



TELEDYNE PARADISE DATACOM, Ltd.

A Teledyne Technologies Company

Installation and Operating Handbook for
Quantum and Evolution
Series Satellite Modems

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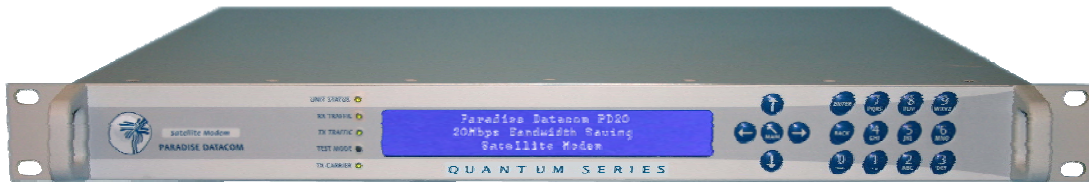
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Chapter 1 Welcome



Quantum and Evolution Series satellite modems incorporate a novel architecture that uses upgradeable programmable logic for all major modem functions, creating a flexible modem platform easily adapted to future demands. They provide a rich feature set and flexibility of configuration, allowing you to purchase only what you need initially and then enable further features in the field at a later date. They set new levels of usability by providing an unrivalled set of diagnostic tools including built-in spectrum and constellation monitors. The latest diagnostic tool is *LinkGuard™*, which monitors underneath the received carrier for interference while on traffic.

The Quantum Series of modems incorporate 100% of the functionality and features of the Evolution Series of Paradise modems and are fully backwards compatible. The Quantum extends the functionality of the Evolution by adding an optional DVB-S2 capability.

DVB-S2 is a highly efficient and robust coding and modulation standard for satellite transmission that can significantly reduce satellite bandwidth requirements compared with legacy standards.

DVB-S2 can be used in one of two ways. Firstly, DVB-S2 can be used as a service in its own right (e.g. the modem could be used to provide a DVB-S2 outbound service combined with an SCPC inbound service). Any combination of SCPC and DVB-S2 Tx and Rx services are possible including both being SCPC or both being DVB-S2. Secondly, SCPC features can be overlaid onto DVB-S2 'space segment' to provide all the functionality of traditional SCPC satellite links (such as IBS, IDR, Drop and Insert, ESC channel, AUPC, remote M&C, remote software upgrade, etc.) but with instantly reduced bandwidth requirements. This overlay capability is provided by advanced Paradise software technology called *SmartLink™*. The Quantum therefore provides a painless migration path to new, more efficient satellite communications technology while fully supporting all legacy SCPC requirements.

Paired Carrier allows space segment reuse. It overlays transmit and receive carriers in the same space segment reducing satellite bandwidth requirements by up to 50%. It is used in addition to, not instead of, other bandwidth saving techniques. It incorporates ViaSat's patented PCMA technology, which is protected under U.S. patent numbers 5,596,439, 6,011,952 and 6,725,017.

This handbook will guide you through the process of installing and using your Quantum or Evolution Series Satellite Modem. It covers all models including IF and L-band variants.

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The models covered by this handbook are:

- Paradise Datacom Evolution Series PD10 IF Satellite Modems
- Paradise Datacom Evolution Series PD10 L-band Satellite Modems
- Paradise Datacom Evolution Series PD25 IF Satellite Modems
- Paradise Datacom Evolution Series PD25 L-band Satellite Modems
- Paradise Datacom Evolution Series PD55 IF Satellite Modems
- Paradise Datacom Evolution Series PD55 L-band Satellite Modems
- Paradise Datacom Quantum Series PD20 IF Satellite Modems
- Paradise Datacom Quantum Series PD20 L-band Satellite Modems
- Paradise Datacom Quantum Series PD60 IF Satellite Modems
- Paradise Datacom Quantum Series PD60 L-band Satellite Modems

Redundancy Switch operation is documented separately – see *‘Installation and Operating Handbook for Quantum and Evolution Series Redundancy Switches’*.

The Quantum PD155i Satellite Modem/IP Router is documented in the *‘Installation and Operating Handbook for Quantum PD155i Satellite Modem/IP Router’*.

Chapter 2 About This Handbook

1.1 Conventions



This symbol is intended to alert the user to the presence of voltage levels that constitute a dangerous risk of electric shock and serious injury.



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

1.2 Trademarks

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

1.3 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 product warranty statement is provided separately to this handbook. Paradise Datacom maintains a programme of continuous product improvement and reserves the right to change specifications without prior notice.

1.4 GNU General Public License

This product contains software source code distributed under the GNU General Public License (GPL). Paradise Datacom fully acknowledges the terms of this license. If you would like a copy of the GPL source code in this product on a CD, then please send (USD) \$15.00 (along with a request for the 'Quantum/Evolution Series Satellite Modem GPL Source Code CD') to Paradise Datacom to cover the cost of preparing and mailing the CD to you.

Chapter 3 Safety Information



PLEASE READ THE FOLLOWING INFORMATION BEFORE INSTALLATION AND USE.

1.5 Safety

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 operation, please ensure that the following points are observed.

1.6 Environmental

The equipment is designed to operate in a static 19-inch rack system conforming to IEC 297-2. Operation of the equipment in transportable installations and vehicles equipped with the means of providing a stable environment is permissible. Operation of the equipment on vehicles, ships or aircraft without means of environmental conditioning may invalidate the safety compliancy. Please contact Customer Technical Support for further advice. Operation of the equipment in an environment other than that stated in the specifications will also invalidate the safety compliancy.

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

- Unpressurised altitudes greater than 2000 metres
- Extremes of temperature outside the stated operating range
- Excessive dust
- Moisture or humid atmospheres above 95% relative humidity
- Excessive vibration
- Flammable gases
- Corrosive or explosive atmospheres

1.7 Installation

The equipment is classified in EN 60950-1 as a pluggable equipment Class A for connection to the mains supply (note that a 48V DC version is also available). As such it is provided with a mains inlet cord suitable for use in the country of operation. In normal circumstances this will be of an adequate length for installation in a rack. If the mains cable proves to be too short then any replacement must have a similar type fuse (if fitted) and be manufactured to a similar specification. (For example, look for HAR, BASEC or

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HOXXX-X ratings on the cable and the connector ends marked with BS1636A (UK free plug 13 amp); BSI, VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, SETI, IMQ, SEV and KEMA-KEUR for the IEC 6 amp free socket. Schuko and North American free plugs must have similar markings.)

The installation of the equipment and the connection to the mains supply must be made in compliance with local and national wiring regulations for a Category II 'impulse over-voltage' installation. The positioning of the equipment must be such that the mains supply socket outlet for the equipment should be near the equipment and easily accessible or there should be another suitable means of disconnection from the mains supply.

The equipment is designed to operate from a TN-type power supply system as specified in EN 60950-1 (i.e. a system that has separate earth, line and neutral conductors). The equipment is not designed to operate with an IT power system that has no direct connection to earth.



This unit has double pole/neutral fusing. To ensure operator safety, fuses should always be replaced with identical type and rating – contact Customer Technical Support for details.

Chapter 4 Electromagnetic Compatibility

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

1. Emissions: EN 55022:2006 Class B – ‘Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement’.
2. Immunity: EN 50024:1998+A1:2001+A2:2003 – ‘Information Technology Equipment – Immunity Characteristics – Limits and Methods of Measurement’.

Extensive testing has been performed to ensure that the unit meets these specifications when configured with any or all of its available hardware options.



To ensure that the modem maintains compliance with electromagnetic compatibility standards please observe the following points:

The equipment must be operated with its cover on at all times. If it is necessary to remove the cover for any reason, then you must ensure that the cover is correctly refitted before normal operation.

For the baseband data interfaces, 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 30 MHz to 1 GHz. 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).

Chapter 5 Installation

1.8 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 packing materials, particularly the molded foam inserts. Should the unit need to be returned to Paradise Datacom then you should use the original packing carton as it is designed to provide the necessary level of protection during shipment.

1.9 Visual Inspection

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

1.10 Getting Started

If the unit is to be rack mounted then adequate ventilation and cooling should be provided. This must include leaving adequate clearance around the ventilation holes on the sides and the fan on the back panel.

Connect the appropriate cables to the Transmit IF and Receive IF connectors at the rear of the unit. Output power level can be controlled using the front-panel menus. The optimum input level for the demodulator is $-45\text{dBm} \pm 15\text{dB}$.

1.11 Power Up

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

For local use, from the front-panel menu, select *Main*, *Edit*, *All* to define all parameters prior to operation.

It is also possible to set up the unit from a web browser (this is described in Section 7.4). When setting up a number of units, it may be preferable to save the configuration settings of one unit and then transfer them to each of the others – this procedure is explained in Section 7.4.3.

Getting started is covered in more detail in the separate Evolution/Quantum modem Quick Start Guide (application note EVO_AN_009).

Chapter 6 Introduction

1.12 Overview

The Quantum and Evolution Series Single-Channel-Per-Carrier (SCPC) satellite modems are designed for both open and closed network operation in a variety of environments (such as ground stations and mobile and fly away terminals) providing a data link between geographically distant sites via satellite.

Features include:

- Open network Intelsat IBS to IESS-309 and IESS-310 and Intelsat IDR to IESS-308 and IESS-310, plus Eutelsat SMS to EESS 501. Closed network modes.
- DVB-S2 (EN 302 307) operation (Quantum only) including Variable Coding and Modulation (VCM) and Adaptive Coding and Modulation (ACM) modes.
- Drop and Insert (D&I) via T1-D4, T1-ESF and G.732 bearer types.
- IF frequency range of 50 to 90MHz and 100 to 180MHz; L-band frequency range of 950MHz to 2050MHz.
- Variable data rate between 4.8kbps and 100Mbps (model specific).
- Support for BPSK, QPSK, Offset QPSK, 8PSK, 8QAM, 16QAM, 16APSK, 32APSK and 64QAM modulation schemes.
- Forward Error Correction (FEC) options of Viterbi, Sequential, Trellis Coded Modulation (TCM), Turbo Product Code (TPC) and FastLink low-latency Low Density Parity Code (LDPC) as well as DVB-S2 (model specific).
- Concatenated Reed-Solomon (RS) and Bose-Chaudhuri-Hocquenghem (BCH) outer FEC (model specific).
- A full range of terrestrial interfaces including RS422, V.35, RS232, (Synchronous and Asynchronous) LVDS, HSSI, Ethernet/Internet Protocol (IP) and G.703 (T1/E1, T2/E2 and T3/E3). There is also a G.703 variant that multiplexes and demultiplexes four E1 interfaces and can be used in a MultiMux configuration, which multiplexes serial data, G.703 and IP traffic. A multiple E1 Sat-Abis interface is available for direct connection to an Abis interface between a GSM BTS and BSC, compressing voice traffic by up to 50%.
- Automatic Uplink Power Control (AUPC) automatically adjusts modem output power to maintain a constant Eb/No at the distant end of the satellite link.
- Front panel display and keypad for local control.
- Remote control through both serial and IP interfaces. IP remote control can be through a variety of methods including: built-in web pages served from the modem's embedded web server to any supported web browser; the Simple Network Management Protocol (SNMP); a standard Telnet protocol session where the user communicates using a Telnet client terminal-emulation program.
- Compact 1U chassis, 405mm deep.
- An extensive set of TCP/IP features including TCP acceleration, header and payload compression, web acceleration, bridging, static and dynamic routing, DHCP, IEEE 802.1p QOS support, IEEE 802.1q VLAN support, traffic shaping, ACM, IPV6, etc. Includes support for dual IPV4/IPV6 operation. Support for IPV6 includes bridging, routing and embedded web server along with entry/display of IPV6 addresses on user interface.

1.13 Hardware Options

Note that an EIA530 card providing selectable RS422, X.21, V.35 and RS232 interfaces via a 25-way D connector is fitted as standard.

Three interface positions are available. The upper interface position (1) supports an EIA530 or an IDR card only. The lower interface position (2) supports any card except IDR. Interface position (3) supports unbalanced G.703 (two BNCs) only. Balanced G.703 is available via the EIA530 card in either interface position 1 or position 2.

1.13.1 IDR Option Card

The IDR option card (part number P3701) provides an IDR capability including two 32kbps ADPCM ESC audio channels, multiple backward alarm support and independent ESC and Auxiliary ports that replace the shared ESC/Aux port on the base unit. The IDR card fits in interface position 1 (upper) at the rear of the modem.

1.13.2 G.703 Option Card

The G.703 option card (part number P3702) provides G.703 E1/T1, E2/T2 and E3/T3 support. The G.703 card fits inside the modem (leaving both interface positions 1 and 2 free) and makes use of either the EIA530 connector in interface position 1 or 2 for balanced signals or BNC connectors (interface position 3) for unbalanced signals.

1.13.3 LVDS Option Card

The LVDS option card (part number P3001) provides LVDS on a D25 female connector. The LVDS card fits in interface position 2 (lower) at the rear of the modem.

1.13.4 HSSI Option Card

The HSSI option card (part number P3705) provides the modem with a High Speed Serial Interface with an industry standard 50-way SCSI-2 type DCE connector, supporting data rates of up to 55Mbps. The HSSI card fits in interface position 2 (lower) at the rear of the modem.

1.13.5 Quad E1 Option Card

The Quad E1 option card (part number P3706) supports four synchronous G.703 HDB3-encoded balanced RJ45 interfaces. Drop and insert of up to 32 timeslots is provided on all four interfaces, alternatively full E1 bearers are also supported.

The combination of drop and insert plus full bearers allows any data rate to be selected between 64kbps and 8448kbps in multiples of 64kbps. The data is multiplexed onto a single carrier using either an IBS/SMS frame format (overhead 6.7%) or

Closed/Closed+ESC frame format (overhead < 0.5%) that ensures extremely efficient use of satellite bandwidth with no bandwidth being wasted at any data rate.

The Quad E1 card is set up and used in a similar way to the G.703 option card. Following selection of the Quad E1 card as the terrestrial interface via the *Edit-Unit-Interface-Terrestrial* screen (Section 7.3.3.3.2), two menus (*Edit-Tx-Interface*, Section 7.3.3.1.8 and *Edit-Rx-Interface*, Section 7.3.3.2.9) can be used to set up the Tx and Rx paths, respectively, of each port of the Quad E1 card.

The P3706 Quad E1 interface card not only provides all the above functionality, but if the MultiMux (*Mux SAF*) feature has also been purchased and enabled, then G.703, serial data and IP traffic may be multiplexed together to form one aggregate satellite carrier. Multimux is explained in a separate document 'Multimux Data Multiplexer Option' (application note 205348) available in the modem documentation area of <http://www.paradisedata.com>. It allows up to two E1s to be amalgamated with up to 2Mbps of IP and up to 2Mbps of EIA530 onto a single carrier. Up to three E1s can be used if amalgamating only one of IP or EIA530. MultiMux can also be used without any E1s.

1.13.6 Eurocom D1 Option Card

There are two versions of the Eurocom option card.

The P300-compatible Eurocom D1 option card (part number P3709) provides a Eurocom D interface, data rates of 16 to 2048kbps, AMI coding, Eurocom G interface at 16 or 32kbps on a 25-pin D male connector.

The Eurocom D1/EIA530 option card (part number P3713) provides Eurocom D interface, data rates of 16 to 2048kbps, Eurocom G interface at 16 or 32kbps as well as EIA530 signals on the same connector, supporting RS422, X.21, V.35, RS232 and balanced G.703. It uses a 25-pin D female connector.

1.13.7 IP Traffic Option Card

An Ethernet traffic interface is always available on the base modem as detailed in Section 6.5. This provides a basic level of IP operation (typically it can handle up to 5Mbps of UDP data or 10Mbps of TCP data).

For more demanding applications, the IP Traffic option card (part number P3714) supports TCP acceleration up to the maximum data rate for the modem (compared to the base modem acceleration of up to 10Mbps) via two RJ45 Ethernet 10/100/1000 (GigE) BaseT connectors. The card supports up to 5000 concurrent TCP connections and typically achieves bandwidth utilization of around 90%. It also supports HTTP acceleration, which downloads typical web pages up to 30% faster on average.

The P3714 IP Traffic card can handle up to 50 000 packets per second, compared to the IP processing built into the base modem, which has a limit of 10 000 packets per second). Please note that the P3714 IP Traffic card is in the process of being replaced by the P3716 IP Traffic card, which has two to three times the processing capability.

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The IP Traffic card automatically selects speed and duplex but these can also be controlled via the menus.

Bridging, static routing and dynamic routing are all supported on both the base modem or the IP traffic card, depending on what is fitted.

On the IP Traffic card, UDP and IP header compression compliant to RFC3095 (ROHC – Robust Header Compression) is supported at throughput rates up to 29000 packets per second. ROHC is recognised as the best performing of all header compression schemes (including IPHC and CRTP) and is the most suitable for satellite. It typically compresses the 28 bytes of UDP and IP headers down to between one and three bytes. Proprietary Ethernet header compression is supported in addition and typically reduces 14 bytes of Ethernet frame down to 1 byte.

IP payload compression is provided (compliant to RFC 1951 'DEFLATE') and compresses TCP and UDP packet payloads by typically 50%. It must be used with TCP acceleration and/or header compression.

Note that the IP Traffic card is dedicated to processing IP satellite traffic only – remote IP-based M&C, including SNMP and access to the modem web server, continue to be supported via the base modem RJ45 M&C connector only.

Note also that all Evolution/Quantum satellite modems support a dual IPV4/IPV6 TCP/IP stack on both the base modem and the IP Traffic card. IPV4/IPV6 bridging and routing are supported and the modem's embedded web server is also IPV4/IPV6 compliant. Modem IP addresses and static routes can be entered and displayed in either IPV4 or IPV6 format.

