the outbound. They generate return carriers back to the hub, which are demodulated by the Q-MultiFlex™. The box count starts at literally one box at the hub and one at each site for the smallest network. Traffic shaping is typically used to control the content of the shared outbound. VLAN tagging is often used to keep traffic for each site separate.

The hub Q-MultiFlex™ can be configured to support remote-to-remote communications, where relevant inbound traffic from one remote modem is retransmitted in the shared outbound to one or more of the other remote modems.

The Q-NET™ control applications will normally be located at the hub where there is connectivity to the whole network (of course, the operators can remotely access the system from any location). The method of performing remote control over the satellite network is described later on.

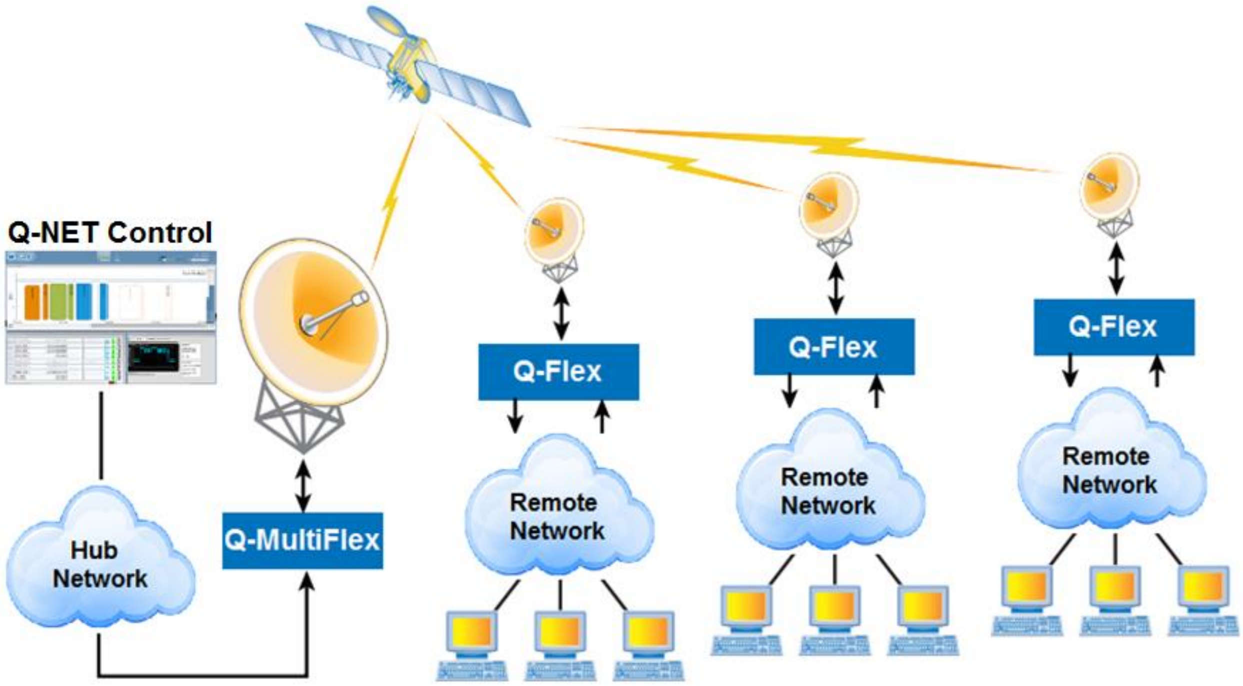


Figure 8-1 Q-NET™ Star Point-to-multipoint Network

Network devices such as routers, switches and VLAN switches can all be connected as required. Multiple Q-MultiFlex™ devices, each supporting up to one modulator and up to 16 demodulators, can be supported at the hub. All Q-MultiFlex™ devices can be configured to share a single outbound carrier, if desired, through a system of cascading which is described later on.

8.1.2 Mesh Network

A mesh network topology is shown in **Figure 8-2**. In a mesh network there is no hub and therefore remote-to-remote communications are all single hop. Each site consists of literally, in the simplest case, a single Q-MultiFlex™. In a full mesh each site transmits an outbound to every site and receives a carrier from every other site. Beyond 16 sites, Rx-only Q-MultiFlex™ get cascaded to the Tx Q-MultiFlex™ so that the site can receive as many carriers as required from other sites, while continuing to transmit only one carrier.

In a full mesh, the Q-NET™ control applications can be located at any site, since each has full visibility of the whole network. In a partial mesh (where some sites communication requires double satellite hops) the control applications need to be located at a point that has maximum network visibility with the least need for double hops.

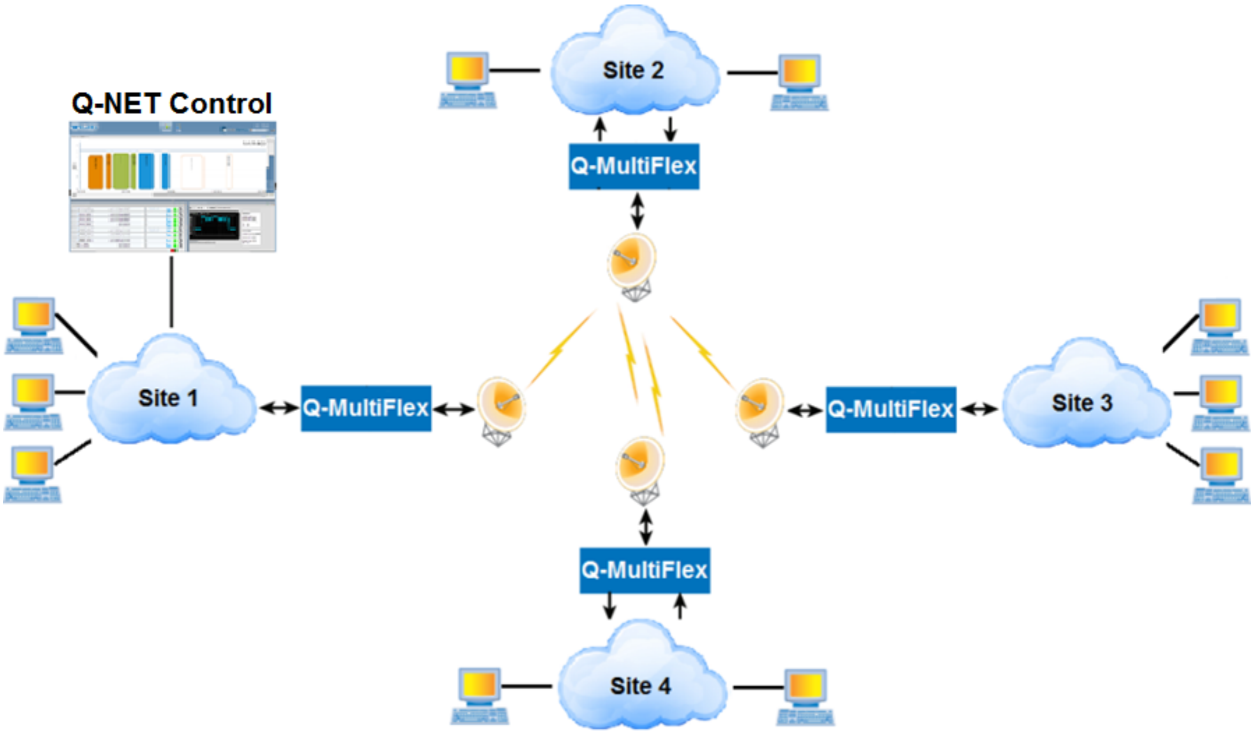


Figure 8-2 Q-NET™ Mesh Network

8.1.3 Point-to-point Network

A point-to-point network topology is shown in **Figure 8-3**. This type of network consists of a series of individual point-to-point links between Q-Flex™ modems. As well as dedicated point-to-point networks, point-to-point links are often used for occasional-use links in larger point-to-multipoint networks or to address parts of the network that require limited connectivity.