1.13.8 Optional L-band BUC Power Supplies

The following PSU options are available for powering BUCs:

Part Number	BUC PSU	Type
P3531	100W 48V output	A.C. in/D.C. out
P3535	200W 48V output	A.C. in/D.C. out
P3532	100W 24V output	A.C. in/D.C. out
P3536	200W 24V output	A.C. in/D.C. out
P3537	+/-48V input, 180W 48V output	D.C. in/D.C. out
P3538	+/-48V input, 180W 24V output	D.C. in/D.C. out
P3539	+48V input, 180W 48V output	D.C. in/D.C. out

Optional BUC Power Supplies

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The following table specifies Paradise BUC PSUs for a range of available BUC types.

Manufacturer & BUC Type	PSU Required			Paradise ODU PSU	
	Voltage	Wattage	Current	24V	48V
Paradise 10W C-band VSAT BUC	24V	120	5A	P3536	-
	48V	120	2.5A	-	P3535
Paradise 20W C-band VSAT BUC	24V	144	6A	P3536	-
	48V	144	3A	-	P3535
Paradise 25W C-band vBUC	24V	173	7.2A	P3536	-
	48V	173	3.6A	-	P3535
Paradise 10W X-band vBUC	24V	100W	4.2A	P3532	-
	48V	96W	2.0A	-	P3531
Paradise 10W Ku-band vBUC	24V	149W	6.2A	P3536	-
	48V	144W	3.0A	-	P3535
Paradise 10W Ka-band vBUC	24V	-	-	-	-
	48V	192	4.0A	-	P3535
Terrasat 5W C-band IBUC	24V	72	3A	P3532	-
	48V	72	1.5A	-	P3531
Terrasat 10W C-band IBUC	24V	108	4.5A	P3536	-
	48V	96	2A	-	P3535
Terrasat 4W Ku-band IBUC	24V	72	3A	P3532	-
	48V	72	1.5A	-	P3531
Terrasat 8W Ku-band IBUC	24V	120	5A	P3536	-
	48V	120	2.5A	-	P3535
NJR 1W C-band 5665 & 5666	24V	30W	-	P3532	-
NJR 2W C-band 5667 & 5668	24V	37.5W	-	P3532	-
NJR 5W C-band 5669 & 5670	24V	55W	-	P3532	-
NJR 10W C-band 5662 & 5663	24V	130W	-	P3536	-
	48V	130W	-	-	P3535
NJR 1W Ku-band 5015	24V	25W	-	P3532	-
NJR 1W Ku-band 5075	24V	18W	-	P3532	-
NJR 1.5W Ku-band 5035	24V	24W	-	P3532	-
NJR 2W Ku-band 5076 & 5016	24V	37.5W	-	P3532	-
NJR 3W Ku-band 5037	24V	30W	-	P3532	-
NJR 4W Ku-band 5077 & 5017	24V	48W	-	P3532	-
NJR 8W Ku-band 5018	24V	170W	-	P3536	-
	48V	170W	-	-	P3535
Codan 5W C-band 6705	24V	60W	-	P3532	-
	48V	60W	-	-	P3531
Codan 10W C-band 6710	48V	105W	-	-	P3535
Codan 20W C-band 6720	48V	130W	-	-	P3535
Codan 4W Ku-band 6904	24V	80W	-	P3532	-
	48V	80W	-	-	P3531
Codan 8W Ku-band 6908	48V	115W	-	-	P3535

Paradise BUC Power Supplies

1.13.9 L-band FSK/DC Option Card

An FSK/DC option card (part number P3503) is available for performing FSK communications with a BUC. This allows remote monitoring and control of any compatible BUC via a modulated FSK signal on the IFL cable to the BUC. The card also provides a DC supply switching capability to the BUC. If FSK communications are not required, then a cheaper option card, namely, the DC Switch card (part number P3509) is available.

1.14 Software Options

There are a number of software options available as shown in the table below. These can be ordered at the time of the original purchase or can be activated in the field. The mechanism that provides access to these features is called Software Activated Features (SAF) – the SAF concept (including time-limited free access to all features) is explained in Section 8.5.

In the table, the *SAF Code* column lists the acronyms by which each feature is referred to in relation to the modem user interfaces, technical datasheets, etc.

Note that the following are provided as standard in the modem: Tx, Rx, DR0, DR1, IRS, VIT, WIF, AUPC, HCP and ESC.

Feature	SAF Code	Description
Transmit	TX	Controls access to the Tx service (required for any transmission to occur).
Receive	RX	Controls access to the Rx service (required for any receive processing to occur).
Terrestrial data rate 0 to 2048kbps	DR0	Enables data rates in the given range (inclusive).
Terrestrial data rate 2048kbps to 10Mbps	DR1	Deprecated. Enables data rates in the given range (inclusive).
Terrestrial data rate 2048kbps to 5Mbps	D1L	Enables data rates in the given range (inclusive).
Terrestrial data rate 5Mbps to 10Mbps	D1H	Enables data rates in the given range (inclusive).
Terrestrial data rate 10Mbps to 16896kbps	DR2	Enables data rates in the given range (inclusive).
Terrestrial data rate 16896kbps to 25Mbps	DR3	Enables data rates in the given range (inclusive).
Terrestrial data rate 25Mbps to 45Mbps	DR4	Enables data rates in the given range (inclusive).
Terrestrial data rate 45Mbps to 55Mbps (Evolution PD55) or 60Mbps (Quantum PD60)	DR5	Enables data rates in the given range (inclusive).

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Feature	SAF Code	Description
IBS/SMS	IBS	Enables Tx and Rx IBS/SMS service.
Drop/Insert	DI	Enables basic transmit and receive T1/E1 Drop/Insert options including Rx terrestrial bearer origination and the ability to replace dropped timeslots with idle code.
Extended Drop/Insert	EDI	Enables selection of extended Tx and Rx Drop/Insert options (processing of E1 Channel Associated Signalling in timeslots 16 and 48, timeslot identity maintenance allowing all possible number of timeslots, partial timeslot insertion, T1 Robbed Bit Signalling and timeslot reordering).
Viterbi	VIT	Enables the Viterbi FEC scheme.
Intelsat RS	IRS	Enables the selection of the Intelsat Reed-Solomon outer FEC.
Wideband IF	WIF	Enables selection of IF frequencies between 104 and 176MHz.
8PSK	8PSK	Enables selection of 8PSK modulation.
16QAM	16QAM	Enables selection of the 16QAM FEC scheme.
Turbo Low Rate	TPCL	Enables selection of the TPC FEC scheme at terrestrial data rates up to and including 10Mbps.
Turbo High Rate	TPCH	Enables selection of the TPC FEC scheme at all terrestrial data rates.
Advanced ESC	ESC	Enables selection of the high-rate asynchronous ESC channel in IBS/SMS mode and asynchronous ESC access to the IDR 8kbps synchronous ESC channel, as well as enabling selection of Closed network plus ESC mode.
Advanced Aux	AUX	Enables the replacement of one or both IDR 32kbps ADPCM audio channels with Aux data.
Custom features	CUS	Enables custom RS N, K and interleaver depth selection; selection of IBS/SMS high-rate asynchronous ESC maximum overhead usage mode; custom selection of IDR framing (high/low rate) format; customisation of the standard 96kbps IDR overhead to allow one or both audio channels to be omitted or allocated in a custom manner (allowing: 1x32k in V1 or 2x16k in V1 with V2 spare or omitted depending on Aux settings; both V1 and V2 spare or omitted depending on Aux settings).
AUPC	AUPC	Enables AUPC operation (additionally requires ESC feature). Note that P300 emulated AUPC requires PAUPC SAF to be present.
PRBS	PRBS	Enables the internal Pseudo Random Bit Sequence (PRBS) Bit Error Rate (BER) tester.
FSK control	FSK	Enables remote control of a BUC via an FSK modulated signal multiplexed onto the IF cable.

Software Activated Features (continued)

Quantum and Evolution Series Installation and Operating Handbook

Feature	SAF Code	Description
TCP acceleration at throughput rates up to 10Mbps	TCP	Enables a Performance Enhancing Proxy that provides acceleration of TCP data over satellite.
Ethernet brotting	BRT	Enables Ethernet brotting function (which supports IP traffic point-to-multipoint operation and the use of an indirect return path).
OM-73	OM73	Enables the OM-73 service including the OM-73 scrambler, symbol mapping and Viterbi compatibility.
Audio	AUD	Enables P1348 emulation via the IDR card that allows IBS 64kbps carrier (2 audio channels) or 128kbps (2 audio and 64kbps data).
TCM	TCM	Enables the TCM FEC scheme. This feature is provided with 8PSK.
TCP acceleration at throughput rates up to 16Mbps	TCP16	Enables a Performance Enhancing Proxy that provides acceleration of TCP data over satellite. This level of acceleration is available only with the IP Traffic option card.
TCP acceleration at throughput rates up to 25Mbps	TCP25	Enables a Performance Enhancing Proxy that provides acceleration of TCP data over satellite. This level of acceleration is available only with the IP Traffic option card.
TCP acceleration to 55Mbps (Evolution PD55) or 60Mbps (Quantum PD60)	TCP55	Enables a Performance Enhancing Proxy that provides acceleration of TCP data over satellite. This level of acceleration is available only with the IP Traffic option card.
Quad E1 option card second E1 port	2E1	Enables the second E1 port on the Quad E1 option card.
Quad E1 option card third E1 port	3E1	Enables the third E1 port on the Quad E1 option card.
Quad E1 option card fourth E1 port	4E1	Enables the fourth E1 port on the Quad E1 option card.
Header compression	HCP	Enables Ethernet frame header compression on the base modem.
Header compression	HCP2	Enables Ethernet, UDP, IP and RTP packet header compression at one-way throughput rates up to 29000 packets per second. This is available only with the IP Traffic option card.
MultiMux	MUX	Enables the multiplexer associated with the Quad E1 card allowing G.703 data, serial data and IP to be multiplexed together into one aggregate satellite carrier. Serial and IP data nominally replace Quad E1 ports 3 and 4 (it is <i>not</i> necessary to purchase the 3E1 and 4E1 SAFs in order to use MultiMux).

Software Activated Features (continued)

Quantum and Evolution Series Installation and Operating Handbook

Feature	SAF Code	Description
Web acceleration	WEB	Enables accelerated browsing using HTTP (requires the modem to be fitted with a P3714 IP traffic card).
Sequential FEC	SEQ	Enables Sequential FEC up to a maximum of 2Mbps.
Wideband L-band	WRF	Deprecated since now provided as standard. Enables selection of additional L-band frequencies between 1950MHz and 2050MHz.
IP terrestrial	IPT	Enables IP Terrestrial base modem interface for PD10/PD10L modem (enabled by default in all other modems).
Clock extension	CLK	When enabled provides a high stability timing reference to the distant end of a satellite link (potential replacement for GPS).
LDPC FEC	LDP5	Deprecated (replaced by FastLink LDPC). Enables conventional LDPC FEC scheme to a maximum data rate of 5Mbps.
LDPC FEC	LDP10	Deprecated (replaced by FastLink LDPC). Enables conventional LDPC FEC scheme to a maximum data rate of 10Mbps.
LDPC FEC	LDP25	Deprecated (replaced by FastLink LDPC). Enables conventional LDPC FEC scheme to a maximum data rate of 25Mbps.
LDPC FEC	LDP55	Deprecated (replaced by FastLink LDPC). Enables conventional LDPC FEC scheme to a maximum data rate of 55Mbps (Evolution PD55) or 60Mbps (Quantum PD60).
Adaptive signal pre-distorter	ASP	Allows 16QAM constellations to be adaptively predistorted to counter the effects of nonlinear distortion in the communications path.
Dynamic routing	RTG	Enables choice of RIP, OSPF and BGP dynamic routing. (Static routing provided as standard.)
DVB-S2 Tx	DVB2T	Enables DVB-S2 Tx operation (includes SmartLink).
DVB-S2 Rx	DVB2R	Enables DVB-S2 Rx operation (includes SmartLink).
DVB IP	DVBIP	Enables MPE, ULE and (Paradise proprietary) PXE DVB-S2 over IP encapsulation (requires P3714 IP Traffic card).

Software Activated Features (continued)

Quantum and Evolution Series Installation and Operating Handbook

Feature	SAF Code	Description
IP traffic shaping	SHP	Provides guaranteed throughput levels for specific IP streams, using standard Committed Information Rate and Burst Information Rate settings. Stream differentiation is by IP address, IEEE 802.1p priority class, Diffserv DSCP class or MPLS EXP field.
Paired Carrier data rate 56kbps to 512kbps	PCMA	Enables Paired Carrier data rates in the given range (inclusive). Incorporates ViaSat's patented PCMA technology. Subject to a minimum of 30kHz of signal cancellation in terms of occupied bandwidth.
Paired Carrier data rate 512kbps to 1.024Mbps	PCMB	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 1.024Mbps to 2.5Mbps	PCMC	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 2.5Mbps to 5Mbps	PCMD	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 5Mbps to 10Mbps	PCME	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 10Mbps to 15Mbps	PCMF	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 15Mbps to 20Mbps	PCMG	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 20Mbps to 25Mbps	PCMH	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 25Mbps to 30Mbps	PCMI	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 30Mbps to 40Mbps	PCMJ	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 40Mbps to 50Mbps	PCMK	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 50Mbps to 60Mbps	PCML	Enables Paired Carrier data rates in the given range (inclusive).
Paired Carrier data rate 60Mbps to 80Mbps	PCMM	Enables Paired Carrier data rates in the given range (inclusive).

Software Activated Features (continued)

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Feature	SAF Code	Description
Paired Carrier data rate 80Mbps to 100Mbps	PCMN	Enables Paired Carrier data rates in the given range (inclusive). Subject to a maximum of 36MHz of signal cancellation in terms of occupied bandwidth.
Paired Carrier data rate 100Mbps to 155Mbps	PCMO	Reserved for future use.
FastLink LDPC data rate 4.8kbps to 1Mbps	FL1	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 1Mbps to 2.5Mbps	FL2	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 2.5Mbps to 5Mbps	FL3	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 5Mbps to 10Mbps	FL4	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 10Mbps to 20Mbps	FL5	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 20Mbps to 25Mbps	FL6	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 25Mbps to 55Mbps (Evolution PD55) or 60Mbps (Quantum PD60)	FL7	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink LDPC data rate 60Mbps to 155Mbps (Quantum PD155i only)	FL8	Enables FastLink low-latency LDPC data rates in the given range (inclusive).
FastLink 8QAM	8QAM	Paradise proprietary 8QAM implementation, optimized for use with FastLink low-latency LDPC.
FastLink 16APSK	16APSK	16APSK implementation, optimized for use with FastLink low-latency LDPC. (Note that this SAF is <i>not</i> required when using 16APSK with DVB-S2.)
FastLink 32APSK	32APSK	32APSK implementation, optimized for use with FastLink low-latency LDPC.
FastLink 64QAM	64QAM	64QAM implementation, optimized for use with FastLink low-latency LDPC.

Software Activated Features (continued)

Quantum and Evolution Series Installation and Operating Handbook

DVB-S2 ACM data rate 50kbps to 2Mbps	ACM1	Enables DVB-S2 ACM feature in Tx to the specified data rate. (Note that DVB-S2 ACM Rx is free of charge, subject to modem supporting DVB-S2 Rx.)
DVB-S2 ACM data rate 2Mbps to 5Mbps	ACM2	Enables DVB-S2 ACM feature in Tx to the specified data rate.
DVB-S2 ACM data rate 5Mbps to 10Mbps	ACM3	Enables DVB-S2 ACM feature in Tx to the specified data rate.
DVB-S2 ACM data rate 10Mbps to 20Mbps (Quantum PD20) or 25Mbps (Evolution PD25)	ACM4	Enables DVB-S2 ACM feature in Tx to the specified data rate.
DVB-S2 ACM data rate 20Mbps (Quantum PD20) or 25Mbps (Evolution PD25) to 60Mbps (Quantum PD60) or 55Mbps (Evolution PD55)	ACM5	Enables DVB-S2 ACM feature in Tx to the specified data rate.
DVB-S2 ACM data rate 60Mbps to 100Mbps	ACM6	Enables DVB-S2 ACM feature in Tx to the specified data rate.
DVB-S2 ACM data rate 100Mbps to 155Mbps	ACM7	Enables DVB-S2 ACM feature in Tx to the specified data rate.
Adaptive equalizer	RADEQ	Receive adaptive equalizer for FastLink SCPC operation. Implements a 9-tap filter that removes inter-symbol interference caused by group delay at the edges of transponders, allowing higher throughput on the transponder.
Terrestrial data rate 60Mbps to 155Mbps	DR6	Enables data rates in the given range (inclusive).
IP payload compression	DC	Enables TCP and UDP payload compression compliant to RFC 1951 ('DEFLATE').

Software Activated Features

1.15 Front Panel



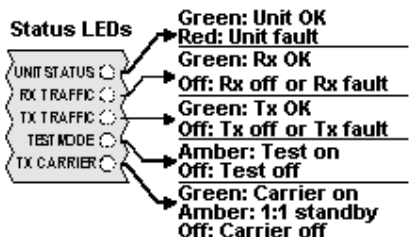
Modem Front Panel

The front panel comprises:

- LEDs (light emitting diodes) that provide basic modem status
- A LCD (liquid crystal display) display that acts as the main user interface
- A keypad for alphanumeric entry and menu selection.

1.15.1 LEDs

The five LEDs display warning and fault information as shown below.




	Off	Red	Amber	Green
Unit Status	<i>Not used</i>	Unit fault	<i>Not used</i>	Unit OK
Rx Traffic	Rx fault or Rx disabled	<i>Not used</i>	<i>Not used</i>	Rx OK
Tx Traffic	Tx fault or Tx disabled	<i>Not used</i>	<i>Not used</i>	Tx OK
Test Mode	Normal mode	<i>Not used</i>	Test mode	<i>Not used</i>
Tx Carrier	Carrier muted	<i>Not used</i>	1-for-1 standby	Carrier active

Front Panel LED Status

1.15.2 LCD Display

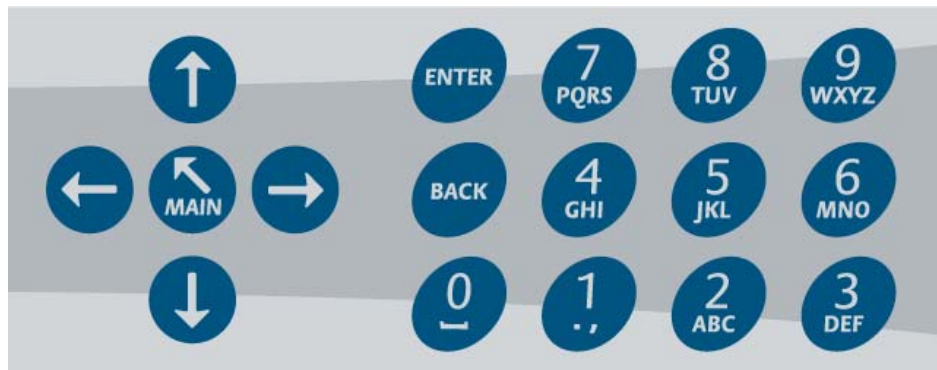
The backlit LCD is a graphical display formatted to give three lines of 40 text characters and is highly legible even in strong ambient light. The right hand side of the display is reserved for icons that indicate status information pertinent to keypad operation. These icons are listed below. The contrast is adjustable and the backlight can be switched off or on.

Local (front panel) control	LOC
Remote control	REM
Keyboard locked	
Help screen	?
Numeric entry mode	123
Alphabetic entry mode	Abc
Modem is on a Tx Edit screen	Tx
Modem is on an Rx Edit screen	Rx

Front Panel LCD Icons

1.15.2.1 Keypad

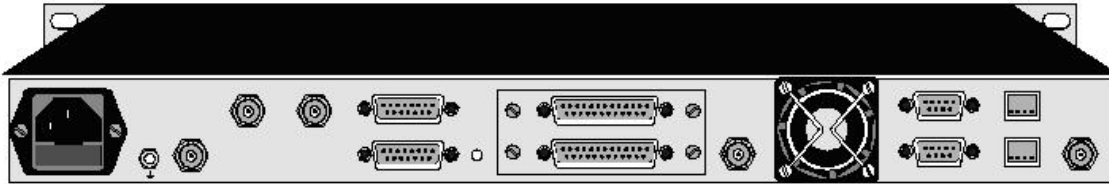
The keypad (see the diagram below) is based on a sealed tactile membrane and allows full alphanumeric entry and navigation using arrow keys.



Front Panel Keypad

1.16 Rear Panel

The rear panel, shown below, provides a full set of terrestrial and satellite data interfaces.



Modem Rear Panel

Full connector pinouts are given in Chapter 11. 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 100-240V (-10%/+6%, i.e. 90V to 254V at the connector), 1 - 0.4A, 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. ALWAYS REPLACE THE FUSE WITH ONE OF THE SAME TYPE AND RATING.

Chassis Ground Stud

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

Tx IF Output Option

This connector is a BNC female and can be used in either 50 Ω or 75 Ω -impedance mode. The output power level can be varied from 0dBm to -25dBm.

G.703 BNCs

Two optional BNC connectors may be fitted. These provide an unbalanced G.703 interface.

Tx L-band Output Option

This connector is an N-type female and is of 50 Ω impedance. The output power level can be varied from -5dBm to -30dBm.

Alarms and AGC Connector

This is a 15-pin male 'D' type connector that provides access to the four form 'C' relay contacts that indicate alarm conditions. There is also an AGC output.

The alarm relays have the following default definitions:

Unit Fault: A unit fault exists, i.e. an equipment failure.

Tx Traffic Prompt: Tx traffic fault exists.

Rx Traffic Prompt: Rx traffic fault exists.

Deferred Alarm: One of the following conditions exists:

- The receive BER is greater than the user defined threshold.
- The receive Eb/No is lower than the user defined threshold.
- Buffer slips are more frequent than the user set threshold.
- A backward alarm is being received from either the satellite or terrestrial ports.

Async ESC Connector

This is a 15-pin 'D' female connector. When the IDR option is *not* fitted, it provides an RS232/RS422/RS485 asynchronous port for either the high rate Async ESC facility (for IBS/SMS or Closed Net Plus ESC services) or the IBS/SMS 'low rate Intelsat oversampled ESC facility' (which is configured as the Aux data channel on the modem). When the IDR option is fitted, separate ports for the ESC and Aux channels on the IDR card are activated and ESC/Aux access on this async connector is disabled. This connector also provides the input port for an RS422-compatible Station Clock.

On-line LED

This LED mirrors the front panel Tx Carrier LED, so that from the rear of the equipment the operator can tell if the carrier is off and which unit of a 1:1 pair is the offline unit.

Terrestrial Interface Connectors

There are two terrestrial interface connector positions. Supported interface cards include EIA530, LVDS, balanced G.703 (unbalanced G.703 is provided via a third interface position), HSSI, Quad E1, IP Traffic and Eurocom D1.

The IDR option is fitted in the upper interface position with the terrestrial interface in the lower position.

If the G.703 option is fitted, then balanced G.703 supporting T1, E1, T2, E2, T3 and E3 modes is available. Balanced-operation T1(1544kbps, 100Ω), E1 (2048kbps, 120Ω) and T2 (6136kbps, 110Ω) is provided on the EIA530 'D' type connector when G.703 is selected in addition to RS422, V.35 and RS232 EIA530 modes. Unbalanced-operation E1 (2048kbps, 75Ω), T2 (6136kbps, 75 Ω), E3 (34376kbps, 75Ω) and T3 (44376kbps, 75Ω) requires the use of the two BNC connectors in interface position 3. The line impedance and all other parameters are selected via software. The software also selects what happens to the G.703 port when power is removed. Either the G.703 ports can be set to go high impedance (used in 1:1 redundancy operation) or they can be configured to loop the G.703

input back to the output (typically used when Drop/Insert is in operation and the same PCM bearer is cascaded through several modems).

ESC and Aux Connector

This connector is fitted as part of the IDR option and provides access to:

- Four backward alarm form 'C' outputs and four backward alarm inputs, together with an Rx summary alarm signal for direct connection to the backward alarm inputs. These are used in IDR mode.
- Two audio ESC ports (4-wire 600Ω, +7 to -16dBm). In addition to normal IDR ESC operation these ports may also be used in IBS modes to generate a 64kbps IBS carrier comprised of two 32kbps ADPCM audio channels or a 128kbps IBS carrier comprised of 64kbps data (from the main data interface of the modem) plus two 32kbps ADPCM audio channels. This is an emulation of the most popular modes of the P1348/P1448 voice/data MUX card often used in SNG applications.
- An RS232/RS422/RS485 port for synchronous/asynchronous ESC traffic. This port replaces the shared ESC/Aux access via the Async ESC connector on the main unit. It is used to provide access to the 8kbps synchronous IDR ESC channel. If the Async ESC feature is available then this port provides both asynchronous access to the 8kbps channel and a high rate asynchronous ESC in IBS/SMS and Closed network plus ESC services.
- An RS232/RS422 port for synchronous/asynchronous Aux traffic. This port replaces the shared ESC/Aux access via the Async ESC connector on the main unit. The Aux port provides 32 or 64kbps access to the IDR overhead in place of one or both of the IDR 32kbps ADPCM audio ESC channels. In IBS/SMS, this port may be configured to provide either the IBS 'low rate INTELSAT oversampled ESC facility' or a higher rate synchronous channel within the IBS/SMS overhead.

Rx IF Input Option

This is a BNC female connector and can be used in either 50Ω or 75Ω impedance mode. The carrier signal level presented at the input of the modem should be in the range -60dBm to -30dBm. A level of -45dBm is recommended. The maximum composite power level that should be applied to this port is 30dB above the desired carrier, up to a maximum of 0dBm.

Rx L-band Input Option

This is an N-type female connector of 50Ω impedance. The carrier signal level presented at the input of the modem should be in the range -20dBm to -70dBm. A level of -45dBm is recommended. The maximum composite-to-wanted power level that can be applied to this port with no implementation loss is +35dBc, with a maximum composite power level of +10dBm.

Fan

There is a fan that runs at all times while the unit is powered. This draws air in from the sides and expels to the rear. The side vents must not be blocked.

1:1 Redundancy Connector

The Modem has a built-in 1-for-1 redundancy-controller that connects to the corresponding port of another modem via a 9-pin male 'D' type connector. A 1:1 redundancy system requires two modems, a 1:1 control cable between the two redundancy connectors, a data

split ('Y') cable and passive splitters/combiners for the IF ports. An overview of 1-for-1 operation is provided in Section 8.4.

Remote M&C Connector

This is a 9-pin female 'D' type connector. The modem supports the Paradise Universal Protocol (PUP) as specified in the document '*Remote M&C Specification for Quantum and Evolution Series Satellite Modems*'. The electrical interface can be selected between RS232 (for direct-to-PC applications) and RS485 (for multidrop applications). The Remote M&C port may be linked under software control to the Async ESC port for distant end remote M&C control over satellite.

Ethernet IP and M&C Connectors

There are two RJ45 auto-sensing 10/100Mbps Ethernet connections. These support both half-duplex and full-duplex operation. One of these can be switched to the main modem traffic channel for sending and receiving TCP/IP data over satellite, while the other is for remote M&C. 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. Although the two connectors are labelled for IP traffic and remote M&C respectively, they are in fact interchangeable since the modem acts as an Ethernet bridge (satellite IP traffic and modem M&C messages can use the same single connector if preferred). It is also possible to change the configuration so that the M&C port is removed from the bridge, which may benefit security in some circumstances where it is important to separate the M&C and IP traffic streams.

An M&C IP address, subnet mask and default gateway may be set in the modem. When using TCP acceleration and the M&C interface does not form part of the Ethernet bridge, then a traffic IP address must be set in addition. Note that the modem is not configured for auto-sense of the cable type and consequently either a straight or crossover (patch) cable may be required, depending on the equipment being connected (typically a straight cable is required when connecting direct to a PC and a crossover cable is required when connecting to a hub or switch). Setting up IP addresses is covered in more detail in Section 8.12.

Station Clock

This connector is a 75Ω BNC female that accepts a 1-10MHz signal, either a square wave of >1V p/p (e.g. a G.703 para. 10 'synchronising clock') or a sinusoid at a power level of 0dBm or greater. An alternative Station Clock signal at RS422 interface levels can be applied to the Async ESC connector. Either signal can be used by the modem as a reference for the receive output clock (the Station Clock does not have to be the same rate as the data as an internal PLL converts between rates). In addition, if the Rx Clocking is set to use the Station Clock and the Tx Clocking is set to Rx, then the Station Clock also sources the internally generated Tx Clock (Tx and Rx data rates are independent). If a 10MHz signal is applied, this signal may also be used in place of the internal reference for the Tx and Rx IF synthesisers.

Chapter 7 User Interfaces

The modem has the following user interfaces:

- A built-in local user interface provided via the modem front panel.
- A built-in remote web user interface that provides web pages from the modem (using a web server) to a web browser.

There are also serial and Ethernet remote control interfaces that allows the built-in interfaces to be replaced or supplemented by an alternative means of modem control. These use a proprietary command protocol called the Paradise Universal Protocol (PUP). This can be used either directly over a serial RS232 or RS485 interface (e.g. via a HyperTerminal session) or via Ethernet (e.g. via a Telnet session). The Simple Network Management Protocol (SNMP) v1, v2c and v3 are also supported.

1.17 User Names, Passwords and Modem Control

The modem can be controlled by either a local user via the local front panel, or a remote web user. In addition, a remote user can either have full control over the modem or be restricted to viewing modem information. Access to the modem is controlled by passwords. These concepts are explained in the following sections.

1.17.1 Local Mode

On shipping from the factory, the modem defaults to Local mode, which allows control of the modem from the front panel interface only. Web users can, however, log in and view the modem settings while the modem is in Local mode.

Note that SNMP is disabled by default and therefore cannot be used as an alternative method of remote control until it is enabled. *When SNMP is enabled, then SNMP commands are always obeyed regardless of any user arbitration that is active within the modem* – this point should be taken into account when adding new control facilities to those already built into the modem.

1.17.2 Giveaway Mode

When the modem is switched to Giveaway mode, a remote web user may assume control of the modem.

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 two passwords associated with these two user names.

Only one remote *admin* user can be logged in to the modem at any time but multiple users can be logged in as *user* at the same time. With remote control users, there is always an explicit login process, requiring both a valid user name and password to be entered. Note that remote *admin* users cannot log in while the modem is in Local mode.

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A user-settable timeout controls for how long the *admin* user is logged in without any user entry activity – when user entry is detected then the user session is extended by the length of the timeout period. An *admin* user can also choose to log out of the modem, which has the effect of closing the browser session and allowing another user to control the modem.

View-only user login sessions do not use any timeout and are maintained until the browser session is closed. They are also unaffected by whether the modem is under local or remote control.

In Giveaway mode, control is passed to the first *admin* user that logs in. If an attempt is made to log in as *admin* when there is already an *admin* user logged in, then the login will succeed but the user will have view-only permissions, thereby ensuring there can never be two users in control of the modem at the same time.

In order to allow a switch back to local control from Giveaway mode, *when there is no remote admin user logged in*, the local front panel interface can gain control at any time simply by issuing a command from the front panel user interface. While a remote *admin* user is logged in then the local front panel interface is restricted to viewing modem settings only.

Once a local user has gained control in Giveaway mode, they can then change the modem back to local control, thereby locking out remote *admin* users. Note that unless the switch back is done, local front panel interface control will time out in a similar way to remote *admin* users and thereby control may be taken away again by a remote *admin* user.

During the period between an *admin* user logging out and either another *admin* login or a command being issued via the local front panel interface to gain control, no user is in control of the modem.

Although there is no explicit login associated with the local front panel interface, there is an implicit login when a key is first pressed. Conceptually, a user at the local front panel interface is logged in as *admin* when in Giveaway mode *and there is no remote admin user currently logged in*, otherwise the local front panel interface is logged in as a view-only user. In Giveaway mode, the user at the local front panel interface can explicitly log out by pressing the *Main* key.

1.17.3 Takeaway Mode

In Takeaway mode, either the user at the local front panel interface or a remote *admin* user can control the modem at any time. In this mode there is no restriction on the number of *admin* users that can be logged in at one time. When the modem is switched out of Takeaway mode to Local mode then all remote *admin* users will be automatically logged out. When it is switched from Takeaway to Giveaway, then all but one instance of *admin* users will be automatically logged out. Although technically only one user is in control at any time, control is relinquished as soon as a command is sent and therefore different control requests from different users are simply interleaved with each other. Because of this, Takeaway mode is best used in circumstances where there are clear operational procedures in place to avoid conflicts arising in relation to modem control.

1.18 Front Panel Interface

1.18.1 Keypad Operation

1.18.1.1 Cursor

A cursor (shown in inverse video) is used to highlight the current position on the LCD display. This is used when making menu selections and when entering values.

1.18.1.2 Navigation Keys

Menus are displayed as a hierarchy of sub-menus. Navigation is performed using either the arrow and *ENTER* keys or by entry of the menu identification number that immediately precedes each menu name.

The *Up* arrow key navigates between menu options by moving the cursor up one line except when entering a numeric value when it increments the digit highlighted by the cursor. (Note that when entering the values of timeslots to be dropped or inserted the *Up* arrow key is used to enter a hyphen.)

The *Down* arrow key navigates between menu options by moving the cursor down one line except when entering a numeric value when it decrements the digit highlighted by the cursor. (Note that when entering the values of timeslots to be dropped or inserted the *Down* arrow key is used to enter a comma.)

The *Left* arrow key moves the cursor to the left. On a menu this is used to navigate between menu options. When entering an alphanumeric value it moves the cursor to the preceding digit. 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. On a menu this is used to navigate between menu options. When entering an alphanumeric value it moves the cursor to the next digit. 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. (Note that when entering the values of timeslots to be dropped or inserted the 0 key pressed together at the same time as the *Right* arrow key deletes the character at the cursor.)

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

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 required to move to the next screen (with the exception of the 'configure all' function where one press of the *ENTER* key provides both steps). Note that when a new value is accepted, it is applied to the modem hardware immediately.

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 backward to the previous screen.

1.18.1.3 Alphanumeric Keys

The alphanumeric keys provide numeric entry. In special cases, 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 (in a similar way to a mobile phone).

1.18.1.4 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 switched off or on by holding down the 0 key and pressing the *ENTER* 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 relevant log or alarm display screen.

Buffer Overflow / Underflow clear

The buffer Overflow and Underflow slip counters can be cleared by pressing the 0 key when on the relevant status/demodulator display screen.

1.18.2 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 entering 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

Note: 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. Alternatively, all SAF features can be enabled for a limited time as described in Section 8.5.
- The feature is 'advanced' and the user level setting is 'basic'. This is a mechanism that has been added to simplify the user interface by hiding options that are less frequently used. Advanced features can be displayed using the process described in Section 7.3.3.3.
- The feature is available but its use is precluded by the current operational modem settings (for example, in normal use, Reed-Solomon 'n' and 'k' values are controlled automatically and cannot be set by the user).

1.19 Front Panel Menu Structure

The menu hierarchy for the front panel is described in the following sections.