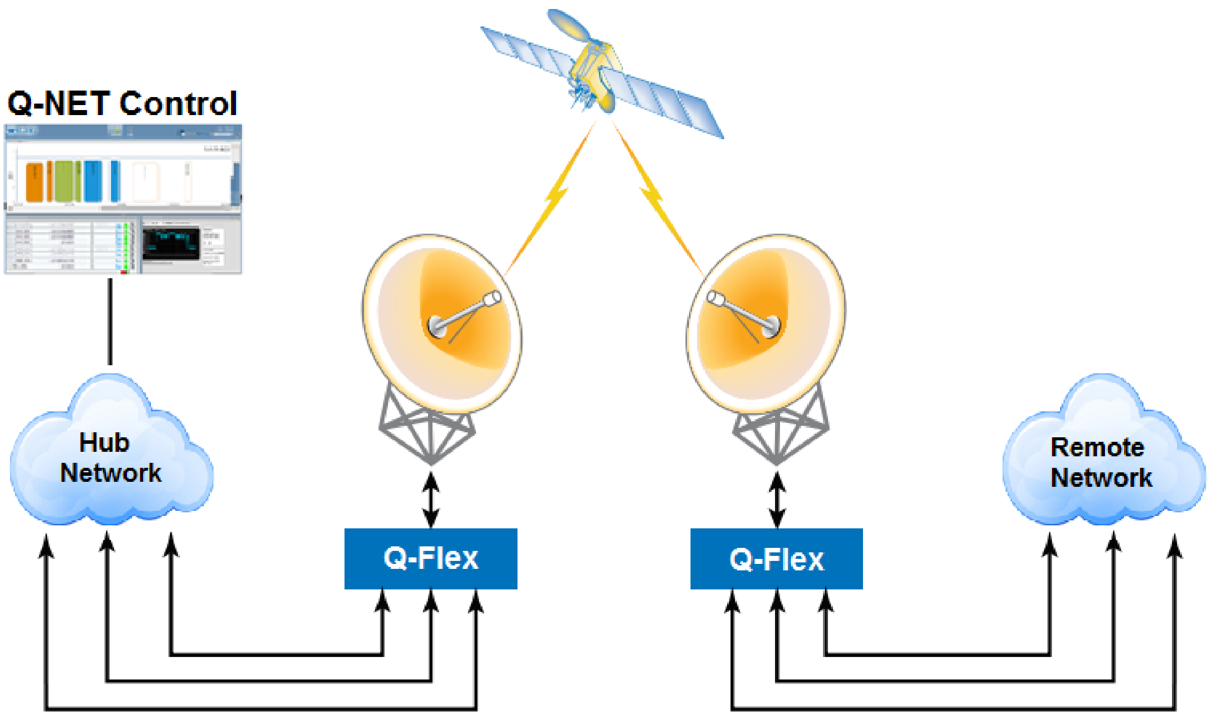


Figure 8-3 Q-NET™ Point-to-point Network

The Q-NET™ control applications will normally be located at the hub where there is connectivity to the whole network.

8.2 TCP/IP Traffic Management

Layer 2 bridging (including the use of VLANs) and Layer 3 routing are supported. Both hardware and software bridges are available. The hardware bridge (switch) is capable of processing many more packets (up to 500,000 per second) while the software bridge supports a larger range of IP optimisation features such as TCP acceleration.

8.2.1 Point-to-Multipoint Bridging

Figure 8-4 shows the most basic configuration used for a point-to-multipoint bridging solution. Ethernet switches can be deployed, as required, between the satellite devices (Q-MultiFlex™, Q-Flex™) and the user network (the user network being any combination of switches, routers and end-user devices). In this scenario, a single subnet is used for the satellite modem network. However, beyond the modems, routers can be used to connect to other subnets as required.

MAC address learning in the satellite modems and the hub multi-demodulator unit ensure that packets automatically find their way correctly over satellite and across the network to the destination devices.

There are several methods for filtering wanted packets from unwanted packets at the remotes. One method (explained later) is to parcel each traffic stream for different remotes (as part of a shared outbound) using Variable Coding and Modulation (VCM). In this situation each remote picks off the stream (modcod) that is relevant to it. Another method is to use VLAN tagging where packets are automatically tagged with the correct VLAN tag for a particular remote. This can be done regardless of whether end-user traffic also uses VLANs (in other words customer and service provider VLANs can be stacked and thereby kept separate). Each remote will then filter out all other packets except the required VLAN(s).

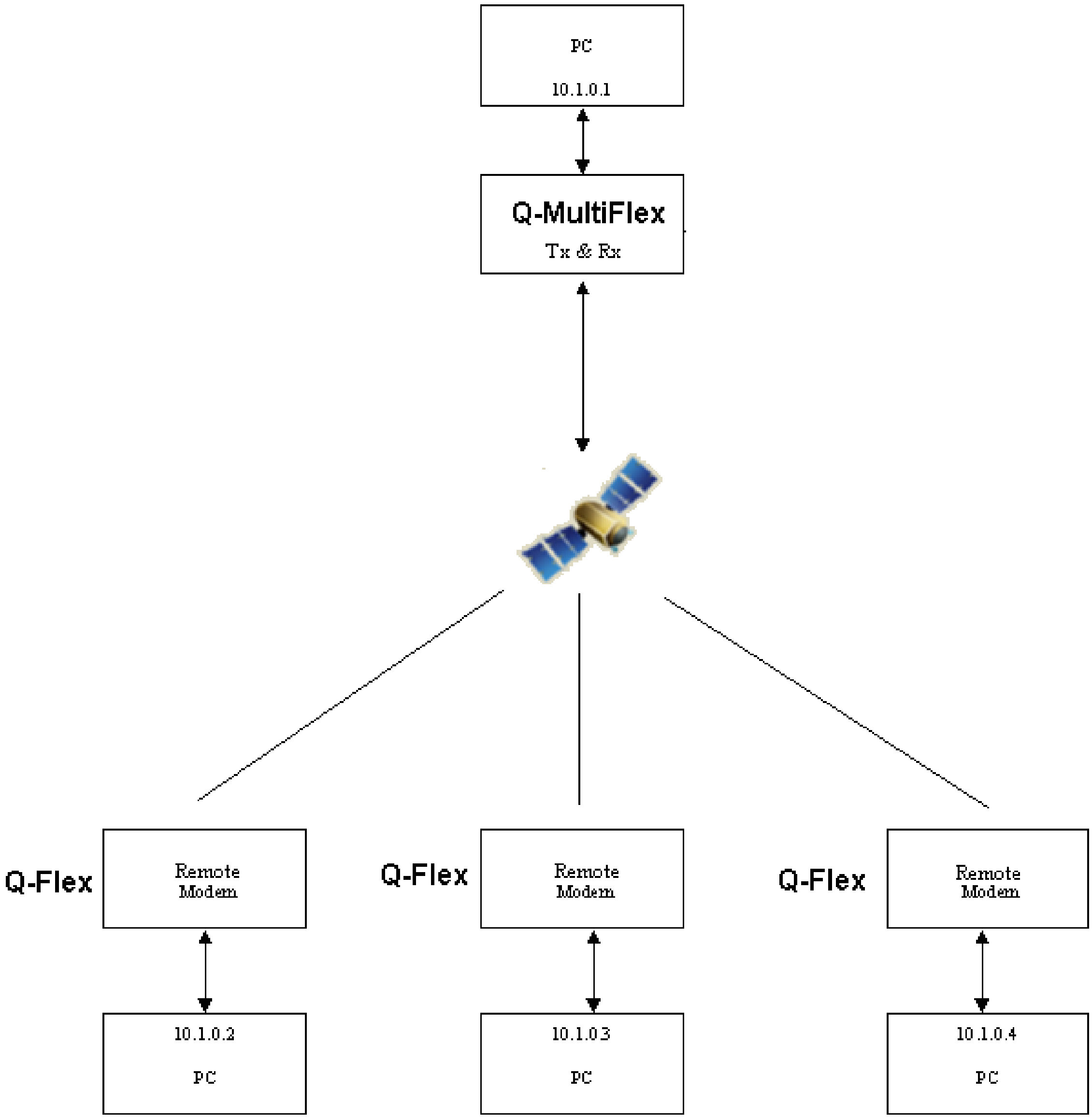


Figure 8-4 Q-NET™ Point-to-multipoint Bridged Network

Note that advanced IP features, including TCP acceleration and compression can be used in point-to-multipoint bridging mode. In these cases, the Q-MultiFlex™ and Q-Flex™ terrestrial IP traffic ports are typically addressless (unlike in routing mode).

Assigning a traffic IP address in bridging mode can be useful as part of status monitoring and fault detection. Being able to ping the IP traffic port allows a monitoring system to confirm the traffic network is accessible at each modem and can help narrow down the point in the network where there is a connectivity problem. This is particularly useful if the IP traffic is run as a separate network to the M&C network and needs its own independent monitoring system (for example, where the M&C network comes under control of the operator while the traffic network remains the responsibility of the end user).

Note also that all forms of Ethernet frame extension, including VLAN tags, MPLS labels and jumbo frames (of up to 10kbytes) are handled correctly, with fully transparent satellite operation as expected.

8.2.2 Point-to-Multipoint Routing

Both point-to-multipoint static routing and dynamic routing are supported. In routing mode, the Q-MultiFlex™ and Q-Flex™ modems act as two-port routers, with the terrestrial IP port being on one subnet and the satellite port being on another subnet. (The M&C network can be on yet another subnet.) The satellite ports of all Q-MultiFlex™ and Q-Flex™ devices are configured to be on the same subnet. Each Q-Flex™ remote modem can be configured to have a unique terrestrial subnet, as required. Routers attached to the modems then allow other networks to be connected.

In **Figure 8-5**, arbitrarily complex networks (potentially with multiple subnets) exist attached to routers on both sides of the satellite network. The Q-MultiFlex™ is configured for a unique subnet that it shares with its local router. A single subnet is used over satellite to connect the satellite ports of the Q-MultiFlex™ and Q-Flex™ modems. The terrestrial port of each Q-Flex™ is configured to be a unique subnet shared with its local router.