1.19.1 Main Menu

Main:	1:Status	2:Edit	3:View
	4:Test	5:Common	
	[London-New York]		

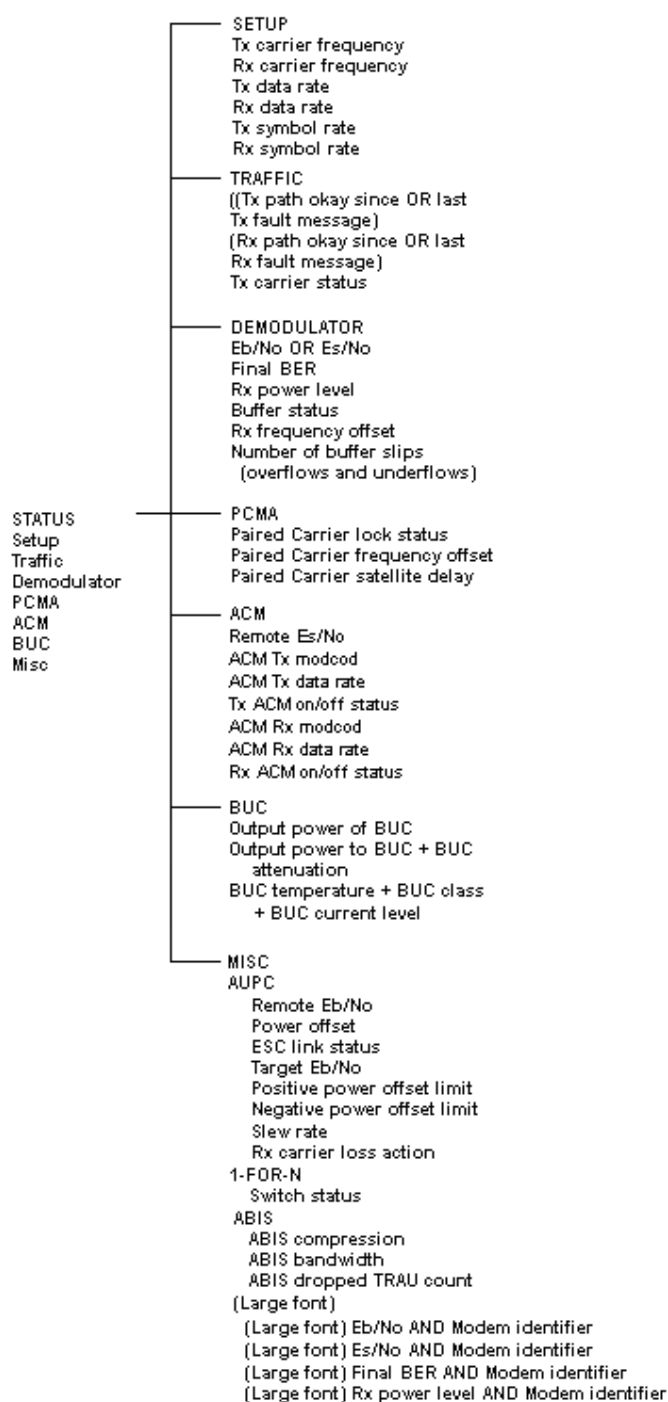
The *Main* menu can be accessed from any display by pressing the *MAIN* key. It is from this menu that all functions are selected.

It contains the following sub-menus:

<i>Status</i>	Displays modem operational status summary information.
<i>Edit</i>	Allows modification of all modem configurable properties.
<i>View</i>	Displays detailed operational status and read-only configurable property values.
<i>Test</i>	Controls the selection of test modes.
<i>Common</i>	This provides quick access (with fewer key presses) to the most commonly used user settings once a modem has been set up for the first time and the link has been established (carrier mute, power levels, frequencies, data rates, modulation and FEC rates). Since all of these options are described elsewhere in this document, the <i>Common</i> menu is not described further.

A user-settable Modem Identifier is shown on the bottom line of the screen and is typically used to specify the physical location of the modem or identify the modem satellite link. This can be set as described in Section 7.3.3.3.1.

1.19.2 Status Menu



Front Panel Status Menus

1:Setup	2:Traffic	3:Demodulator
4:PCMA	5:ACM	6:BUC
7:Misc		

The *Status* menu contains the current modem status split over several screens as described below.

Status-Setup Screen

Tx:70.0000MHz	Rx:74.0000MHz
2048000bps	2048000bps
4096000sps	4096000sps

This screen is constantly updated with the following information:

- Transmit carrier frequency
- Receive carrier frequency
- Transmit terrestrial data rate
- Receive terrestrial data rate
- Transmit symbol rate
- Receive symbol rate

Status-Traffic Screen

Tx OK since 10:14:46 on 6/4/05
Rx OK since 10:14:46 on 6/4/05
Carrier:Mute-Brk

This screen is constantly updated with the following information:

- 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.
- 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 explained above).

When a receive path fault exists then a fault message is displayed instead that indicates the nature of the fault.

- The transmit carrier status, which displays one of the following.
 - *'Normal'*: the carrier is on.
 - *'Mute-Ext'*: the carrier is muted due to an alarm detected by the modem hardware.
 - *'Mute-Ter'*: the carrier is muted due to either the terrestrial Tx RTS pin being active (this is an input signal that can be used to mute the carrier under external control as required) or some other problem being experienced with the terrestrial interface.
 - *'Mute-1:1'*: the carrier is muted due to being the Standby modem in a 1-for-1 Standby system.
 - *'Mute-Brk'*: the carrier is muted due to a power outage.
 - *'Mute-Flt'*: the carrier is muted due to an alarm detected by the modem software.
 - *'Mute-Cfg'*: the carrier is muted due to the modem being in the process of reconfiguring.
 - *'Mute-Off'*: the carrier has been muted by the user.

Status-Demodulator Screen

Eb/No:6.3dB	BER:<1.0E-12
Rx power:-33dBm	Buffer: 57%
Freq offset:0.0Hz	O:1 U:0

This screen is constantly updated with the following information:

- The receive path Eb/No figure (energy per bit to spectral noise density ratio). This is replaced by Es/No (energy per symbol to spectral noise density ratio) when the *Down* arrow is selected.
- The receive path final bit error rate (BER). Please note that this figure gives only a crude indication of BER linked directly to the Eb/No measurement. In most instances the actual BER is significantly better when measured using either the internal PRBS BERT or external equipment.
- The receive path power level.
- The receive path buffer fill status.
- The receive signal frequency offset from the carrier centre frequency. This is the measured error of the received carrier, relative to the expected frequency. It can be used to determine any frequency shift due to the satellite and frequency conversion equipment.
- Number of Doppler buffer slips in relation to overflows and underflows (shown on the display as *O* and *U* respectively). The counts can be cleared by pressing the *O* key while on this screen. The counts are also cleared when the demodulator goes out of lock. Note that the Doppler buffer is not used when *Satellite clock* is selected as the Rx clock source.

Status-PCMA Screen

PCMA: Locked
Offset: 0.02kHz
Delay: 262.1ms

This screen shows the status of Paired Carrier.

- PCMA status is shown as *Locked* when Paired Carrier has locked to one of the overlapping carriers. Note that when Paired Carrier is enabled, the demodulator cannot lock until Paired Carrier has locked. PCMA status is shown as *Unlocked* when Paired Carrier has not managed to lock to a carrier. Please consult the separate *Paired Carrier Quick Start Guide* for a list of potential causes. If Paired Carrier is disabled then PCMA status will be shown as *PCMA disabled*.
- The frequency offset between the two interfering overlapped carriers is shown on the second line.
- The measured delay to the satellite is shown on the third line. Once this value is established then the carrier acquisition time can be reduced by setting the Paired Carrier minimum and maximum satellite delays accordingly (it is recommended that these are set to the measured delay $\pm 0.5\text{ms}$ respectively) via the *Edit/Rx/Carrier/Advanced/PCMA* menu.

Status-ACM Screen

Remote Es/No: 11.3dB
Tx: 16APSK 8/9 10243830bps ACM: On
Rx: 8PSK 5/6 523830bps ACM: Off

This screen is constantly updated with the following information (some of which potentially change dynamically) when ACM is active:

- The remote modem's Es/No (energy per symbol to spectral noise density ratio).
- The transmit path modulation, FEC rate and data rate, along with the on/off status for ACM in the transmit path. When ACM is on, the modulation, FEC rate and data rate will change dynamically in response to changes in Es/No.
- The receive path modulation, FEC rate and data rate, along with the on/off status for ACM in the receive path. When ACM is on, the modulation, FEC rate and data rate will change dynamically in response to changes in Es/No.

ACM operation is described in Section 8.12.14.

Status-BUC Screen

Output: 40.0dBm Mode: Terminal RF: -15.3dBm BUC: -10.0dB Status: 25°C Type: 10W 12.8A

This screen is available only on L-band modems. It is updated with the following information:

- *Output*: this is the output power in dBm at the waveguide flange, or *Off* if the BUC is not transmitting.
- *Mode*: in Terminal (closed loop) mode, this presents the Terminal RF output power level (i.e. the modem output power to the BUC) and the BUC attenuation level. In open loop mode, Terminal RF and BUC attenuation data is not shown and instead the mode is shown as *Independent*.
- *Status*: this shows the temperature in degrees Centigrade reported by the BUC.
- *Type*: this field shows the BUC power class in Watts and the BUC current level in Amperes.

Status-Misc Screen

1:AUPC	#:1-for-N	3:ABIS
4:LARGE		

The *Status-Misc* menu contains the status of miscellaneous modem features split over several screens as described below. Note that the 1-for-N screen is not available unless the modem is the standby modem in a 1-for-N redundancy switch. The 1-for-N redundancy switch user interface is documented separately in the document '*Installation and Operating Handbook for Quantum and Evolution Series Redundancy Switches*'.

Status-Misc-AUPC Screen

Remote Eb/No:	8dB
Power offset:	2.1dB
Link:	OK

This screen is constantly updated with the following information:

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- *Remote Eb/No*: this is the instantaneous Eb/No measured by the remote modem while AUPC is enabled.
- *Power offset*: this is the instantaneous offset that has been applied to the modem Tx power output level to maintain the remote Eb/No at a constant level.
- *Link*: this is the status of the ESC link, which is used to pass AUPC control messages to the remote modem and to read back the remote Eb/No level. The status is set to *Failed* if the link is not working correctly otherwise the status is shown as *OK*.

Selecting the *Down* arrow displays the following screen.

Distant Eb/No: 8dB
Target: 10.0+/-0.1dB
Delta power: 2.1dB

This screen is constantly updated with the following information:

- *Distant Eb/No*: this is the instantaneous Eb/No measured by the remote modem while AUPC is enabled.
- *Target*: this is the target Eb/No level set for the remote modem.
- *Delta power*: this is the instantaneous offset that has been applied to the modem Tx power output level to maintain the remote Eb/No at a constant level.

Selecting the *Down* arrow displays the following screen.

Limits:+1.0dB -1.0dB
Slew: Unlimited
Comms loss action: Nominal

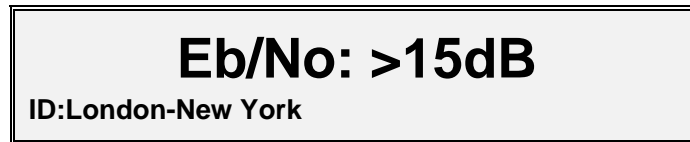
This screen shows the following information:

- *Limits*: this shows the AUPC positive and negative power offset limits – see the *Edit-Tx-Carrier-Advanced-AUPC* section for more details of how these are used.
- *Slew*: this shows the instantaneous slew rate is the target Eb/No level set for the remote modem.
- *Comms loss action*: this shows the action to be taken in the event that communications with the remote modem fail – see the *Edit-Tx-Carrier-Advanced-AUPC* section for more details of the loss action options.

Status-Misc-ABIS Screen

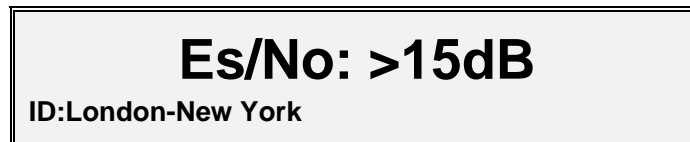
When a Sat-ABIS interface card is fitted this screen is constantly updated with the achieved ABIS compression ratio, the instantaneous bandwidth being used and the dropped TRAU count.

Status-Misc-Large Font Screen



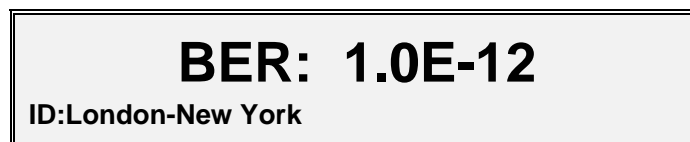
Eb/No: >15dB
ID:London-New York

This screen shows the receive path Eb/No figure (energy per bit to spectral noise density ratio) in large font for easy viewing. It shows the user-settable Modem Identifier on the bottom line of the screen. Selecting the *Down* arrow displays the following screen.



Es/No: >15dB
ID:London-New York

This screen shows the receive path Es/No figure (energy per symbol to spectral noise density ratio) in large font for easy viewing. It shows the user-settable Modem Identifier on the bottom line of the screen. Selecting the *Down* arrow displays the following screen.



BER: 1.0E-12
ID:London-New York

This screen shows the receive path final bit error rate (BER) in large font for easy viewing. It shows the user-settable Modem Identifier on the bottom line of the screen. Selecting the *Down* arrow displays the following screen.



This screen shows the receive signal power level in large font for easy viewing. It shows the user-settable Modem Identifier on the bottom line of the screen.

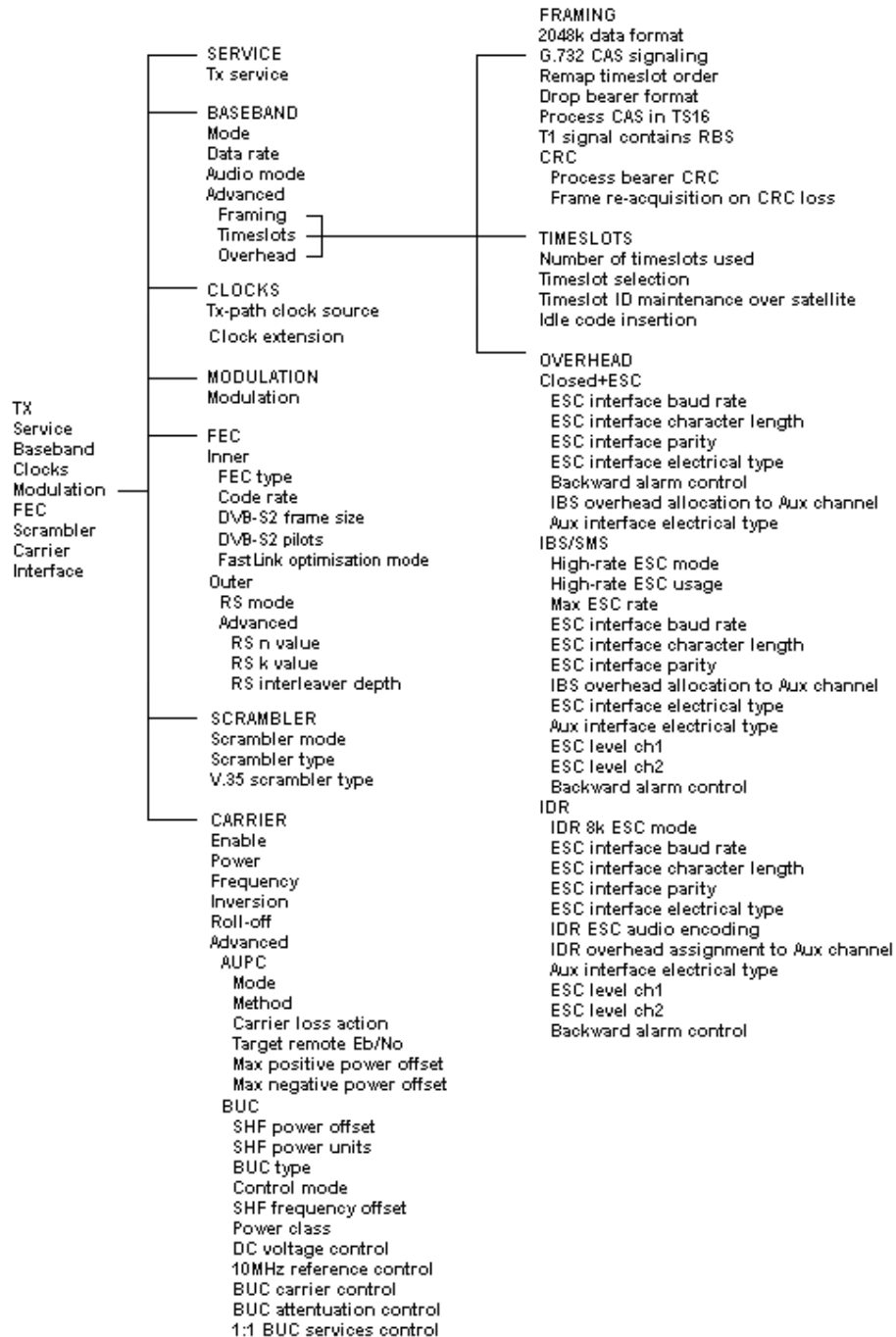
1.19.3 Edit Menu

Edit:	1:All	2:Tx
	3:Rx	4:Unit
	5:Memories	6:Redundancy

This menu contains the following options:

- *All*. This option leads the user through the most commonly used modem settings, giving a quick way of setting up the modem. The sequence can be terminated at any time by pressing the *MAIN* key.
- *Tx*. This selects the transmit path edit submenu, which allows all of the modem Tx properties to be changed.
- *Rx*. This option selects the receive path edit submenu, which allows all of the modem Rx properties to be changed.
- *Unit*. This selects the unit edit submenu. This allows all of the modem properties that are independent of the Tx and Rx paths to be changed.
- *Memories*. This option selects the configuration memory submenu, which allows the modem configuration to be saved or a previous configuration to be recalled.
- *Redundancy*. This contains submenus that control the operation of 1:1 and 1:N redundancy systems.

1.19.3.1 Edit-Tx Menu



Front Panel Edit-Tx Menus

1:Service	2:Baseband	3:Clocks
4:Modulation	5:FEC	6:Scrambler
7:Carrier		

The *Edit/Tx* menu contains the following options:

- *Service*. This option allows the selection of the framing mode for the modem.
- *Baseband*. This option leads to a submenu that allows terrestrial framing, timeslots and overhead to be configured.
- *Clocks*. This allows the transmit path clock source to be selected.
- *Modulation*. This leads to a submenu that allows the modulation scheme to be configured.
- *FEC*. This leads to a submenu that contains options for selecting the inner and outer forward error correction (FEC) schemes.
- *Scrambler*. This leads to a submenu that allows scrambling to be controlled.
- *Carrier*. This leads to a submenu that allows the carrier, frequency, power, spectrum inversion and AUPC (Automatic Power Up-link Control) to be controlled.

1.19.3.1.1 Edit-Tx-Service Screen

Tx service: [Closed]			
1:Off	2:Closed	3:CI+ESC	4:IBS/SMS
5:IDR	6:OM-73	7:DVBS2	

Options:

Off

The Tx service is switched off.

Closed network

This mode adds no overhead to the data and is compatible with other closed network equipment. It is provided as part of the base modem.

Closed network plus ESC

This adds the lowest possible overhead to the satellite data to provide whatever ESC rate is selected (the variable-rate ESC channel can provide up to 70% of the main channel rate). It also provides a backward alarm facility. Above 32kbps a synchronous scrambler is used in place of the error-multiplying V.35 scrambler normally used on closed networks. This mode supports drop and insert and maintains timeslot identity. This

mode is provided as part of the base modem.

IBS/SMS

This is an open network mode where 1/15 framing overhead is added to the data. This mode is compatible with other open network equipment. IBS/SMS mode is described in Section 8.2.1. This mode requires the IBS SAF feature.

IDR

This mode adds 96kbps of framing overhead to the data. This mode is compatible with other open network equipment. IDR mode is described in Section 8.2.2. This mode requires an IDR option card to be fitted.

OM-73

This mode provides OM-73 scrambling, symbol mapping and OM-73 Viterbi compatibility and requires the OM-73 SAF feature.

DVBS2 (Quantum only)

This selects the DVB-S2 service. When selected, a 'pure' DVB-S2 service is provided with all SCPC features (such as Drop and Insert, IBS, ESC channel, etc.) disabled.

Note that there are two ways of enabling DVB-S2 and this particular option should be used only for IP, which, through the use of standard IP over DVB encapsulation methods is interoperable at a basic level with other manufacturer's DVB-S2 equipment.

DVB-S2 interoperability with other vendors is not supported when using other terrestrial interfaces and therefore the DVB-S2 service should not be used. Instead, the *SmartLink* mode should be selected from the FEC type menu. If DVB-S2 is required but no SCPC features are required then as well as selecting *SmartLink*, the Tx service should be set to *Closed network* as this does not add any extra framing to that provided by DVB-S2.

Once DVB-S2 has been selected, various other DVB-S2 configuration menu options become available, including choice of modulation and FEC rate, as well as DVB-S2 FEC frame size choice and DVB-S2 pilots.

Factory default: *Off*

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Description: Framing mode for the Tx path. In general, on the Quantum, all combinations of SCPC and DVB-S2 services are provided including DVB-S2 outbound with SCPC return, SCPC both outbound and inbound, DVB-S2 both outbound and inbound, etc. *SmartLink* mode (see the *Edit-Tx-FEC-Inner-FEC* screen) allows SCPC features such as Drop and Insert and the ESC channel to be overlaid on top of DVB-S2, thereby allowing legacy applications to benefit from the bandwidth saving efficiencies and extra robustness of DVB-S2.

1.19.3.1.2 Edit-Tx-Baseband Menu

Baseband: 1:Mode 2:Data rate
3:Audio mode 4:Advanced

This menu contains the following options:

- *Mode*. This controls the transmit baseband mode.
- *Data rate*. This sets the terrestrial transmit data rate.
- *Audio mode*. This controls the audio/data baseband mode format in IBS/SMS emulation mode. It is possible to generate a 64kbps data stream from the two 32kbps ADPCM audio ports on the IDR card or a composite 128kbps data stream can be generated from the two 32kbps ADPCM audio ports plus 64kbps from the main data port.
- *Advanced*. When the user level is set to *Advanced*, this allows configuration of framing, timeslots and overhead.

Edit-Tx-Baseband Mode Screen

Baseband mode: [Continuous]
1:Continuous 2:Drop MUX
3:Audio/data

Options:

Continuous

This selects normal continuous data interface operation.

Drop MUX

This requires the Drop and Insert SAF features to be enabled. It processes a T1 or E1 PCM bearer, with Tx data being dropped from specific timeslots of the bearer (on the Rx side, data can be inserted back into the same timeslots or into different timeslots).

Audio/data

This requires an IDR card to be fitted, plus IBS/SMS satellite framing, which provides a P1348 emulation mode. It uses the audio ports normally used for the IDR audio ESC circuit, as the main traffic data. A 64kbps carrier can be generated, comprising two 32kbps ADPCM audio channels,

or a 128kbps carrier can be generated, comprising 64kbps data (from the modem main data interface) plus two 32kbps ADPCM audio channels. These modes emulate the popular P1348/P1448 voice/data MUX card.

Factory default: *Continuous*

Description: Mode selection for baseband processing.

Edit-Tx-Baseband-Data Rate Screen

Tx data rate:4800 to 60000000bps
[02048000] Step 1bps
New: 02048000

Units: Bps
Minimum value: 4800
Maximum value: Modem specific – see datasheet for particular modem model.
Step size: 1
Factory default: 2048000

Description: Terrestrial bit rate. This is used in Continuous mode but is automatically set in other baseband modes.

The upper data rate limit is set according to which SAF data rates have been enabled and is model specific. Note that the full data range is not available in every mode of operation and may be restricted by other settings such as the terrestrial interface type, Framing service, FEC type and FEC rate. If the maximum valid data rate is exceeded then a configuration warning will be generated.

Edit-Tx-Baseband-Advanced Menu

Advanced:	1:Framing
	2:Timeslots
	3:Overhead

When the user level is set to *Advanced* (see the *Edit-Unit-Advanced-User Level* screen), this menu allows configuration of framing, timeslots and overhead.



Note that the Advanced Baseband menu, including support for framing, timeslots and overhead, is described separately in Chapter 14.

1.19.3.1.3 Edit-Tx-Clocks Screen

Tx-path clock source:
[Tx Clock In]
New: Receive reference

Options:

Tx Clock In

The external clock supplied on the interface *Clock In* line will be used. Should this clock fail then the modem will switch to an internal backup clock.

Internal

The modem outputs a clock on the *Int Tx Clock Out* line for use by external equipment. The clock is normally generated from the internal frequency reference. Alternatively, a station clock of 10MHz can be applied to the unit and used to synchronise all internal clocks and IF synthesisers which normally use the internal reference.

Receive reference

The Tx clock is generated from the Rx output clock. This is only of any practical use when the Rx clock is set to *Satellite* or *Station clock*.

Station

The Tx clock is generated from the station clock.

Hub

Factory default:

Internal

Description: Sets the clock source for the Tx path.

If the Tx clock is set to Internal, a G.703 interface card is fitted but NOT currently selected and the G.703 clock extension SAF feature is enabled then the following menu will be displayed at this point:

Use G.703 as clock reference:

[Off]

New: E1

This allows the G703 clock to be forwarded over satellite as a clock reference (see Section 8.8 for further details).

Options:

OFF

E1

T1

Factory default: OFF

Description: This provides a high-stability clock over satellite derived from a G.703 card that can be used for clocking any interface in place of GPS.

1.19.3.1.4 Edit-Tx-Modulation Screen

Modulation: [BPSK]

**1:BPSK 2:QPSK 3:OQPSK 4:8PSK 5:16QAM
6:8QAM 7:16APSK 8:32APSK 9:64QAM**

The table shown under *Edit-Tx-FEC-Inner* defines normal operation with respect to FEC mode, FEC rate and modulation scheme.

Options:

BPSK

QPSK

OQPSK

8PSK

Requires 8PSK SAF feature. Applicable to TCM, TPC and FastLink LDPC.

16QAM

Requires 16QAM SAF feature. Applicable to TPC and FastLink LDPC.

8QAM

Requires 8QAM SAF feature. Applicable to FastLink LDPC.

16APSK

Requires 16APSK SAF feature. Applicable to FastLink LDPC (DVB-S2 16APSK does *not* require this SAF).

32APSK

Requires 32APSK SAF feature. Applicable to FastLink LDPC.

64QAM

Requires 64QAM SAF feature. Applicable to FastLink LDPC.

Factory default:

QPSK

Description: Selects the modulation used for the carrier.

1.19.3.1.5 Edit-Tx-FEC Menu

FEC:	1:Inner 2:Outer
-------------	----------------------------------

This menu contains the following options:

- *Inner*. This submenu controls the Inner FEC settings for the modem.
- *Outer*. This submenu controls the Outer Reed-Solomon FEC settings for the modem.

Edit-Tx-FEC-Inner Menu

Inner:	1:FEC 2:Rate
---------------	-------------------------------

This menu contains the following options:

- *FEC*. This selects the Inner FEC type.
- *Rate*. This selects the FEC rate.

The next table defines normal operation with respect to FEC mode, FEC rate and modulation scheme.

FEC Mode	FEC Rate	Modulation Scheme
Viterbi (<i>default</i>)	1/2, 3/4, 7/8 (<i>default</i>)	BPSK, QPSK (<i>default</i>), OQPSK
Sequential	1/2, 3/4, 7/8	BPSK, QPSK, OQPSK
TCM	2/3	8PSK
TPC	5/16 21/44 1/2 (Paradise) 2/3 (Paradise) 3/4 de facto 0.789 (Paradise) 7/8 de facto 7/8 (Paradise) (<i>default</i>) 0.93 (Paradise)	BPSK, QPSK, OQPSK
TPC	3/4 de facto 7/8 de facto (<i>default</i>) 0.93 (Paradise)	8PSK, 16QAM
Conventional LDPC	1/2	QPSK
Conventional LDPC	2/3	QPSK, 8PSK
Conventional LDPC	3/4	QPSK, 8PSK, 16QAM
DVB-S2 (Quantum only)	1/4, 1/3, 2/5, 1/2	QPSK
DVB-S2 (Quantum only)	3/5	QPSK, 8PSK
DVB-S2 (Quantum only)	2/3, 3/4, 4/5, 5/6, 8/9, 9/10	QPSK, 8PSK, 16APSK
FastLink LDPC	0.499	BPSK
FastLink LDPC	0.532, 0.639, 0.710, 0.798	(O)QPSK
FastLink LDPC	0.639, 0.710, 0.778	8PSK, 8QAM
FastLink LDPC	0.726, 0.778, 0.828, 0.851	16APSK, 16QAM
FastLink LDPC	0.778, 0.886, 0.886, 0.938	32APSK
FastLink LDPC	0.828, 0.886, 0.938, 0.960	64QAM

Table of Normal Operation with respect to FEC Mode, FEC Rate and Modulation Scheme

Edit-Tx-FEC-Inner-FEC Screen

FEC type: [TPC] New: SmartLink

Options:

Viterbi

Requires the Viterbi SAF feature (standard on base modem).

TCM

Requires the TCM SAF feature, which is provided free with the 8PSK SAF feature.

TPC

Requires the TPC SAF feature.

Sequential

Requires the Sequential SAF feature.

LDPC

Requires one or more of the LDPC data rate SAFs. This enables Conventional LDPC. *Note that this feature has been superseded by FastLink low-latency LDPC, which gives comparable performance.*

SmartLink (Quantum only)

This is provided as part of DVB-S2 and is not a SAF feature in its own right. This selects *SmartLink*, which allows SCPC features to be used with DVB-S2 'space segment'. DVB-S2 provides very efficient forward error correction (FEC), modulation and satellite framing and very robust demodulation (working lower into the noise). *SmartLink* is described in more detail in Section 8.13.

However, the DVB-S2 standard does not directly support various features traditionally used in SCPC links such as Drop and Insert, ESC channel, remote M&C control, AUPC, IDR audio channels, etc. *SmartLink* allows ALL modem features that rely on SCPC framing (including IBS/SMS, IDR, Closed Network plus ESC, etc.) to be used in conjunction with DVB-S2, allowing legacy SCPC applications to immediately benefit from bandwidth savings and the increased robustness of DVB-S2 while providing exactly the same services as before.

If DVB-S2 is required but no SCPC features are required then as well as selecting *SmartLink*, the Tx or Rx service should be set to *Closed network* as this does not add any extra framing to that provided by DVB-S2 (bypassing the framer in the diagram in Section 8.13).

Note that *SmartLink* allows *any* terrestrial interface to be used with DVB-S2. Using *SmartLink* in Closed network mode does not add any overhead beyond that of DVB-S2. This therefore allows pure DVB-S2 G.703 operation, serial interface operation, etc., bringing the full efficiency benefits of DVB-S2 to all terrestrial data types, not just packet based interfaces.

Once *SmartLink* has been selected, various other DVB-S2 configuration menu options become available, including choice of modulation and FEC rate, as well as DVB-S2 FEC frame size choice and DVB-S2 pilots.

FastLink

Requires one or more of the *FastLink* data rate SAFs. This enables Paradise's *FastLink* low-latency LDPC. *FastLink* gives BER performance approaching that of conventional LDPC but with latency nearer to that of TPC. In addition, *FastLink* supports modes that optimize either BER performance or latency even further, giving the flexibility to match FEC performance more closely to the constraints of the satellite application. In many, if not all applications, *FastLink* should be able to replace TPC or conventional LDPC. Note that *FastLink* does not suffer from the error floor 'flaring' problem of earlier generation LDPC FECs and consequently does not require the use of any outer codec to enhance performance.

Factory default:

Viterbi

Description: Controls the inner FEC mode. (Note that the *FEC off* option is no longer available through this menu and has been moved to the *Edit-Unit-Advanced-Special Modes* menu.)

Edit-Tx-FEC-Inner-Rate Screen

FEC code rate:
[.75(3/4) de facto]
New: .75(3/4) de facto

Options:

1/4

DVB-S2/*SmartLink* only.

0.312(5/16)

TPC only.

1/3

DVB-S2/*SmartLink* only.

2/5

DVB-S2/*SmartLink* only.

0.477(21/44)

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TPC only.
<i>0.493(1/2) Paradise</i> TPC only.
<i>1/2</i> Viterbi/Sequential/DVB-S2/ <i>SmartLink</i> only.
<i>3/5</i> DVB-S2/ <i>SmartLink</i> only.
<i>2/3</i> TCM only.
<i>0.666(2/3) Paradise</i> TPC only.
<i>3/4</i> Viterbi/Sequential/DVB-S2/ <i>SmartLink</i> only.
<i>.75(3/4) de facto</i> TPC only.
<i>4/5</i> DVB-S2/ <i>SmartLink</i> only.
<i>0.789 Paradise</i> TPC only.
<i>5/6</i> DVB-S2/ <i>SmartLink</i> only.
<i>7/8</i> Viterbi/Sequential.
<i>0.875(7/8) de facto</i>

TPC only.
<i>0.875(7/8) Paradise</i> TPC only.
<i>8/9</i> DVB-S2/ <i>SmartLink</i> only.
<i>9/10</i> DVB-S2/ <i>SmartLink</i> only.
<i>0.929 Paradise</i> TPC only.
<i>0.499</i> <i>FastLink</i> only.
<i>0.532</i> <i>FastLink</i> only.
<i>0.639</i> <i>FastLink</i> only.
<i>0.710</i> <i>FastLink</i> only.
<i>0.726</i> <i>FastLink</i> only. <i>0.778</i> <i>FastLink</i> only.
<i>0.798</i> <i>FastLink</i> only.
<i>0.828</i> <i>FastLink</i> only.

<p><i>0.851</i></p> <p><i>FastLink only.</i></p>
<p><i>0.886</i></p> <p><i>FastLink only.</i></p>
<p><i>0.938</i></p> <p><i>FastLink only.</i></p>
<p><i>0.960</i></p> <p><i>FastLink only.</i></p>

Factory default: $\frac{1}{2}$ Viterbi

Description: Sets the FEC code rate i.e. the number of bits input to the Forward Error Correction encoder relative to the number output, thereby determining the level of information redundancy and protection of the data stream against errors. (In DVB-S2 IP multistreaming mode then there will be one FEC rate screen shown for each stream, as each can be set independently.) **Not all FEC rates are available for all modulations and FEC schemes – please check the ‘Table of Normal Operation with respect to FEC Mode, FEC Rate and Modulation Scheme’ shown in the *Edit-Tx-FEC-Inner Menu* section.**

Note: Paradise TPC rate 7/8 was developed to give better performance than Viterbi rate 7/8ths (by about 1dB) with a similar latency. However, if you require interoperability with other manufacturers’ equipment or a better coding gain, then you should select de facto TPC rate 7/8.

Edit-Tx-FEC-Frame Type Screen

The following screen may be shown at this point after the FEC has been selected (in DVB-S2 IP multistreaming mode then there will be one of these screens for each stream):

FEC frame size: [Normal] New:[Short]

Options:

Short

Selects a DVB-S2 frame size of 16200 bits.

Normal

Selects a DVB-S2 frame size of 64800 bits.

Factory default: *Short*

Description: Sets the DVB-S2 FEC frame size.