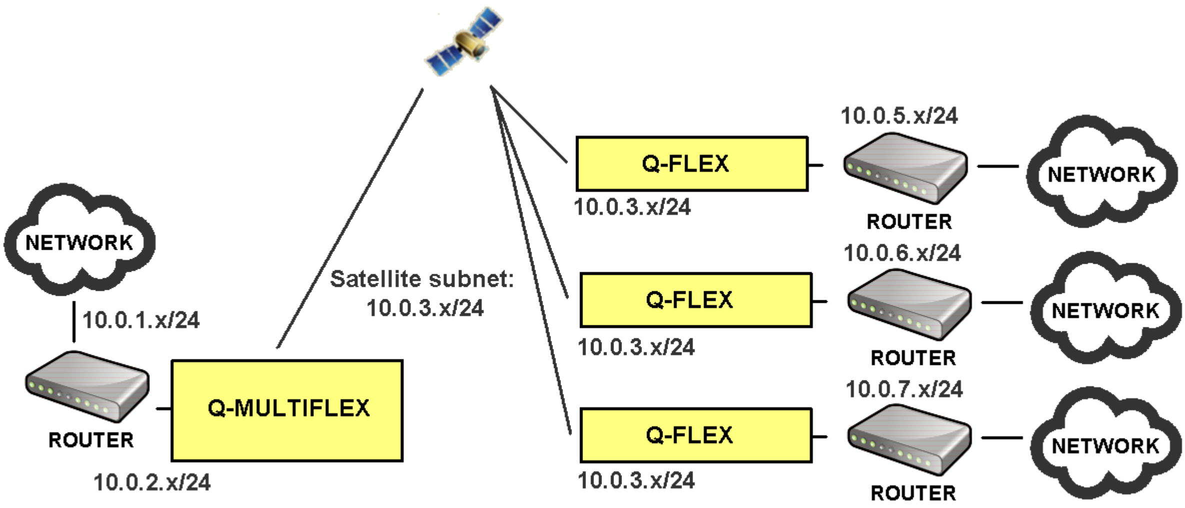


Figure 8-5 Q-MultiFlex™ Point-to-multipoint Routed Network

If static routing is being used then static routes are set up in each Paradise device to route packets as required. Routes can be allocated bandwidth using the traffic shaping feature and they can also be used to determine which packets are dropped or forwarded at each remote.

One method of handling unwanted packets at the remotes is to specify 'black hole' static routes at the remotes that route the unwanted data to non-existent gateways, causing the packets to be dropped. This prevents unwanted packets being forwarded onto the local network.

Advanced IP features, including TCP acceleration and compression can be used in point-to-multipoint routing mode. Unlike in bridging mode, the Q-MultiFlex™ and Q-Flex™ terrestrial IP traffic ports use explicit IP addresses when in routing mode.

One benefit of routing is that it minimises satellite overhead and therefore increases bandwidth efficiency, since no Ethernet frames are ever transmitted.

8.3 Cascading Multiple Q-MultiFlex™ Units

Multiple Q-MultiFlex™ units can be cascaded together in order to address an arbitrarily large number of remote modems with a single outbound carrier.

There are two methods that can be used to cascade units together. The first involves cascading units directly together and involves no external equipment. The second method is to use an Ethernet switch.

Direct cascading (addressing up to 64 remotes) is shown in **Figure 8-6**. Each Rx-only Q-MultiFlex™ unit is connected to the Ethernet expansion ports of the Q-MultiFlex™ that is transmitting the outbound carrier. All M&C and IP traffic from each Q-MultiFlex™ will be correctly transmitted and received over satellite.

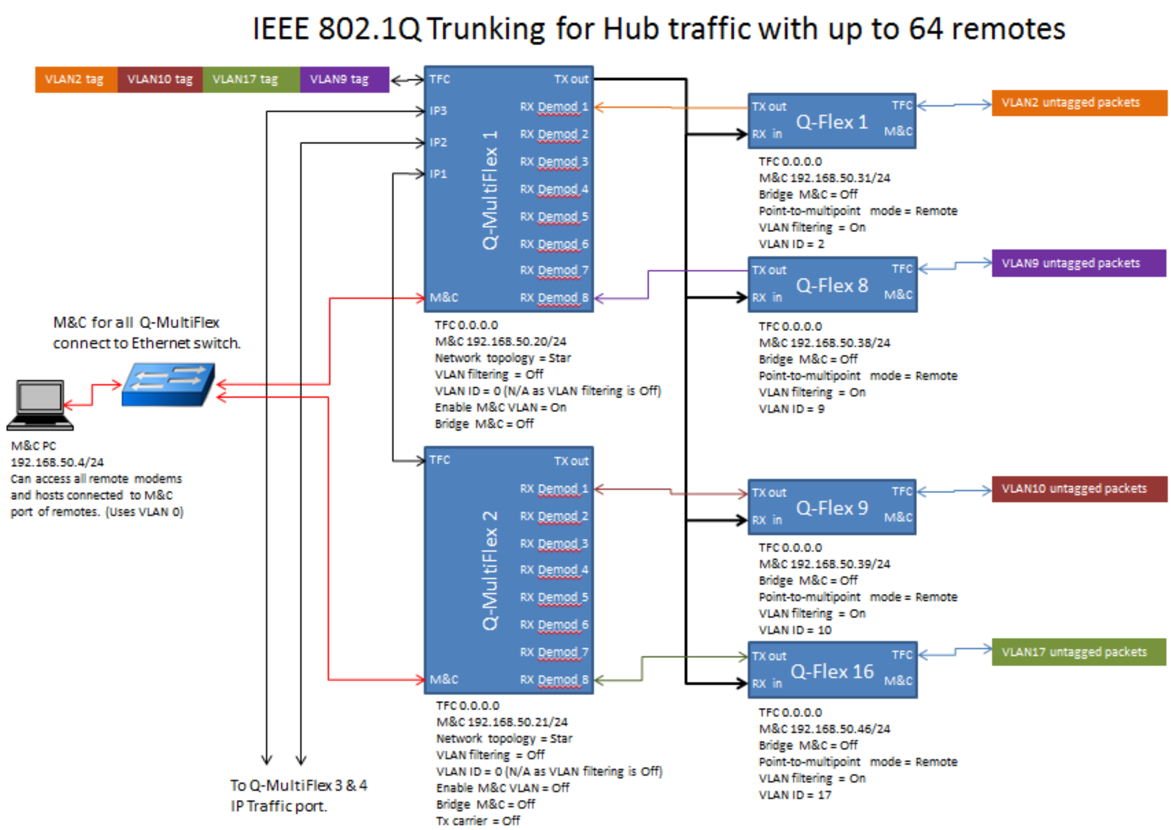


Figure 8-6 Cascaded Q-MultiFlex™ Units (up to 64 remotes per shared outbound)

When configured for directly cascaded Q-MultiFlex™ units as shown, the traffic shaping rules under Edit->Service->General->Tx QoS will automatically display 64 VLAN rules, allowing the bandwidth in the outbound carrier to be partitioned for each remote modem, as required.

Above 64 remotes sharing a single outbound carrier, a more general system of cascading is required as shown in **Figure 8-7** (or, alternatively, a standard Ethernet switch can be used). This shows how 128 remotes can be addressed using a single outbound carrier (each blue box representing a Q-MultiFlex™). The 'T' in the diagram refers to the IP traffic port on the base modem and the numbers 1 to 3 refer to the ports on the IP extension card.

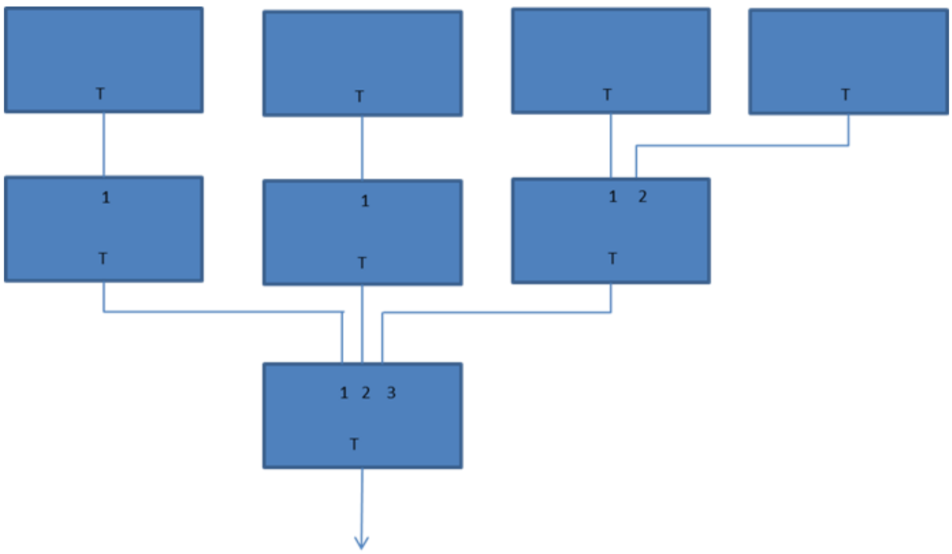


Figure 8-7 Cascaded Q-MultiFlex™ Units (for up to 128 remotes per shared outbound)

8.4 Modem Redundancy Protection

Various levels of redundancy are supported.