Edit-Tx-FEC-Pilots Screen

The following screen may be shown at this point after the FEC has been selected (in DVB-S2 IP multistreaming mode then there will be one of these screens for each stream):

Pilot tones: [Off] New:[On]
--

Options:

Off

On

Factory default: *Off*

Description: Pilot tones are an optional part of DVB-S2. They provide an unmodulated tone at regular intervals in the transmitted data that can help receivers to lock and stay in lock particularly when using higher order modulation schemes in noisy environments. They add an overhead of around 2.5% to the transmitted data.

Edit-Tx-FEC-FastLink Optimisation Mode Screen

The following screen will be shown at this point after the FEC has been selected if FastLink has been selected:

FastLink optimisation mode:
[Balanced]
New:[Low latency]

Options:

Balanced

Provides performance that is a good balance between low latency and good BER performance. It is the best compromise between trying to achieve the low latency of TPC and the BER performance of conventional LDPC.

Low latency

Provides a lower level of latency that attempts to match or beat that of TPC. This is at the expense of a small increase (typically around 0.3dB compared to *Balanced* mode) in Eb/No required to achieve a specific BER level.

Low BER

Provides better BER performance (typically reducing the Eb/No required to achieve a particular BER level by around 0.3dB compared to *Balanced* mode) at the expense of higher latency. Latency halves as data rate doubles so this mode is suitable for applications that are not latency sensitive and for higher data rate applications (nominally 2Mbps and above).

Factory default:

Short

Description: Sets the FastLink optimisation mode. FEC design involves a trade-off between achieving low latency and good BER performance and the optimisation mode allows performance to be slanted towards one or the other of these, or set to be a balance between both. This flexibility allows FastLink to be used in place of both TPC and conventional LDPC.

Edit-Tx-FEC-Outer Menu

Outer:	1:RS mode 2:Advanced
---------------	---------------------------------------

This menu contains the following options:

- *RS mode*. This controls whether the Reed-Solomon outer-FEC encoder is active.
- *Advanced*. This submenu allows custom values of n , k and interleaver depth to be set.

Reed-Solomon FEC is a powerful scheme wrapped around the inner FEC that can be used to correct the remaining errors from the Viterbi and TCM inner FEC. The code rate is specified by three values, namely, n , k , and t . These have a fixed relationship of $n - k = 2t$, making t half the difference between n and k . A typical code rate is specified as $(n, k, t) = (126, 112, 7)$.

Reed-Solomon error correction works on codewords (blocks) of bytes, where n is the length of the block of which there are k bytes of original data and $2t$ bytes of error correction information. The Reed-Solomon codec can correct any bytes in error up to a value of t bytes. In the above example with $t=7$, up to seven bytes within 126 may be corrected no matter

how many individual bits per byte are in error. However, when the error rate exceeds the correctable level, unlike other FEC schemes that degrade gracefully, Reed-Solomon fails catastrophically. Once the error correction threshold is passed then the codec considers it uncorrectable and passes the entire block uncorrected, i.e. the error rate goes from 0 to no error correction in one step. There is a small transitional area where due to the distribution of the errors, the errors in some blocks may be just below the threshold (and therefore fully correctable) and some blocks may be just above (and therefore uncorrectable). In practice, this effect gives a Reed-Solomon satellite circuit a transition from error free to unserviceable in approximately 1dB of change in Eb/No.

In addition to the (n, k, t) specification of the code rate, there is a parameter called *interleaving depth*, which controls the number of Reed-Solomon codewords that are interleaved. Interleaving is used to mix up the blocks such that a burst of channel errors is distributed over a number of codewords, rather than affecting a lot of bytes from a single block, thus improving the resilience to error bursts. Interleaving is usually of depth 4 or 8.

Reed-Solomon outer FEC must never be used in the absence of an inner FEC scheme.

Section 8.8 describes how to choose optimum custom values for n and k .

Edit-Tx-FEC-Outer-RS Mode Screen

RS FEC: [Normal]	
1:Off	2:Normal
3:Other	

Options:

Off

Normal

Requires Reed-Solomon SAF feature (standard in base modem). In this mode the Reed-Solomon FEC is active and the modem automatically chooses appropriate values for n , k and interleaver depth.

Other

Requires both the Reed-Solomon and Custom SAF features. In this mode, the user can choose the values of n , k and interleaver depth.

Factory default:

Off

Description: Controls whether the Reed-Solomon outer-FEC encoder is active.

Edit-Tx-FEC-Outer-Advanced Menu

Advanced: 1:RS N
 2:RS K
 3:Interleave

This menu can be selected (when user level is set to *Advanced*) following the setting of the modulation type. It contains the following options:

- *RSN*. This sets the Reed-Solomon codeword length, i.e. k data symbols + (n - k) parity symbols, where (n - k)/2 symbol errors per codeword can be corrected.
- *RSK*. This sets the number of data symbols per Reed-Solomon codeword (range (n - 2) to (n - 20) in steps of 2).
- *Interleave*. This is used to set the Reed-Solomon interleaver depth, which controls resilience to burst errors (larger depth gives best BER) through data dispersal at the expense of introducing processing delay.

The table below defines normal Reed-Solomon operation.

Service	FEC	Terrestrial Data Rate	Normal RS		
			Type	(n,k,t)	Depth
Off	x	x	x	x	x
Closed, IBS/SMS, IDR, Closed+ESC, OM73	TCM	>1544k	Intelsat	(219,201,9)	8
		<=1544k			
	Other	2048k		(225,205,10)	4
		1544k		(194,178,8)	
		6312k		(126,112,7)	
		8448k		(126,112,7)	
		Other		(126,112,7)	
Closed, IBS/SMS, Closed+ESC, OM73	Other	all		(126,112,7)	

Table of Reed-Solomon N, K and Interleaver Depth Values for Normal Operation

Edit-Tx-FEC-Outer-Advanced RSN (Codeword Length) Screen

RS n value:60 to 255symbols
[126] Step 1 symbols
New: 126

Units: symbols
Minimum value: 60
Maximum value: 255
Step size: 1
Factory default: 126

Description: Reed-Solomon codeword length, i.e. k data symbols + $(n - k)$ parity symbols, where $(n - k)/2$ symbol errors per codeword can be corrected.

Edit-Tx-FEC-Outer-Advanced RSK (Data Length) Screen

RS k value:40 to 253symbols
[112] Step 2 symbols
New: 112

Units: symbols
Minimum value: 40
Maximum value: 253
Step size: 2
Factory default: 112

Description: Number of data symbols per Reed-Solomon codeword (range $(n - 2)$ to $(n - 20)$ in steps of 2).

Edit-Tx-FEC-Outer-Advanced interleaver Depth Screen

RS interleaver depth: [4 codewords] 1:4 codewords 2:8 codewords 3:12 codewords
--

Options:

4 code-words
8 code-words
12 code-words

Factory default: 4 code-words

Description: Controls resilience to burst errors (larger depth gives best BER) through data dispersal at the expense of introducing processing delay.

1.19.3.1.6 Edit-Tx-Scrambler Menu

Scrambler: 1:Enable 2:Type
--

This menu contains the following options:

- *Enable*. This is the master control for all scramblers. It can be used to switch scrambling off or on. When on, the choice of scrambler can be made automatically by the modem or selected manually.
- *Type*. This option selects the type of scrambler to apply when manual control of the scrambler type is active (i.e. when automatic selection is switched off).

The following table defines normal operation with respect to scrambler selection.

Service	Scrambler Availability
IBS/SMS	IBS/SMS (default), Intelsat-RS (available only if RS mode is On), V.35, OM-73, Turbo (available only if FEC mode is TPC)
IDR, Closed	Intelsat-RS (default if RS mode is On and FEC mode is not TPC; available only if RS mode is On), V.35 (default if FEC mode is not TPC and RS mode is Off), OM-73, Turbo (default if FEC mode is TPC; available only if FEC mode is TPC)
Closed Network Plus ESC	IBS/SMS (default if terrestrial data rate is ≥ 32000 and RS mode is Off), Intelsat-RS (default if RS mode is On), V.35, OM-73, Turbo (available only if FEC mode is TPC)
OM-73	OM-73

Table of Valid Scrambler Options in Normal Operation

Edit-Tx-Scrambler-Enable Screen

Scrambler mode: [Other] 1:Off 2:Normal 3:Other
--

Options:

Off
Normal
Other

Factory default: *Normal*

Description: Master control for all scramblers. In *Normal* mode, scrambler settings are set automatically.

Edit-Tx-Scrambler-Type Screen

Scrambler type:
[V.35]
New: V.35

Options:

IBS/SMS

Only available in Closed Network plus ESC (above 32kbps) and IBS/SMS.

V.35

This self synchronizing scrambler will multiply the errors, degrading performance.

Turbo

Only available in when the TPC FEC is selected.

OM-73

Intelsat Reed-Solomon

Only available when the Reed-Solomon FEC is selected.

Factory default:

V.35

Description: Controls the type of scrambler to apply. Only available when scrambler selection is set to *Other*.

Edit-Tx-Scrambler-Type-V.35 Screen

V.35 scrambler type:
[Intelsat (normal)]
New: Intelsat (normal)

Options:

Intelsat (normal)

Fairchild

Linkabit

CCITT

Factory default: *Intelsat (normal)*

Description: Controls the particular type of scrambler to apply when V.35 scrambling is enabled. Only available when scrambler selection is set to *Other*.

1.19.3.1.7 Edit-Tx-Carrier Menu

Carrier:1:Enable	2:Power
3:Frequency	4:Inversion
5:Roll-off	6:Advanced

This menu has the following options:

- *Enable*. This controls the carrier (on/off).
- *Power*. This option controls the IF output power level.
- *Frequency*. This sets the IF frequency used to transmit to the satellite.
- *Inversion*. This controls whether the I and Q channel outputs are swapped, to give Spectrum Inversion.
- *Roll-off*. This controls the slope (gradient) of the carrier at its edges and therefore controls the occupied bandwidth.
- *Advanced*. This submenu provides AUPC (Automatic Up-link Power Control), BUC Type selection and BUC control menus. AUPC attempts to maintain the remote Eb/No at a specified target level by varying the local modem transmit power level. Note that when AUPC is active then the ESC overhead channel is not available for user data.

Edit-Tx-Carrier-Enable Screen

Carrier mode: [On] [Off] New: Off
--

Options:

Off

The carrier is off.

On

The carrier is on and will remain on even after the equipment is switched off and on again.

On-mute if outage (mute if power break)

Mute on power break requires confirmation of transmission (i.e. selecting Edit/Unit/Advanced/Operation and select `Ack Pwr Bre`) following a power outage.

Rx enabled

When enabled, then the carrier will be switched off whenever an Rx traffic fault is present in the modem.

RTS enabled

When RTS is enabled then the carrier is controlled by the interface RTS line.

**Factory
default:** *Off*

Description: Tx carrier control.

Edit-Tx-Carrier-Power Screen (IF Modem)

IF output power:-25 to 0dBm [-10.0] Step 0.1dBm New: -10.0

Units: dBm
Minimum value: -25.0
Maximum value: 0
Step size: 0.1
Factory default: -20.0

Description: Tx IF output power level.

Edit-Tx-Carrier-Power Screen (L-band Modem)

RF output power:-30 to 0dBm
[-10.0] Step 0.1dBm
New: -10.0

Units: dBm
Minimum value: -30.0
Maximum value: 0
Step size: 0.1
Factory default: -30.0

Description: Tx L-band output power level.

Edit-Tx-Carrier-Frequency Screen (IF Modem)

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

Units: MHz
Minimum value: 50.0000
Maximum value: 180.0000
Step size: 0.0001
Factory default: 70.0000

Description: Tx IF frequency used to transmit to satellite. Note that values between 90 and 100MHz cannot be selected.

Edit-Tx-Carrier-Frequency Screen (L-band Modem)

IF carrier freq: 950 to 2050MHz
[950.0000] Step 100Hz
New: 950.0000

Units: MHz
Minimum value: 950.0000
Maximum value: 2050.0000
Step size: 0.0001
Factory default: 950.0000

Description: Tx L-band frequency used to transmit to satellite.

Edit-Tx-Carrier-Inversion Screen

Rx spectral inversion: [On]
1:Off
2:On

Factory default: Off

Description: Controls whether the I and Q channel outputs are swapped.

Edit-Tx-Carrier-Roll-off Screen

Filter roll-off:
[35%]
New: 20%

Options:

35%

This selects a filter roll-off factor of 35%.

25%

This selects a filter roll-off factor of 25%.

20%

This selects a filter roll-off factor of 20%.

Factory default: 35%

Description: Controls the slope of the carrier at its edges and therefore has an effect on both occupied bandwidth and the potential for interference from adjacent carriers. A factor of 20% is the most bandwidth efficient.

Edit-Tx-Carrier-Advanced-AUPC Menu

AUPC:1:Mode
2:Target Eb/No
3:Power offset

This menu contains the following options:

- *Mode*. This controls the ability to attempt to maintain the remote Eb/No at a specified target level by varying the local modem transmit power level.
- *Target Eb/No*. This is used to set a target Eb/No for the distant modem that this modem tries to maintain by adjusting the transmit power level.
- *Power offset*. This sets the maximum increase in transmit power level that can be made to maintain the distant Eb/No.

Edit-Tx-Carrier-Advanced-AUPC-Mode Screen

AUPC mode: [Off]
1:Off 2:Monitor
3:Maintain

Options:

Off

Monitor remote Eb/No

In this mode, the modem will monitor the Eb/No of the remote modem via

the ESC, without making any changes to the Tx power level.

Maintain remote Eb/No

In this mode, the modem will attempt to maintain the remote Eb/No at the specified target level. As with Monitor remote Eb/No above, it uses the ESC to maintain the distant end Eb/No.

**Factory
default:**

Off

Description: This controls the AUPC mode of operation. Note that both modems *must* be placed in either *Monitor* or *Maintain* mode for AUPC to work. Typically, the local controlling modem is placed in *Maintain* mode and the remote modem is placed in *Monitor* mode (unless it is also controlling another modem via AUPC). If AUPC is switched off in the remote modem then the modem in question will not respond to requests to provide Eb/No information. See Section 8.3 for a full description of AUPC.

Edit-Tx-Carrier-Advanced-AUPC-Method Screen

AUPC method:
[Normal]
New: Normal

Options:

Normal

This should be selected when two Quantum/Evolution modems are at either ends of the satellite link.

Self

In this mode, the modem will adjust power output in an attempt to maintain the Eb/No at its target level using the Eb/No from its own received carrier rather than the Eb/No value being passed back from any remote modem.

P300

This should be selected when the distant end modem is a P300 series modem. This uses a P300 style of ESC communications involving RS485, as opposed to native Evolution/Quantum ESC communications, which use IP over the ESC channel. The P300 RS485 messages are more concise and may reduce ESC bandwidth requirements.

Factory

Normal

default:

Description: This controls the AUPC method of operation.

Edit-Tx-Carrier-Advanced-AUPC-Carrier-Loss-Action Screen

Carrier loss action:
[Freeze at current value]
New: Freeze at current value

Options:

Set to Nominal

The AUPC delta power is set to zero, so the carrier returns to its nominal power.

Freeze at current value

The carrier power is frozen at its current value.

Set to max

The AUPC delta power increases to the maximum power limit as set on the AUPC Max positive delta power screen.

**Factory
default:**

Set to Nominal

Description: This controls the AUPC delta power action in the event of losing the incoming carrier. In most cases this should be set to *Nominal*.

Edit-Tx-Carrier-Advanced-AUPC-Eb/No Screen

Target remote EbNo:0.1 to 14.9dB
[3.1] Step 0.1dB
New: 3.1

Units: dB
Minimum value: 0.1
Maximum value: 14.9
Step size: 0.1
Factory default: 10.0

Description: This is the distant Eb/No that AUPC tries to maintain by adjusting the Tx power level.

Edit-Tx-Carrier-Advanced-AUPC-Power Offset Screen

Max power offset:0 to 25dBm
[1.0] Step 0.1dBm
New: 1.0

Units: dBm
Minimum value: 0
Maximum value: 25
Step size: 0.1
Factory default: 1

Description: This is the maximum increase in Tx power level that AUPC is allowed to make to maintain distant Eb/No.

Edit-Tx-Carrier-Advanced-AUPC-Power-Negative Offset Screen

Max neg. power off: 0 to 25dBm
[1.0] Step 0.1dBm
New: 1.0

Units: dBm
Minimum value: 0
Maximum value: 25
Step size: 0.1
Factory default: 1

Description: This is the maximum decrease in Tx power level that AUPC is allowed to make to maintain distant Eb/No.

Edit-Tx-Carrier-Advanced-BUC Control Menu

The following BUC screens are available only on L-band modems.

BUC:
1:Power offset 2:BUC type 3:PSU 4:Reference
5:Output 6:Attenuation 7:1-for-1

This menu contains the following options:

- *Power offset.* This allows the user to set the system gain or loss after the modem, so the modem can display the transmit carrier level in terms of either the transmit power or EIRP, measured in dBm or dBW.
- *BUC type.* Allows the type of BUC to be selected from a list of supported BUCs, with the option of either open loop control (Independent mode) or closed loop control (Terminal mode). In closed loop mode, the modem attempts to maintain a constant BUC output power by adjusting the modem output power and BUC attenuation level.
- *PSU.* If the modem is fitted with an internal DC power supply option then this screen allows the user to turn on or off the DC power supply to the BUC.
- *Reference.* This controls whether the modem provides a 10MHz reference signal to the BUC.
- *Output.* Turns the BUC RF output on or off.
- *Attenuation.* This allows the user to vary the BUC attenuator level.

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- *1-for-1*. This controls whether BUC services (i.e. DC supply and 10MHz reference) stay with the on-line modem or switch to the standby modem when a 1-for-1 switchover occurs in a 1-for-1 redundant pair of modems. Note that FSK communications will always be switched over.