Figure 8-8 shows a typical hub redundancy setup where transmit and receive services for up to 64 remote sites are protected by a single backup unit. A PDQS redundancy switch (and backup Q-MultiFlex™) is used to protect four Q-MultiFlex™.

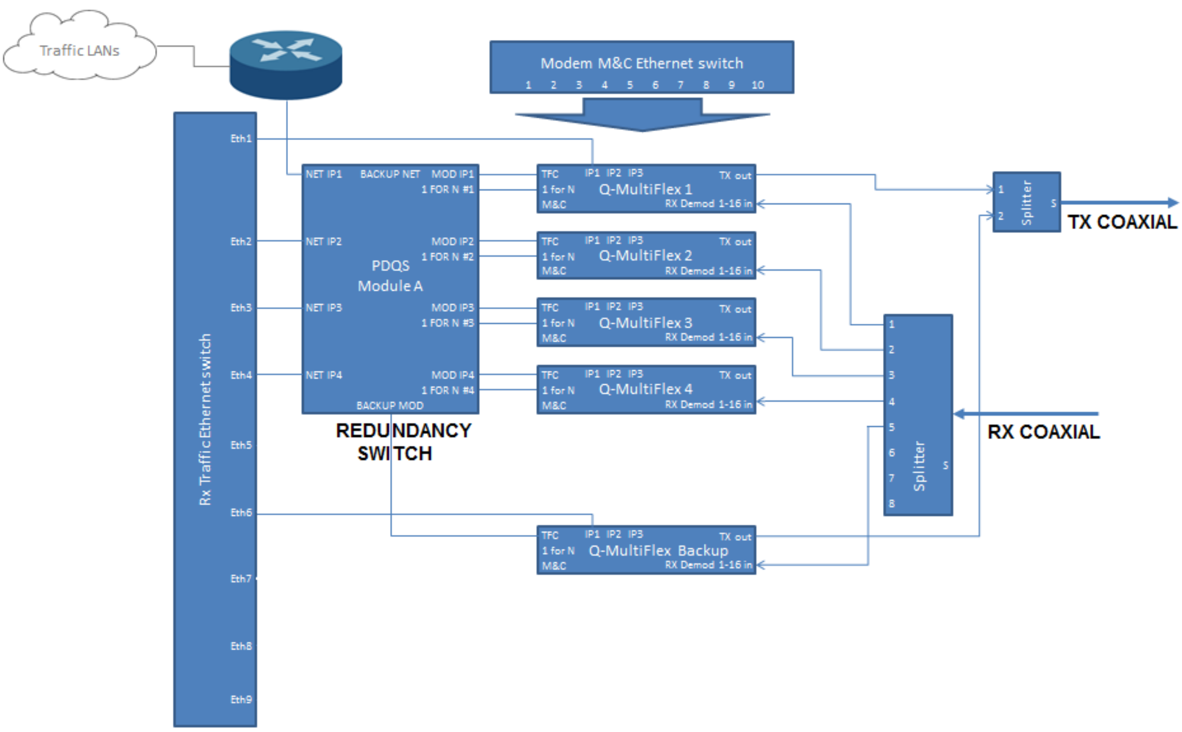


Figure 8-8 Q-MultiFlex™ 1:4 Redundancy Setup (64 remotes sharing single outbound)

However, users may want to consider independent protection for the hub Tx and Rx functions, giving each their own separate backups, allowing for continued correct system operation even in the event of multiple concurrent failures, leading to extremely high system reliability and availability. In this scenario, we recommend using 1:1 protection for the Tx services (since potentially large numbers of remotes all dependent on a single shared outbound carrier) and using a separate 1:N redundancy system where one backup unit is shared between all of the Rx services, as shown in **Figure 9-9**.

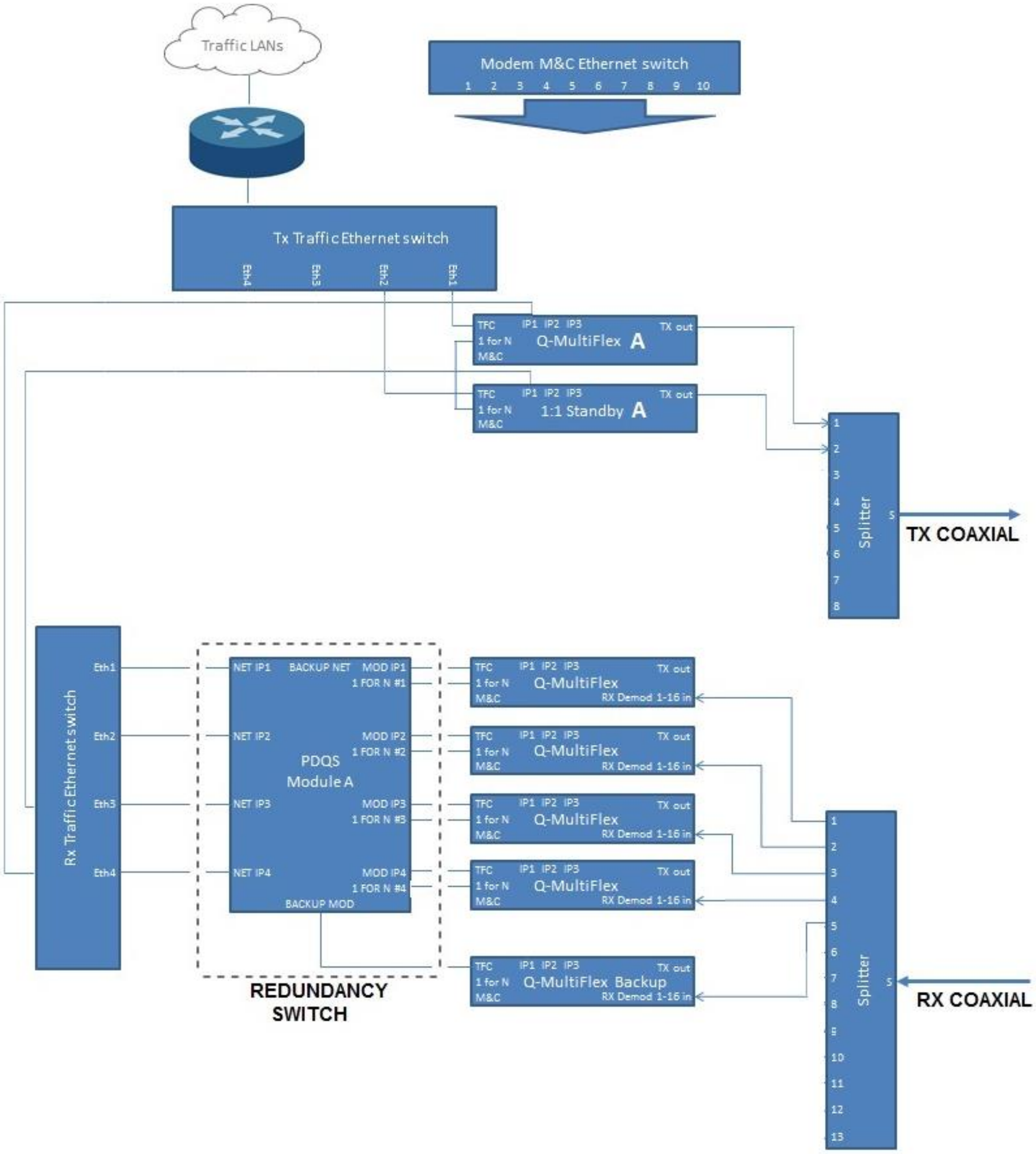


Figure 8-9 Separate Tx (1:1) and Rx (1:N) Redundancy Setup

8.5 Remote Modem M&C

When the user configures the Q-MultiFlex™ so as bridge the M&C Ethernet port to the IP traffic ports then all M&C traffic sent to the Q-MultiFlex™ will be transmitted over the satellite link if it is addressed to any of the remote modems (or to any other equipment attached to the remote modems). However, the implication of bridging the ports together is that M&C and traffic share a single IP address.

In the situation where the M&C network and the IP traffic network are required to exist on separate subnets another remote M&C method is required. Paradise has chosen to create an alternative, which is a special VLAN that is used just for M&C traffic. (VLAN 0 is used for this purpose and will not interfere with user VLAN traffic.) This can be enabled simply by turning on the ‘M&C VLAN’ menu option in the units at either end of the link. The modems will thereafter ensure that M&C traffic is kept separate from user traffic and it will automatically be forwarded between hub and remotes modems as required. The M&C VLAN is filtered by each modem and the commands processed. This applies equally to both point-to-point and point-to-multipoint operation.

The M&C VLAN can be used in all modes (including bridging and routing) and for all waveforms, regardless of whether VLANs are being used more generally or not. There is no restriction on how much bandwidth can be used for the M&C VLAN and it will consume as much or as little as required. However, M&C bandwidth can be controlled via the traffic shaping feature, if required.

There is a separate menu option to enable remote-to-remote communications, where the hub retransmits requests made from one remote modem when attempting to communicate with another remote modem.

8.6 Multiple Streams and Traffic Shaping

8.6.1 VCM

Single stream mode allows a single modcod to be applied to the shared outbound carrier, whereas with multiple streams, potentially different modcods can be applied to the individual streams when they are transmitted over satellite in the shared outbound carrier (a feature known as Variable Coding and Modulation (VCM)). VCM typically increase overall throughput by around 25% since it takes advantage of the fact that different remote sites will be at different positions in the satellite footprint and will be capable of receiving different signal levels (hence some will be able to use more bandwidth-efficient modulations and FEC rates than others). There is no change to the overall symbol rate or power of the outbound carrier when VCM is active - the configured bandwidth is simply shared between several different modcods in accordance with the configured traffic shaping rules.

When the shared outbound is represented by a single stream (i.e. single modcod) then the QoS classification methods are VLAN IDs, IP addresses, Diffserv and IEEE 802.1p priority tags.

With multiple streams, there are two tiers of QoS classification. The primary multistreaming QoS classification methods are VLAN ID and IP address. If VLAN ID is used for the primary classification then a secondary classification method can be selected (from amongst IP address, Diffserv and IEEE 802.1p priority tags).

Multiple streams are supported only when DVB-S2 or DVB-S2X is used as the Tx FEC. The number of streams that are supported is the same as the number of demodulators that have been SAF enabled in the Q-MultiFlex™.

In summary, when the terrestrial traffic is treated as a single stream, it is defined by a single modcod and an optional set of QoS classes. Multiple streams are defined by a set of modcods (one per stream) and up to two tiers of QoS classes. The first tier defines which packets go to which remote (and how much bandwidth each remote gets as part of the shared outbound) and the second tier defines how the bandwidth is split between the different types of packets destined for a particular remote. As an example, bandwidth in the shared outbound may be shared equally between all remotes based on VLAN ID and then the bandwidth may be further subdivided based on Diffserv classes that represent different applications running at each remote.

Traffic shaping configuration is covered in detail in the QoS description of this user manual.

8.6.2 ACM

Adaptive Coding and Modulation (ACM) can optionally be used to maximize the efficiency of the shared outbound. It does this by dynamically varying each VCM modcod (one per stream) in the shared outbound with varying link conditions as experienced by each remote modem. ACM therefore converts any unused link margin (on a per-site basis) into additional throughput.

ACM also provides 100% link availability by allowing the use, during heavy rain fades, of modcods with very high error-correcting ability (down to QPSK ¼).

Chapter 9 Remote Control Protocol

The modem supports the following remote control interfaces:

- A built-in remote web user interface that provides web pages from the modem (using a web server) to a web browser. This is accessed by entering the IP address of the modem into a web browser address bar (the web server being on port 80).
- A serial interface (selectable between RS232 and RS485) that can be used to send and receive Paradise Universal Protocol (PUP) messages. This interface can be driven either through a generic user-entry application such as HyperTerminal (in the case of RS232) or through an application that uses a driver developed specifically to implement the PUP protocol. In the case of RS485, a message wrapper (defined in the document *'Remote M&C Specification for* ***Q-Flex™*** *Satellite Modem'*, which also covers the ***Q-MultiFlex™***) is used to encapsulate PUP commands and responses, which are incorporated into the message payload.
- An Ethernet interface that can be used to send and receive PUP messages or Simple Network Management Protocol (SNMP) messages. This interface can be used in several ways.

  Firstly, a generic user-entry application such as Telnet can be used to automatically send or manually enter PUP commands.

  Secondly, PUP messages can be encapsulated directly into TCP packets using the message format defined in the document *'Remote M&C Specification for* ***Q-Flex™*** *Satellite Modem'*. These must be sent to a specific TCP port that the modem listens on for PUP commands. Typically this will result in much faster communications than when using Telnet. This method is referred to as 'direct encapsulation' elsewhere in this document to differentiate it from the Telnet type of communications.

  Thirdly, SNMP V1 or V2c can be used to communicate between an SNMP network manager and the SNMP agent on the modem.

The remote control protocol for the modem is specified in the document '*Remote M&C Specification for Q-Flex™ Satellite Modem*', which also covers the *Q-MultiFlex™*.

M&C message example

The following example shows how to:

1) *get* the transmit power from a modem. (The response has a value of -25. Note that numeric text denotes the message contents as hexadecimal characters.)

```
            g  e  t     T  I  F  T  x  I  F  P  w  r  *
02 15 01 09 67 65 74 20 54 49 46 54 78 49 46 50 77 72 2A 0B 03

            -  2  5  *
02 0A 01 09 2D 32 35 2A C8 03
```

2) Login to the modem to be able to make changes. (The response has a value of *.)

```
                l  o  g  i  n     p  a  r  a  d  i  s  e  *
02 15 01 09 6C 6F 67 69 6E 20 70 61 72 61 64 69 73 65 2A B6 03
```

```
                   *
02 08 01 09 20 2A 54 03
```

3) *Set* the transmit power to a new value. (-20). (The response has a value of *.)

```
                s  e  t     T  I  F  T  x  I  F  P  w  r     -  2  0  *
02 19 01 09 73 65 74 20 54 49 46 54 78 49 46 50 77 72 20 2D 32 30 2A C6 03
```

```
                   *
02 08 01 09 20 2A 54 03
```

4) *get* the transmit power to prove that the change has been accepted. (The response indicates a value of -20.)

```
                g  e  t     T  I  F  T  x  I  F  P  w  r  *
02 15 01 09 67 65 74 20 54 49 46 54 78 49 46 50 77 72 2A 0B 03
```

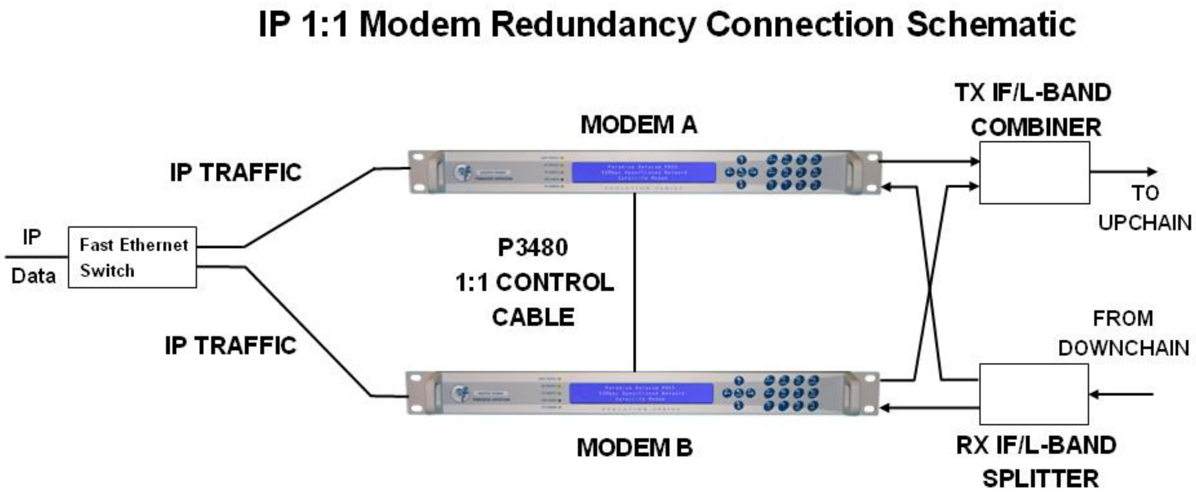
```
                -  2  0  *
02 0A 01 09 2D 32 30 2A C3 03
```

Chapter 10 Data Interfaces

The modem provides Ethernet IP interfaces as standard plus options for optical Ethernet and a 4-port IP Ethernet switch (to expand the base modem IP capabilities).

1:1 Redundancy Operation

The IP interface requires separate but parallel connections to the network.



IP Interface

The IP is a standard interface supplied with the modem.

The modem supports two RJ45 Ethernet port for IP traffic and remote control respectively.

The Ethernet supports 10/100/1000Mbps data rates and uses CAT 5 Ethernet cable. Both straight and crossover cables are supported.

Chapter 11 Connector Pinouts

1:N (1:1) Interface

Connector type: 9-pin `D' male.

1:n CONNECTOR	
1	Ground
2	Line In
3	Line Out
4	Serial In (A) (RS232/485)
5	Serial In (B) (RS232/485)
6	Fail In
7	Fail Out
8	Serial Out (A) (RS485)
9	Serial Out (B) (RS485)

Serial In/Out
This is an uncommitted and currently unused RS232 or RS485 serial port.

Line In/Out & Fail In/Out
The 1:1 redundancy cable is wired as follows:

Modem 1	Modem 2	Signal Name
Pin 1	Pin 1	Circuit ground (screen)
Pin 2	Pin 3	On-Line signal 2-1
Pin 3	Pin 2	On-Line signal 1-2
Pin 6	Pin 7	Fail signal 2-1
Pin 7	Pin 6	Fail signal 1-2

The cable must be of the shielded variety and should be kept as short as practical.