Edit-Tx-Carrier-Advanced-BUC Power Offset Screen

Tx power offset: -99.9 to 99.9dB
[-00.0] Step 0.1dB
New: -00.0

Units: dBm/dBw
Minimum value: -99
Maximum value: +99
Step size: 0.1dB
Factory default: 0

Description: This screen allows the modem to display and the user to edit the final SHF power instead of the IF carrier level. Use the up/down arrows to change the sign. Once set, the user is navigated to the Tx power units selection screen.

Edit-Tx-Carrier-Advanced-BUC Power Units Screen

Tx power units: [dBm]
1: dBm
2: dBw

This allows the user to set the modem to display and edit the Tx carrier level in terms of either the Tx Power or EIRP, measured in dBm or dBW.

Edit-Tx-Carrier-Advanced-BUC Type Screen

BUC Type:
[None]
New: C 5.8 – 6.425 GHz

Options:

None

There is no BUC attached or it is controlled independently.

Other

If you are not using a Paradise BUC, select Other and manually configure the BUC parameters.

RFT5000 Ku

Uses RS485 comms to RFT5000. LO frequency: 15450 MHz

User

FSK enabled, but user must set LO frequency of BUC.

C5.85 – 6.725 GHz (CODU)

Uses RS485 comms to CO unit. LO frequency: 4900MHz

Ku 14 – 14.5 GHz (CODU)

Uses RS485 comms to CO unit. LO frequency: 13050MHz

Ext Ku 13.75 – 14.5 GHz (CODU)

Uses RS485 comms to CO unit. LO frequency: 12800MHz

RFT5000 C

Uses RS485 comms to RFT5000. LO frequency 4900 MHz

C 5.8 – 6.425 GHz (VSAT)

Only available if FSK option fitted. LO frequency: 4900MHz

PALAPA 6.425 – 6.725 GHz (VSAT)

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Only available if FSK option fitted. LO frequency: 5475MHz

INSATC 6.725 – 7.025 GHz (VSAT)

Only available if FSK option fitted. LO frequency: 5775MHz

Ku 14.0 – 14.5 GHz (VSAT)

Only available if FSK option fitted. LO frequency: 13050MHz

Offset Ku 13.75 – 14.25 GHz (VSAT)

Only available if FSK option fitted. LO frequency: 12800MHz

**Factory
default:**

None

Description

Allows the user to select from a number of Paradise BUCs or *Other* if another manufacturer's BUC is being used. If an option other than *None* is selected, then the user is taken to the following Terminal Mode screen.

Edit-Tx-Carrier-Advanced-BUC Terminal Mode Screen

BUC terminal mode: [Off]
1: Off
2: On

This allows the user to select either open loop control (Independent mode) or closed loop control (Terminal mode). In closed loop mode, the modem attempts to maintain a constant BUC output power by adjusting the modem output power and BUC attenuation level. In open loop mode, no feedback from the BUC is used. Once a selection has been made and if the BUC type has been set to *Other* then the following SHF Frequency Offset screen is displayed.

Edit-Tx-Carrier-Advanced-BUC Frequency Offset Screen

SHF freq offset: -99.999 to 99.999GHz
[+12.80000000] Step 100Hz
New: +12.80000000

Units: GHz
Minimum value: -99.999
Maximum value: 99.999
Step size: 0.0000001GHz
Factory default: 0.000

Description: This screen allows the modem to be set to display and edit the final SHF frequencies instead of the IF frequencies. When the BUC type has been set to a known Paradise BUC and the modem has the FSK communications option then this setting is done automatically and the menu option to manually set the frequency shift is not presented.

Edit-Tx-Carrier-Advanced-BUC Power Screen

Power if over 170W: 0 to 999W
000] Step 1W
New: 000

Units: W
Minimum value: 0
Maximum value: 999
Step size: 1W
Factory default: 0.000

Description: This screen tells the modem what the BUC power class is. However, this can be ignored unless a CO has been selected, with a power output greater than 170W.

Edit-Tx-Carrier-Advanced-BUC DC Supply Screen

DC supply voltage: [Off]
1: Off
2: On

This screen allows the user to control the DC to the BUC. Either +48V DC 3A (200W) or +24v DC 5.5A (200W) may be sourced via the coax (line powered) if the BUC power supply option is fitted.



Severe damage may occur if a DC supply is fed to a BUC not configured to be `Line powered`.

Edit-Tx-Carrier-Advanced-BUC 10MHz Reference Screen

10MHz reference:	[Off]
	1: Off
	2: On

By selecting *On*, the modem's internal 10MHz reference signal can be sourced from the modem up the coaxial site cable to the BUC.

Edit-Tx-Carrier-Advanced-BUC Output Screen

BUC carrier:	[Off]
	1: Off
	2: On

This switches the BUC Tx carrier on and off independently of the modem's Tx carrier on/off control. This may be useful where one BUC carries several carriers (passively combined but with one modem providing DC/10MHz Ref/FSK) and you wish to mute all the carriers.

Edit-Tx-Carrier-Advanced-BUC Attenuation Screen

BUC attenuation: -15 to 0dB
[-15] Step 1dB
New: -15

Units: dB
Minimum value: 0
Maximum value: -15
Step size: 1dB
Factory default: 0

Description: This allows the user to vary the attenuator in the BUC. Typically this is used when there is a short run from the modem to the BUC made with reasonable quality cable, and where with a low loss the minimum output from the modem could saturate the BUC input unless the attenuator (early in the BUC gain profile) is set suitably high.

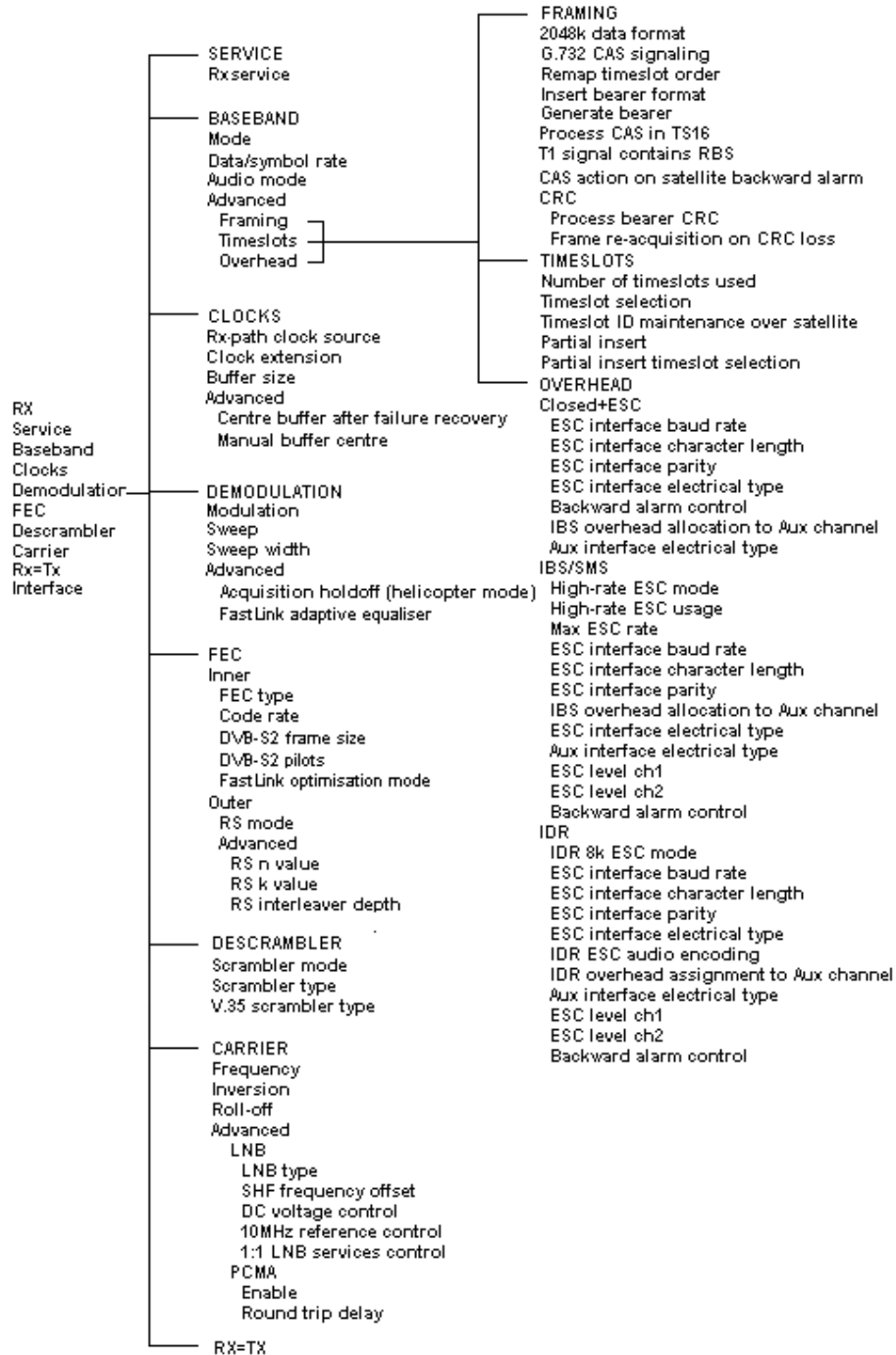
If in doubt always start with the minimum modem Tx carrier level and the maximum BUC attenuation.

Edit-Tx-Carrier-Advanced-BUC-1-for-1 Screen

Mute services in Standby: [Off]
1: Off
2: On

This controls whether BUC services (i.e. DC supply and 10MHz reference) stay with the on-line modem or switch to the standby modem when a 1-for-1 switchover occurs in a 1-for-1 redundant pair of modems. Note that FSK communications will always be switched over.

1.19.3.2 Edit-Rx Menu



Front Panel Edit-Rx Menus

1:Service	2:Baseband	3:Clocks
4:Demodulate	5:FEC	6:Descrambler
7:Carrier	8:Rx=Tx	

This menu contains the following options:

- *Service*. This option allows the selection of the framing mode for the modem.
- *Baseband*. This option leads to a submenu that allows terrestrial framing, timeslots and overhead to be configured.
- *Clocks*. This allows the receive path clock to be set up.
- *Demodulate*. This leads to a submenu that allows the demodulation scheme to be configured.
- *FEC*. This leads to a submenu that contains options for selecting the inner and outer forward error correction (FEC) schemes.
- *Descrambler*. This leads to a submenu that allows descrambling to be controlled.
- *Carrier*. This leads to a submenu that allows the frequency and spectrum inversion to be controlled.
- *Rx=Tx*. This option allows the receive path to be automatically configured to be the same as the transmit path, thereby simplifying set up. There are a number of exceptions including carrier frequency, spectral inversion, timeslots and clocks.

1.19.3.2.1 Edit-Rx-Service Screen

See the description of the transmit path equivalent (including follow-on screens for FastLink optimization mode and DVB-S2 frame size/pilots setting).

1.19.3.2.2 Edit-Rx-Baseband Menu

See the description of the transmit path equivalent.

Edit-Rx-Baseband Mode Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Data Rate Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced Menu

See the description of the transmit path equivalent (Chapter 14).

Edit-Rx-Baseband-Advanced-Framing Menu

1:2048k mode	2:CAS	3:TS order
4:Insert	5:Bearer	6:G732 sig
7:T1 sig	8:ABCD	

This menu contains the following options:

- *2048k mode*. This option is used to indicate whether a 2048kbps traffic stream is formatted as G.732 or not.
- *CAS*. This option specifies whether Channel Associated Signalling (CAS) information is present in Timeslot 16.
- *TS order*. This controls whether timeslot reordering is allowed.
- *Drop mode*. This specifies the framing format for Drop MUX operation.
- *Bearer*. This controls the origination of a terrestrial bearer from the Insert MUX.
- *G732 sig*. This option controls whether CAS information is processed and routed through the satellite.
- *T1 sig*. This specifies whether Robbed Bit Signalling (RBS) information is present in the traffic source.
- *ABCD*. This determines the action to be taken with respect to the Rx CAS 'ABCD' signalling block in relation to satellite backward alarms.

Edit-Rx-Baseband-Advanced-Framing-2048k Mode Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-CAS Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-TS Order Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-Insert Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-CAS in TS16 Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-T1 RBS Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Framing-CAS Action on Backward Alarm Screen

CAS action on satellite backward alarm:	
1:abcd normal	2:abcd = AIS
3:b=1	4:a=1, b=1

Options:

Signalling bits abcd normal

Signalling bits abcd=AIS

Signalling bit b=1, acd normal

Signalling bits ab=1, cd normal

Factory default: *Signalling bits abcd normal*

Description: Determines actions to be taken with respect to Rx CAS signalling block code.

Edit-Rx-Baseband-Advanced-Timeslots Menu

Timeslots:1:Number used 2:Timeslots 3:Maintain ID 4:Partial 5:Partial TS

This menu contains the following options:

- *Number used.* This indicates the number of timeslots sent over the satellite.
- *Timeslots.* This option is used to select which timeslots are inserted.
- *Maintain ID.* This controls whether timeslot identity has been maintained over satellite (i.e. whether the timeslots represent different data streams or are all part of the same stream).
- *Partial.* This controls whether part or all of the received data is to be inserted into the terrestrial bearer.
- *Partial TS.* When Partial Insert is active, this controls which timeslots from the satellite are inserted into the terrestrial bearer.

Edit-Rx-Baseband-Advanced-Timeslots-Number Used Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Timeslots-Timeslots Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Timeslots-Maintain ID Screen

See the description of the transmit path equivalent.

Edit-Rx-Baseband-Advanced-Timeslots-Partial Insert Screen

Partial insert: [Normal] 1:Normal 2:Partial
--

Options:

Normal

Partial

Factory default: *Normal*

Description: Controls whether part or all of the received data is to be inserted into the terrestrial bearer.

Edit-Rx-Baseband-Advanced-Timeslots-Partial Timeslots Screen

Sat data to insert in terr bearer :
[1]
New:1

Options:

Ignore

Insert

Factory default: *Ignore*

Description: When Partial Insert is active, controls whether the timeslot from the satellite is to be inserted into the terrestrial bearer.

Edit-Rx-Baseband-Advanced-Overhead Menu

See the description of the transmit path equivalent.

Edit-Rx-Clocks Menu

Clocks: **1:Source**
 2:Buffer
 3:Advanced

This menu contains the following options:

- *Source*. This selects the receive path clock source.
- *Buffer*. This option sets the buffer capacity for received data. This provides Doppler and plesiochronous buffering (see Section 8.1 for a full description of buffering).

- *Advanced.* This menu offers advanced satellite buffering options.

1.19.3.2.3 Edit-Rx-Clocks-Source Screen

Rx-path clock source: [Satellite]	
1:Satellite	2:Tx Clock In
3:Internal	4:Station

Options:

Satellite

This is the clock from the satellite. This is converted back to the rate required at the terrestrial port.

Tx Clock In

The Tx path input clock is used to clock Rx data to the terrestrial port. This is plesiochronous mode and requires the receive buffer to be set to a value sufficient to accommodate both the difference in the clocks at each end of the link and any Doppler shift, whilst providing the required interval between buffer slips.

Internal

The internal reference clock is used to clock data to the terrestrial port. This requires the receive buffer to be set as per the *Tx Clock In* option.

Station

If the station clock frequency is the same as the Rx data rate then the station clock is used directly,. If the station clock is a different frequency to the Rx data rate then an internal conversion to the correct frequency is made. This requires the receive buffer to be set as per the *Tx Clock In* option.

Factory default:

Satellite

Description: Sets the source of the clock for the Rx path.

If the Rx clock is set to Satellite, a G.703 interface card is fitted but *not* currently selected and the G.703 clock extension SAF feature is enabled then the following menu is displayed at this point:

Clock extension over sat:
[Off]
New: E1

This allows a high stability G.703 clock reference to be generated from the satellite signal (see Section 8.8 for further details).

Options:

OFF

E1

T1

Factory default: OFF

Description: This provides a high-stability clock over satellite derived from a G.703 card that can be used for clocking any interface in place of GPS.

1.19.3.2.4 Edit-Rx-Clocks-Buffer Screen

Buffer size:0 to 99ms
[8] Step 1ms
New: 8

Units: ms

Minimum value: 0

Maximum value: 99

Step size: 1

Factory default: 8

Description: Buffer capacity for received data. This is used when the Rx clock is not set to *Satellite*. Should the capacity be exceeded (unflow or overflow) and the buffer slips, then it will slip by exactly half its chosen capacity, back to 50% full. See The buffer fill state can be viewed on the *Status Demodulator* screen. Section 8.1 for details of how the buffer operates.

Edit-Rx-Clocks-Advanced Menu

Advanced: 1:Auto centre
 2: Manual centre

This menu contains the following options:

- *Auto centre*. This controls whether the Rx (Doppler) buffer is centred following an Rx
- *Manual centre*. This allows the Rx buffer to be recentred manually.

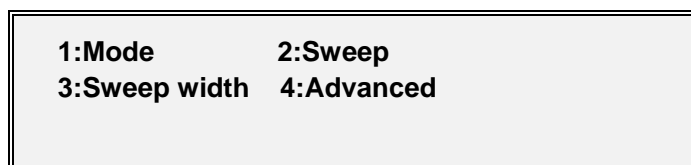
Edit-Rx-Clocks-Advanced-Auto Centre Screen

Centre buffer after failure recovery: [On]
 1:Off
 2:On

Factory default: *On*

Description: Controls whether the Rx buffer is centred following an Rx path recovery from failure. This should be disabled where minor outages occur where the errors or synchronisation losses caused by centring the buffer are potentially larger than those caused by the outage.

1.19.3.2.5 Edit-Rx-Demodulation Menu



This menu contains the following options:

- *Mode*. This selects the receive path modulation scheme.
- *Sweep*. This controls the Rx signal sweep configuration.
- *Sweep width*. This controls the Rx signal sweep width.
- *Advanced*. This controls an Rx adaptive equalizer for the FastLink FEC (which compensates for transponder group delay). It also controls a holdoff time for demodulator loss of lock used to prevent spurious loss of lock being reported when the Rx antenna is briefly obscured.