A standard 1:1 lead (part number P1391) is available from Teledyne Paradise Datacom. The lead is 10cm long and is designed for use when two modems are mounted vertically adjacent to each other in the rack.

Alarms and AGC Connector

Connector type: 15-pin `D' male

ALARMS CONNECTOR	
2, 12	Fault Relay - Common
4	Prompt Unit fault - N/O
11	Prompt Unit fault - N/C
3	Prompt Rx Traffic fault (prompt) - N/O
10	Prompt Rx Traffic fault (prompt) - N/C
5	Prompt Tx Traffic fault (prompt) - N/O
13	Prompt Tx Traffic fault (prompt) - N/C
1	Deferred alarm - N/O
9	Deferred alarm - N/C
6	Uncommitted analog output from processor – not currently used
7	Transmit inhibit
8	Buffered direct AGC voltage. This may be used as an antenna-pointing signal when the demod is unlocked. It responds to composite power in approximately a 2MHz bandwidth around the nominal Rx carrier frequency.
14	Not connected
15	Ground

To externally inhibit the Transmit carrier, either apply a TTL/CMOS 'low' signal to pin 7, or short pin 7 to ground (for example with an external relay closure).

All relay contacts are rated 30V DC 2A, or 125VAC 0.4A.

Note: N/O means 'normally open' *in the non-fail state of the modem* (relays energised) when power is removed the relays fall back to the non-normal (ie non-energised) alarm state.

Chapter 12 Fault Messages

The following table lists all of the modem faults along with a description of what the fault means. It also describes relevant checks the operator might make to try to eliminate the fault condition. Note that the text shown in the table will be displayed in full on the web user interface and in the system log but may appear in an abbreviated format on the front panel LCD display due to space considerations.

The acronyms used to define the actions taken on each fault occurring are as follows:

Actions: Relays

U: Prompt unit fault relay.
T: Prompt traffic fault relay.
D: Deferred alarm relay.

Actions: To Terrestrial

TA: AIS in selected timeslot if the Insert MUX is active or AIS over all data if not in Insert mode. If Insert mode is active and the user control thin route spoofing is on, then AIS is forced over the whole PCM bearer, not just the selected timeslots to spoof full bearer connectivity when passed over a Thin Route satellite circuit.
TB: Frame Backward alarm.
TC: AIS forced in the G.732 CAS ‘abcd’ signalling nibble.
TD: Force a fixed value in the G.732 CAS ‘abcd’ signalling nibble.
TE: Multiframe Backward alarm in IBS/SMS TS16/TS48 over satellite.

Actions: To Satellite

SA: AIS framed and scrambled and subject to RS coding if active.
SB: Frame Backward alarm.
SC: AIS in CAS signalling carried in IBS/SMS TS16/TS48 over satellite.

Actions: Other

CM: Carrier mute.
TF: Tx flow control CTS (Clear To Send) line is switched off.
RF: Rx flow control RR (Receive Ready) line is switched off.

12.1 Transmit Faults

Fault Text	Notes	Relays	To Ter	To Sat	Other
Tx fault: BUC PSU outside limits.	The current drawn by the BUC has exceeded the permissible upper & lower limits.				CM
Tx fault: Tx terrestrial DPLL unlocked.	Consult technical support if this alarm cannot be cleared.				CM
Tx fault: Tx channel DPLL unlocked.	Consult technical support if this alarm cannot be cleared.				
Tx fault: FastLink: Aligned frame FIFO overflow.	FastLink error whereby FEC is unable to process the data to be transmitted due to an internal buffer overflow.				
Tx fault: FastLink: Uncoded FIFO overflow.	FastLink error whereby FEC is unable to process the data to be transmitted due to an internal buffer overflow.				
Tx fault: Encoder fault.	Unspecified DVB-S2 encoder fault. Consult factory.				
Tx fault: Framer sync lost.	Unspecified DVB-S2 encoder fault. Consult factory.				
Tx fault: Data failure to modulator.	Unspecified DVB-S2 modulator fault. Consult factory.				

12.2 Transmit Warnings

Fault Text	Notes	Relays	To Ter	To Sat	Other
Tx warning: Cannot hold/reach power set at BUC	The required BUC output power cannot be achieved. This alarm is only displayed when the modem is in terminal mode & the modem attempts to set the BUC output power by adjusting it's output level & a attenuator in the BUC. This can be caused by too much attenuation in the cross site cabling or inability to control the attenuator in the BUC (such as use of a non-Paradise BUC with no input attenuator)	D			
Tx warning: Carrier out of range.	The carrier frequency selected for the Tx carrier has exceeded the permissible range for the configured symbol rate.				CM
Tx warning: Tx symbol rate outside range.	The modems current configuration exceeds the permissible symbol rate, check the configuration.				CM

12.3 Receive Faults

Fault Text	Notes	Relays	To Ter	To Sat	Other
Rx fault: Demodulator unlocked. Check modem settings.	The demodulator cannot find a carrier to lock to at the specified frequency. Check the frequency, data rate and FEC settings. Check the demodulator by enabling IF loopback test mode.	R	TA,TC	SB	RF
Rx fault: FEC Decoder synchronization lost.	Synchronisation has been lost in the FEC decoder. Check inner FEC configuration.	R	TA,TC	SB	RF
Rx fault: Rx channel DPLL unlocked.	Consult technical support if this alarm cannot be cleared.	D			
Rx fault: Rx terrestrial DPLL unlocked.	Consult technical support if this alarm cannot be cleared.	D			
Rx fault: Physical layer sync lost.	DVB-S2 demodulator cannot detect valid DVB-S2 satellite frames (no data detected).				
Rx fault: PCMA unlocked.	Consult troubleshooting section of Paired Carrier quick start guide for list of potential causes.				
Rx fault: No GPS data, check connection.	GPS input to Paired Carrier (for calculating the delay to satellite) has failed. Check status of, and cable to, the external GPS system.				
Rx fault: Terrestrial muted due to sync loss.	This is as a result of setting the modem to mute terrestrial data on an rx loss of sync (where the data isunmuted when the Eb/no threshold is exceeded). This is used to counter an excessive number of log entries due to sun outages (scintillations) causing the demod to continuously go into and out of lock.				
Rx fault: Baseband sync lost.	This is a DVB-S2 error when valid DVB-S2 baseband frames are not detected in the DVB-S2 satellite frames. This could be due to corruption due to interference, poor signal, etc.				
Rx fault: No transport traffic.	This is a DVB-S2 alarm indicating that no valid MPEG2 transport stream packets were detected within the received DVB-S2 satellite frame.				
Rx fault: Baseband CRC error.	The received DVB-S2 satellite frame does not contain a valide baseband frame, indicating the the data has become corrupted (poor signal, interference, etc).				

12.4 Receive Warnings

Fault Text	Notes	Relays	To Ter	To Sat	Other
Rx warning: Rx data rate outside interface range.	Configuration error, data rate for terrestrial interface exceeded.				
Rx warning: The remote Eb/No has fallen below the user threshold.		D			
Rx warning: The receive Eb/No is worse than the user threshold set for the deferred alarm.		D			
Rx warning: Rx symbol rate outside range.	The modems current configuration exceeds the permissible symbol rate, check the configuration.				
Rx warning: Selected Rx output clock has failed.	The clock selected as the Receive data output clock has failed. The modem has switched to using a backup clock generated by the Rx PLL to preserve the receive traffic. This fault can only occur if the source is the same frequency as the Rx data rate (otherwise the clock is not used directly but is instead rate converted by the Rx PLL and would result in a different failure). Check which signal the PLL uses as a backup clock.	D			
Rx warning: Demodulator FIFO overflowed.	This should not occur in normal operating circumstances. Consult factory.				
Rx warning: Backward alarm at Insert MUX, indicating equipment downstream of Rx has failed.	This will only be displayed if the modem if fitted with an interface that provides four ports for separate input and output of separate Tx/Drop and Rx/Insert PCM bearers. It indicates a backward alarm has been detected at the Rx bearer input. This indicates that equipment downstream of the receive path has failed and is returning an alarm. This may be due to any receive downstream equipment, but could be due to the modem Rx output failing. Check the modem Rx path indicates OK and that the Rx data output from the modem is connected to the downstream equipment.	D			
Rx warning: Wanted Rx input power out of range.	Indicates that the wanted signal is very low or very high.				
Rx warning: Composite Rx input power out of range.	Indicates very high level of composite power.				
Rx warning: Composite to wanted power level ratio >37dBc.	Indicates very high level of composite-to-wanted power.				
Rx warning: LinkGuard interfererence over threshold.	A source of interference has been detected underneath the receive carrier that exceeds the alarm threshold set by the user. This may be degrading the received signal and should be investigated and reported to the satellite operator.				
Rx warning: Rx failed LDPC/BCH decoding.	The receiver was unable to decode the demodulated LDPC carrier successfully. This indicates either that the satellite data has become corrupted or that there is a configuration incompatibility between the encoder and decoder.				

12.5 Unit Faults

Fault Text	Notes	Relays	To Ter	To Sat	Other
Unit fault: One or more PSU rails are out of range.	A PSU line has failed. The unit has a linear supply and will fail if the mains input is below the specified minimum level. Check the mains voltage and the internal PCB-mounted low-voltage fuses.	U	TA,TC		RF, TF, CM
Unit fault: Station clock has failed. Check clock source.	A valid signal cannot be detected on the external Station clock input. Check the cable and the clock source.	U,D			
An internal fault has occurred. Please consult factory.	This indicates that the software has been unable to initialise the hardware. Power the modem down and back up to see whether this clears the problem.	U	TA,TC		TF, RF, CM
Unit fault: Rx backup clock has failed	The clock used when the selected Rx clock fails has also failed. Contact technical support for advice.	U	TA,TC		RF
Unit fault: Communications with the BUC have failed. Check connections.	Unable to communicate with the BUC, check BUC type & services are correctly configured.	U			TF
Unit fault: BUC PLL failure.	The PLL in the BUC is reporting out of lock. Check reference clock.	U			TF
Unit fault: BUC over-temperature failure.	The BUC is indicating an over-temperature fault.	U			TF
Unit fault: Modulator DPLL has lost lock.	Consult technical support if this alarm cannot be cleared	U			
Unit fault: Tx Synth has lost lock.	Consult technical support if this alarm cannot be cleared	U			TF, CM
Unit fault: Rx Synth has lost lock.	Consult technical support if this alarm cannot be cleared	U	TA,TC		RF
Unit fault (occurs initially as unit warning): Operating temperature exceeded.	This refers to the internal unit temperature, Check the modem vent slots are clear and the rear fan has not failed. This alarm is a warning beyond 60 deg C and becomes a fault at 70 deg C	U,D	TA,TC		TF,RF, CM

12.6 Unit Warnings

Fault Text	Notes	Relays	To Ter	To Sat	Other
Unit warning: One or more of the cooling fans have failed.					
Unit warning: One or more PSU rails are out of range.	One of the PSU on the redundancy switch have failed				
Unit warning: Carrier muted due to power outage. Acknowledge power-up to enable.	The Tx carrier is set to mute after a power failure. The power has failed and returned. The fault needs to be acknowledged in order to allow the carrier to be unmuted.	D			CM
Unit warning: AUPC at maximum power offset.	While attempting to maintain a constant Eb/No at the distant modem, the AUPC function has adjusted the modem power level to the maximum offset allowed. Check AUPC settings.				
Unit warning: Rental SAF features %s will expire in less than 48 hours.	Indicates that one or more SAF features (such as Paired Carrier) that have been purchased on a temporary license are about to expire. A new purchase order should be raised if the features are still required.				

12.7 Start-up Problems

Fault Text	Notes	Relays	To Ter	To Sat	Other
Unit fails to boot, due to an invalid configuration, but passes the initial built in test, proceeding to the initialising screen.	Remove the mains input lead, wait for a short period of time and then re-power the unit. As soon as the initialising screen is reached enter 1, 3, 7, and 9 using the keypad. The scrolling full stops seen after the initialising message should change to asterisks (****) and the Modem will boot. The invalid configuration will be stored to memory, entitled, deleted_date.				
Software upgrade fails or unit fails to boot.	Hold down the [main] button whilst applying power, choose the front panel menu option: [rescue], connect a PC to the top Ethernet port (IP traffic) and browse to the default IP address of the modem, 10.0.70.1, login as normal then upload the new software using the upgrade button.				

Chapter 13 Specification Summary

13.1 Common Main Specifications

Parameter	Modem
Modulation	BPSK, QPSK, OQPSK, 8PSK, 8APSK, 8QAM, 16APSK, 16QAM, 32APSK, 64QAM, 64APSK
IF Frequency Range	50 to 90MHz and 100 to180MHz
L-band Frequency Range	950 to 2150 MHz
Frequency Resolution	100Hz
Traffic Interface - Electrical	Ethernet 10/100/1000 BaseT IP Traffic on RJ45 with link and traffic indicators
Traffic Interface - Options	Optical Ethernet on small-form-factor pluggable module 4-port Ethernet switch (expansion card to enhance base modem IP capability)
User Traffic Data Rate	4.8kbps to 160Mbps
User Traffic Data Rate Resolution	1bps
DVB-S2 DVB-S2X **FastLink™**	350kbps (350ksps) to 132Mbps (37.5Msps) 100kbps (100ksps) to 160Mbps (50Msps) 4.8kbps to 100Mbps

Inner Forward Error Correction	**DVB-S2**: QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 **DVB-S2X Normal Frame:** QPSK: 13/45, 9/20, 11/20 8PSK: 23/36, 25/36, 13/18 8APSK-L: 5/9, 26/45 16APSK: 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90 16APSK-L: 5/9, 8/15, 1/2, 3/5, 2/3 32APSK: 32/45, 11/15, 7/9 32APSK-L: 2/3 64APSK: 11/15, 7/9, 4/5, 5/6 64APSK-L: 32/45 **DVB-S2X Short Frame:** QPSK: 11/45, 4/15, 14/45, 7/15, 8/15, 32/45 8PSK: 7/15, 8/15, 26/45, 32/45 16APSK: 7/15, 8/15, 26/45, 3/5, 32/45 32APSK: 2/3, 32/45 **DVB-S2X Paradise Very Short Frame:** (Frame size of 5,400 bits, reducing latency to 33% of standard DVB-S2 Short frame) QPSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 8PSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 16APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 32APSK: 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 4/5, 13/15, 14/15 **DVB-S2X Paradise Ultra Short Frame:** **(**Frame size of 3,240 bits, reducing latency to 20% of standard DVB-S2 Short frame) QPSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 8PSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 16APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 32APSK: 1/3, 4/9, 5/9, 2/3, 7/9, 8/9 **FastLink™** Low-Latency LDPC option: BPSK 0.499 (O)QPSK 0.532, 0.639, 0.710, 0.798 8PSK/8QAM: 0.639, 0.710, 0.778 16APSK/16QAM: 0.726, 0.778, 0.828, 0.851 32APSK: 0.778, 0.828, 0.886, 0.938 64QAM: 0.828, 0.886, 0.938, 0.960
IF Connector Type	BNC female
L-band connector Type	N-type female
IF Impedance	50Ω & 75Ω
L-band Impedance	50Ω
IF Return Loss	>18dB
L-band Return Loss	>15dB
Internal Frequency Reference - Ageing	<1ppm/yr
External Reference	Clocking only: 1 to 10MHz in 1kHz steps.

	Clocking and RF frequency: 10MHz, 0dBm±1dB

13.2 Tx Modulator Specifications

Parameter	Modem
IF Output Power Level	0 to –25dBm continuously variable in 0.1dB steps
L-band Output Power Level	0 to –40dBm continuously variable in 0.1dB steps
Output Level Accuracy and Stability	Accuracy: ±0.375dB; Stability: ±1dB, 0ºC to 50ºC
Transmit Filtering	Spectral roll-off factors of 5%, 10%, 15%, 20%, 25% and 35%. See the document 'Saving Satellite Bandwidth by Optimising Spectral Roll-off' (document number AN_035) from the White Papers section of http://www.paradisedata.com) for more details, including occupied bandwith calculations
Occupied Bandwidth	See referenced document AN_035 above
Recommended Channel Spacing	See referenced document AN_035 above
Phase Accuracy	±2º maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As IESS-308, IESS-316 and DVB-S2 standard, nominally 3dB better
IF Output Frequency Stability	±0.05 ppm per year
L-band Output Frequency Stability	±0.05 ppm per year
IF Harmonics	Better than –55dBc/ 4kHz in band
L-band Harmonics	Better than –55dBc/ 4kHz in band
IF Spurious	Better than –55dBc/ 4kHz in band
L-band Spurious	Better than –55dBc/ 4kHz in band
Transmit On/Off Ratio	-65dB minimum
External Transmit Inhibit	By external contact closure or by TTL signal applied to rear panel Alarms & AGC connector

13.3 Rx Demodulator Specifications

Parameter	Modem
IF Input Range	Minimum: -115+10 log (symbol rate) Maximum: -80 + 10 log (symbol rate)
L-band Input Range	Minimum: -130 + 10 log (symbol rate) Maximum: -80 + 10 log (symbol rate)
Maximum Composite signal	+10dBm
Wanted-to-composite Level	IF: -94 + 10 log (symbol rate) L-band: -102 + 10 log (symbol rate)
Frequency Acquisition Range	Selectable from ±1kHz to ±250kHz (10kHz steps)
Acquisition Threshold	<5dB Es/No QPSK
Acquisition Time	At 9.6kbps, less than 1s at 6dB Es/No. QPSK At 10 Mbps, less than 100ms at 6dB Es/No. QPSK
Clock Tracking Range	±100ppm minimum
Receive Filtering	Spectral roll-off factors of 5%, 10%, 15%, 20%, 25% and 35%. See the document 'Saving Satellite Bandwidth by Optimising Spectral Roll-off' (document number AN_035) from the White Papers section of http://www.paradisedata.com) for more details, including occupied bandwith calculations.
Performance Monitoring	Measured Eb/No (range 0-15dB, ±0.2dB). Measured Frequency Offset (100Hz resolution). Wanted signal level strength indicator centred on the middle of the Rx input range.

13.4 Clocking and Buffering Specifications

Parameter	Modem	
Clock Integrity	Frequency Locked Loops give phase-hit immune operation even with poor clock sources such as routers etc.	
Tx Clocking	Internal	±0.5ppb per day
Rx Clocking	Buffer Disable	Clock from Satellite

13.5 Framing and Deframing Specifications

Parameter	Modem
Closed Network Format	Unframed, no overhead.

13.6 BERT Option Specifications

Parameter	Modem
BER Channel	The BERT may operate through main traffic channel in non DVB-S2/S2X modes.
Test Patterns	2^{11}-1, 2^{15}-1, 2^{20}-1 and others, compatible with common standalone BER testers.
Results	Display of error count and average BER
Autolog	Automatic logging of performance parameters at regular intervals.

13.7 AUPC Specifications

Parameter	Modem
Modes of Operation	Monitor of remote Eb/No and BER only, full remote Eb/No maintenance. Unidirectional or Bi-directional operation.
User Parameters	Target Eb/No, positive power offset, negative power offset.

Modulation/FEC	FEC Rate de facto	Min Data Rate kbps	Max Data Rate Mbps
DVB-S2 QPSK	1/4	50	10.90
DVB-S2 QPSK	1/3	65.7	18.77
DVB-S2 QPSK	2/5	79	22.70
DVB-S2 QPSK	1/2	98.9	25.32
DVB-S2 QPSK	3/5	118.9	34.51
DVB-S2 QPSK	2/3	132.3	38.44
DVB-S2 QPSK	3/4	148.8	42.38
DVB-S2 QPSK	4/5	158.8	45.00
DVB-S2 QPSK	5/6	165.5	47.62
DVB-S2 QPSK	8/9	176.7	51.56
DVB-S2 QPSK	9/10	178.9	53.37
DVB-S2 8PSK	3/5	178	51.48
DVB-S2 8PSK	2/3	198.1	57.35
DVB-S2 8PSK	3/4	222.9	83
DVB-S2 8PSK	5/6	247.9	90
DVB-S2 8PSK	8/9	264.7	160
DVB-S2 8PSK	9/10	268	160
DVB-S2 16APSK	2/3	263.8	160
DVB-S2 16APSK	3/4	296.7	160
DVB-S2 16APSK	4/5	316.6	160
DVB-S2 16APSK	5/6	330.1	160
DVB-S2 16APSK	8/9	352.4	160
DVB-S2 16APSK	9/10	356.8	160
FASTLINK LOW-LATENCY LDPC: SEE SEPARATE DATASHEET			
NOTE: Maximum data rate for FastLink is 100Mbps, for low-cost DVB-S2 is 132Mbps and for DVB-S2X is 160Mbps			

13.8 Traffic Log Specifications

Parameter	Modem
Capacity	Over 6000 entries
Entry Format	Fault message with time and date stamp. Separate entry when fault clears/changes.

13.9 Common Specifications

Parameter	Modem
Test Modes	Transmit CW (Pure Carrier) Transmit Alternate 1-0 Pattern
Alarm Relays	4 Independent Change-Over Contacts: Unit Fault, Rx Traffic Fault Tx Traffic Fault, Deferred Alarm
Embedded Software	Revised embedded software may be downloaded into non-volatile memory via Ethernet port (or USB) with modem remaining in equipment rack.
Configuration Memories	>100 configurations can be stored and recalled from the front panel or remote M&C. Memories can be labeled with text string to aid identification.
User Interface	Clear and intuitive operator interface with plain English dialogue (other languages supported). Graphic display, backlit, high contrast, wide angle LCD. 17 key tactile full keyboard.
Remote Monitor and Control	Ethernet (10/100/1000 BaseT) via RJ45, embedded Web server, SNMP agent V1, V2c, V3.
Redundancy Features	1:1 redundancy controller built in. “Y” cables passively split data maintaining impedances. IF inputs/outputs are passively split/combined outside the units. Off-line unit tri-states data outputs and mutes Tx carrier. 1:N (up to 16) supported for many interface types.
Monitor	0 to 10V analogue output (Signal level, Eb/No, or Rx offset frequency) on Alarms & AGC connector
Mechanical	1U chassis, 410mm deep, excluding front panel handles and rear panel connectors and fans.
Weight	3.5 Kg
Power Supply	90 to 264VAC, 1A @100V, 0.5A @ 240V, 47 to 63Hz Fused IEC connector (live and neutral fused); 24V and 48V DC options
Safety	EN60950-1
EMC	EN55022 Class B (Emissions) EN55082 Part 1 (Immunity)
Environmental	Operating Temperature Range 0 to 50ºC
Mains data	AC Mains inrush surge current at power up = 25A @ 250V Modem uses 3.15A slow blow fuses in all cases. Maximum power consumption fully loaded is approx 105W.

	Earth leakage current is approx 2mA @250V

13.10 Internet Traffic

Parameter	Modem
Standard (unaccelerated)	Throughput depends on traffic format – formats such as UDP that do not require acknowledgements run at up to the maximum data rate of the modem – unaccelerated TCP (which requires acknowledgements) will typically run at up to 128kbps per connection, 80 Connections/Sec

13.11 BUC / LNB facilities

Parameter	Modem
BUC Power Supply Options	Mains input, +48V DC 2A output (100W) to BUC via Tx IFL Mains input, +24V DC 4A output (100W) to BUC via Tx IFL Mains input, +48V DC 3.5A output (200W) to BUC via Tx IFL Mains input, +24V DC 6A output (200W) to BUC viaTx IFL +48V DC input, +48V DC 3.5A output (180W) to BUC via Tx IFL +48V DC input, +24V DC 6A output (180W) to BUC viaTx IFL
LNB Power	+13/15/18/24V 0.5A DC to LNB via Rx IFL (standard)
FSK Control	Requires a BUC Power Supply to be fitted. Allows monitor & control of a compatible BUC from the modem, via the IFL
10MHz Reference via IFL Option	10MHz may be provided via the Tx IFL to the BUC and via the Rx IFL to the LNB. Stability is $5x10^{-8}$/yr. Level: +3dBm (+/-2dB)

13.12 Performance Graphs

For **FastLink™** low-latency LDPC, DVB-S2 and DVB-S2X, please see separate datasheet on the Teledyne Paradise Datacom web site at http://www.paradisedata.com.

Chapter 14 Glossary

ACM	Adaptive Coding and Modulation
AGC	Automatic Gain Control
ARP	Address Resolution Protocol
AUPC	Automatic Up-link Power Control
BER	Bit Error Rate
BERT	Bit Error Rate Tester
BIR	Burst Information Rate
BUC	Block Up Converter
CIR	Committed Information Rate
CRC	Cyclic Redundancy Check
CW	Continuous Wave
FEC	Forward Error Correction
LCD	Liquid Crystal Display
LDPC	Low Density Parity Code Check
IESS	Intelsat Earth Station Standard
M&C	Monitor and Control
MIB	(SNMP) Management Information Base
PUP	Paradise Universal Protocol
PLL	Phase Locked Loop
PRBS	Pseudo-Random Bit Sequence
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
Rx	Receive or Receiver
SAF	Software Activated Feature
SNMP	Simple Network Management System
Tx	Transmit or Transmitter

Chapter 15 Technical Support

Technical Support can help with:

- Queries regarding equipment operation.
- The return of equipment for upgrade or repair.
- Customer training.
- Application notes and white papers.

Contact details in Europe and North America are as follows:

Teledyne Paradise Datacom Ltd.
2&3 The Matchyns, Rivenhall End,
Witham, Essex, CM8 3HA, England.
Tel: +44(0)1376 515636
Fax: +44(0)1376 533764

Teledyne Paradise Datacom LLC
328 Innovation Blvd.
State College, PA 16803, U.S.A.
Tel: +1 814 238 3450
Fax: +1 814 238 3829

Worldwide support via email is available by filling in the Technical Support Contact Form on the Support web page at http://www.paradisedata.com, which will forward your support issues to your local Teledyne Paradise Datacom Technical Support team for your geographic area.

Repair/Return Procedure

Please refer to the equipment warranty statement for full details of returning equipment for repair or upgrade. In summary:

1. Ensure the equipment really does have a fault.

2. Write an *explicit fault report*, including what appears to be wrong, the circumstances under which it occurs and what other equipment is involved.

3. Provide an official Purchase Order to cover the cost of any repairs or sign disclaimer on the Fault Report page.

4. Outside of the UK, contact either the UK or US Teledyne Paradise Datacom offices for a Return Material Authorisation (RMA) number and information on import/export procedures. The RMA number must be quoted on all documentation and on the outside of the packaging.

   Within the UK, contact Paradise UK for an RMA number.

5. Generate the required import paperwork explicitly following the import/export procedures stated when the RMA number was given.

6. Outside of the UK, fax the paperwork to us directly and return the goods to Teledyne Paradise Datacom. Within the UK, fax the paperwork and return the goods to the Teledyne Paradise Datacom UK facility.