Edit-Rx-Demodulation Screen

See the description of the transmit path equivalent.

The table shown under *Edit-Tx-FEC-Inner* defines normal operation with respect to FEC mode, FEC rate and modulation scheme.

Edit-Rx-Demodulation-Sweep Screen

Sweep mode: [Normal]
1:Normal (+/-32kHz)
2:Other

Options:

Normal

In this mode the sweep width is controlled automatically by the modem. The width is always set to +/-32kHz by the modem.

Other

This mode allows the user to set the sweep width in order to compensate for carrier frequency uncertainty due to Tx frequency, satellite and Rx frequency conversions. This may be required to optimize performance at very low data rates by setting a sweep width that is smaller than the default.

Factory default:

Normal

Description: Controls the Rx signal sweep configuration.

Edit-Rx-Demodulation-Sweep Width Screen

Sweep width(+/-):1 to 250kHz
[032] Step 1kHz
New: 032

Units: kHz
Minimum value: 1
Maximum value: 250
Step size: 1
Factory default: 32

Description: Controls the Rx signal sweep width when the *Sweep mode* is set to *Other*. This is a +/- setting, i.e. the total width is twice the value that is entered. In general the default value should be use but at very low data rates it may reduce demodulator acquisition time if the sweep width is

set to a lower value.

Edit-Rx-Demodulation-Advanced Menu

Advanced:	
1:Reacquire	2:Equaliser

This menu can be selected (when user level is set to *Advanced*) following the setting of the modulation type. It contains the following options:

- *Reacquire (reacquisition holdoff)*. This applies only to MIL-STD-188-165A L-band modems. It allows a period of time to be defined for which, after the demodulator loses the carrier signal, the demodulator does not go back to its normal acquisition mode but continues to try to track the signal. This is useful where there may be a temporary obstruction to the satellite signal, such as from a helicopter, as it potentially allows the demodulator to regain the carrier more quickly than would otherwise be the case.
- *Equaliser*. This menu controls a 9-tap adaptive equaliser for FastLink (note that DVB-S2 has a built-in equalizer that is used automatically all the time). Typically about 15% of the bandwidth on transponders at the band edges is subject to signal distortion called 'group delay'. This causes inter-symbol interference due to filters on the transponder processing different frequency components of the signal in different amounts of time. This restricts how the transponder band edges can be used. In particular, large carriers cannot use the band edges without compensating for the problem. The FastLink adaptive equaliser, which is a SAF feature and requires an add-on hardware card, compensates for group delay and amplitude distortion.

1.19.3.2.6 Edit-Rx-FEC Menu

See the description of the transmit path equivalent.

Edit-Rx-FEC-Inner Menu

See the description of the transmit path equivalent.

Edit-Rx-FEC-Inner-FEC Screen

See the description of the transmit path equivalent.

The table shown under *Edit-Tx-FEC-Inner* defines normal operation with respect to FEC mode, FEC rate and modulation scheme.

Edit-Rx-FEC-Inner-Rate Screen

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer Menu

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer-RS Mode Screen

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer-RS Type Screen

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer-Advanced Menu

See the description of the transmit path equivalent.

See the *Edit-Tx-FEC-Outer-Advanced* description for a table of Reed-Solomon N, K and Interleaver Depth values used in normal operation.

Edit-Rx-FEC-Outer-Advanced RSN (Codeword Length) Screen

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer-Advanced RSK (Data Length) Screen

See the description of the transmit path equivalent.

Edit-Rx-FEC-Outer-Advanced Interleaver Depth Screen

See the description of the transmit path equivalent.

1.19.3.2.7 Edit-Rx-Descrambler Menu

See the description of the transmit path equivalent.

The transmit section description also includes a table that defines normal operation with respect to scrambler selection.

Edit-Rx-Descrambler-Enable Screen

See the description of the transmit path equivalent.

Edit-Rx-Descrambler-Type Screen

See the description of the transmit path equivalent.

1.19.3.2.8 Edit-Rx-Carrier Menu

Carrier:	
1:Frequency	2:Inversion
3:Roll-off	4:Advanced

This menu has the following options:

- *Frequency*. This sets the IF frequency used to receive from the satellite.
- *Inversion*. This controls whether the I and Q channel outputs are swapped.
- *Roll-off*. This controls the expected slope (gradient) of the received carrier at its edges (this affects the occupied bandwidth).
- *Advanced*. This controls the *Paired Carrier* (PCMA) carrier overlap feature. On L-band modems it also allows control of an LNB.

Edit-Rx-Carrier-Frequency Screen

See the description of the transmit path equivalent.

Edit-Rx-Carrier-Inversion Screen

See the description of the transmit path equivalent.

Edit-Rx-Carrier-Advanced Menu

Advanced:	1:LNB
	2:PCMA

This menu has the following options:

- *LNB*. This controls the LNB type, DC supply and 10MHz reference to the LNB, and 1:1 LNB control (whether LNB services stay with the failed modem or switch over to the backup modem on a failure).

Edit-Rx-Carrier-Advanced LNB Menu

The following LNB screens are only available on the L-band modem.

LNB:	1:LNB type	2:PSU
	3:Reference	4:1:1

This menu has the following options:

- *LNB type*. This allows selection of the LNB type that is fitted. It also allows the modem to display and the user to edit the final SHF frequencies instead of the normal L-band frequencies.
- *PSU*. This allows the DC supply to the LNB from the modem to be turned on or off.
- *Reference*. This controls whether a 10MHz reference signal is supplied to the LNB from the modem.
- *1-for-1*. This controls whether LNB services (i.e. DC supply and 10MHz reference) stay with the on-line modem or switch to the standby modem when a 1-for-1 switchover occurs in a 1-for-1 redundant pair of modems. Note that FSK communications will always be switched over.

Edit-Rx-Carrier-Advanced-LNB Type Screen

LNB type:
[None]
NEW: C 3.635 – 4,2 GHz

Options:

None

There is no LNB attached.

Other

If you are not using a Paradise LNB, select *Other* and manually configure the LNB parameters.

C 3.635 – 4.200 GHz LO Frequency: 5150MHz

Ku 10.95 – 11.45 GHz. LO Frequency: 10000MHz

Ku 11.2 – 11.7 GHz LO Frequency: 10250MHz

Ku 11.7 – 12.2 GHz LO Frequency: 10750MHz

Ku 12.25 – 12.75 GHz LO Frequency: 11300MHz

Factory default:

None

Description

Allows the user to select a number of Paradise LNBs or *Other* if another manufacturer's LNB is being used. If *Other* is selected then the following LNB frequency offset screen is displayed.

Note the `Std C` LNB uses a high side Local Oscillator (LO) and the received SHF frequency is LO - IF frequency (not LO + IF as with most other bands). This is academic as it is handled automatically by the modem, which displays the correct SHF frequency.

Edit-Rx-Carrier-Advanced-LNB Frequency Offset Screen

SHF freq offset: -99.999 to 99.999GHz
[-05.15000000] Step 100Hz
New: -05.1500000

Units: MHz
Minimum value: 0
Maximum value: 65535
Step size: 1
Factory default: 0

Description: Once set, all Rx IF frequencies displayed or edited include the frequency shift of the LNB or downconverter chain.

Note that the entry of the SHF frequency shift expects a high side Local Oscillator (LO) and therefore displays the SHF frequency = LO - IF. Changing the sign allows the modem to display a low side LO. (High side LO is - and Low side LO is +.) Move the cursor over the sign and use the up/down arrows to change.

Edit-Rx-Carrier-Advanced-LNB PSU Menu

DC voltage:
[Off]
New: 15v

The L-band modem can supply either 15V or 24V at 500mA to the LNB up the coaxial site cable or `line powered`. The options available are *Off*, *15V*, *24V* and Multiswitch. Note that the Multiswitch option selects the Global Communications LNB Multiswitch, allowing selection of a high-band/low-band LO and horizontal/vertical polarization.



Severe damage may occur if a DC supply (or the wrong voltage DC supply) is fed to a LNB not configured to be `Line powered`.

Edit-Rx-Carrier-Advanced-LNB 10MHz Reference Screen

10MHz reference:	[Off]
	1: Off
	2: On

When switched on, the modem's internal 10MHz reference signal is sourced from the modem up the coaxial site cable to the LNB.

Edit-Rx-Carrier-Advanced-LNB 1:1 Screen

Mute Services in Standby:	[Off]
	1: Off
	2: On

This controls whether LNB services (i.e. DC supply and 10MHz reference) stay with the on-line modem or switch to the standby modem when a 1-for-1 switchover occurs in a 1-for-1 redundant pair of modems. Note that FSK communications will always be switched over.

Edit-Rx-Carrier-Advanced PCMA Menu

PCMA:	1:Enable
	2:Round trip delay

This menu has the following options:

- *Enable*. This is used to switch *Paired Carrier* off and on. Access to this menu option requires the *Paired Carrier* feature to have been previously enabled through the modem SAF mechanism.
- *Round trip delay*. This allows the option of setting the satellite round trip delay either by entering positional coordinates for the modem (earth station) and the satellite or alternatively setting an absolute delay. The delay is required in order for the *Paired Carrier* signal processing algorithm to find a best match for its stored copy of the outgoing transmitted signal with the composite return signal, in order to subtract the unwanted near signal leaving just the far carrier.

Edit-Rx-Carrier-Advanced-PCMA Enable Screen

PCMA enable:	[Off]
	1: Off
	2: On

This is used to switch *Paired Carrier* off and on. Access to this menu option requires the *Paired Carrier* feature to have been previously enabled through the modem SAF mechanism.

For first-time use please see the *Paired Carrier* deployment recommendations in the information box overleaf.

When switched on, the modem expects the received signal to consist of two overlapped carriers utilizing the same space segment. When on, a copy of the modem's transmitted signal will be stored in memory and the *Paired Carrier* signal processing algorithm will attempt to match this with the composite return signal, in order to subtract the unwanted near signal leaving just the far carrier.

Prior to enabling *Paired Carrier* it is necessary to set up the delay to satellite as in the following menu options.

Note that there are no other control settings that are specific to *Paired Carrier* operation – other settings used by the *Paired Carrier* algorithm such as centre frequency and sweep width form part of the normal setup of the modem even for non-overlapped carriers and

work in the same way. The cancellation bandwidth itself is automatically deduced by the modem from the larger of the transmit and receive symbol rates and roll-off factors (i.e. occupied bandwidth).

The table below indicates the circumstances under which modem signal inversions are required in relation to *Paired Carrier* operation.

Paired Carrier Working?	BUC	LNB	Tx Modem Inversion	Rx Modem Inversion
Yes	Non Inverting	Non Inverting	No	No
Yes	Non Inverting	Inverting	No	Yes
Yes	Inverting	Inverting	No	No
No	Inverting	Non Inverting	N/A	N/A



PLEASE READ THE FOLLOWING INFORMATION FOR FIRST-TIME SETUP OF A PAIRED CARRIER LINK.

In relation to *Paired Carrier*, generally there are no restrictions on how the overlapped carriers are brought up and the satellite link is established. However, the following guidelines may be useful in proving correct *Paired Carrier* operation as part of the overall initial link deployment process. Once correct operation is established then *Paired Carrier* can be switched on and off or reconfigured just like any other modem feature.

You must get each link working correctly as a normal link prior to switching *Paired Carrier* on! You must ensure that there is no spectral inversion in the RF chain – if there is then this must be corrected by re-inverting it for *Paired Carrier* operation to work – see the above table.

1. Ensure *Paired Carrier* is switched off (Main, 2:Edit, 3:Rx, 7:Carrier, 4:Advanced, 2:PCMA, 1:Enable and set to OFF).
2. Before starting, it is strongly recommended to prepare for a BER data transparency test, using data test sets connected to each modem, or using the modem internal PRBS BER test feature, which can be temporarily enabled if necessary.
3. Configure both modems for identical services, including the same Tx and Rx frequencies.

Different PRBS test patterns must be used in each direction (e.g. for Modem 1 Tx to Modem 2 Rx use 2¹⁵-1 and for Modem 2 Tx to Modem 1 Rx use 2²³-1). This ensures that the two signals are sufficiently different from each other to allow *Paired Carrier* to work.

4. Check the Tx power level setting is correct and bring up the first carrier (using the selected common transmission frequency) and
 - Check the receive signal level, Eb/No, spectrum and constellation are as expected.
 - Check the received signal is data transparent.

5. Switch the first carrier off.
6. Check the Tx power level setting is correct and bring up the second carrier (using the selected common transmission frequency) and
 - Check the receive signal level, Eb/No, spectrum and constellation are as expected.
 - Check the received signal is data transparent.
7. Switch the second carrier off.

To avoid non-linear distortion, ensure adequate HPA back-off when using multiple carriers through a single amplifier, particularly with higher order modulations when testing at a single site.

8. At each modem, set either location information or, alternatively, the round trip delay to satellite (Main, 2:Edit, 3:Rx, 7:Carrier, 4:Advanced, 2:PCMA, 2: Round Trip Delay). If location information is entered for the modem position then the satellite delay will be calculated automatically. To minimise acquisition time when using a round trip delay, the delay should be specified to within ± 1 ms of the nominal value that you have calculated.
9. Enable the Tx carrier in the first modem. Both demodulators should lock (Rx traffic LED should go green).
10. Enable the Tx carrier in the second modem. Both demodulators should go out of lock (Rx traffic LED should go out). Please note: the combined carrier power will increase by 3dB when the second carrier is enabled.
11. Enable *Paired Carrier* in the first modem (Main, 2:Edit, 3:Rx, 7:Carrier, 4:Advanced, 2:PCMA, 1:Enable and set to ON). Its demodulator should lock (Rx traffic LED should go green).
12. Enable *Paired Carrier* in the second modem (Main, 2:Edit, 3:Rx, 7:Carrier, 4:Advanced, 2:PCMA, 1:Enable and set to ON). Its demodulator should also lock (Rx traffic LED should go green).
13. Enable the BER test and check for data transparency in both directions. Inject errors via the BER testers in both directions and ensure they are received correctly.
14. If the modems do not lock or are not data transparent then
 - Ensure there is no spectral inversion in the RF chain. If there is, then this must be corrected by re-inverting it for *Paired Carrier* operation to work.
 - Check the modem/satellite location information or round trip time that has been set in each modem. The range entered for the round trip time must cover the actual distance to the satellite. Try widening out the round trip delay to ensure that it definitely covers the actual time delay to satellite. Try switching from location to round trip delay or vice versa.
 - Switch *Paired Carrier* off and on again in each modem (to counter the possibility of a false lock).
 - If this does not work then switch the carrier off and on again in each modem.
 - Check the receive signal level and Eb/No are correct.
 - Check the spectrum and constellation for signs of signal degradation such as noise or interference.
 - Otherwise check the general modem settings for correct configuration and overlap of the two carriers (note that there are

restrictions on the supported level of power asymmetry and symbol rate asymmetry).

15. If the modems take a long time to lock then
 - Narrow the difference between the minimum and maximum round trip delay times (if these are being used) to minimise the uncertainty in the range to the satellite (Main, 2:Edit, 3:Rx, 7:Carrier, 4:Advanced, 2:PCMA, 2: Round Trip Delay). This has a significant effect on acquisition time. If using a round trip delay then try switching to using location information.
 - Check for signs of signal degradation such as poor Eb/No values or poor spectrum and constellation.
16. If 1:1 or 1:N redundancy is being used, Paradise recommends setting the modems to switch on Unit Faults only (i.e. setting the Tx and Rx fail switchovers off via the *Main-Edi-Unit-Advanced-1 for 1* menu option). This is because when a modem is in standby, no transmit carrier is generated, therefore there is nothing for *Paired Carrier* to cancel and the standby demodulator will not lock because it cannot separate the two interfering carriers (from the online modem and the remote modem). In this case, a switchover from the online modem can never occur since the standby modem is, from a logical point of view, faulty and a switchover will not occur to a standby modem deemed faulty. Please refer to application note AN_027A (1:1 quick start guide) for further details.
17. When using *Paired Carrier* with IP as the terrestrial interface type, Paradise recommends setting the master hub transmit timing to *Internal*, the hub and remote receive clocking to *Satellite* and the remote transmit clocking to *Rx reference*. This ensures only one master clock is providing timing for both modems and can prevent data pattern clashes (between the two overlapping carriers caused by similarities in the satellite framing) that otherwise can degrade *Paired Carrier* performance.

Edit-Rx-Carrier-Advanced-PCMA Round Trip Delay Screen

Round trip delay:
[Set location]
New: Set delay

Options:

Set location

Select this mode if you want the modem to automatically calculate the satellite round trip delay using coordinates that you enter for the modem and satellite positions.

Set delay

Select this mode to enter fixed minimum and maximum satellite round trip delay times.

Use GPS

This mode allows mobile Paired Carrier operation (for example, on ships) allowing travel anywhere in the world without having to change location or satellite delay information for Paired Carrier. Paired Carrier operation is seamless regardless of changes in position. It assumes that there is a GPS source attached to the modem via RS232. When this mode is selected, the modem remote serial control port is configured into RS232 mode at 4800 baud. The modem will poll the serial port on a regular basis for the latest GPS position and use this in the Paired Carrier control process. The modem automatically selects two commonly used GPS protocols, namely, GGA (GPS Fix Data) and GLL (Geographic position Latitude/Longitude), and will support whichever is available. It uses the GPS information to calculate the minimum and maximum delays to satellite and updates these if they need to change from their existing values.

**Factory
default:**

Set location

Description: Allows the selection of the method for determining the satellite round trip delay. This can be entered as a time delay or can be automatically calculated from location information. It can also be calculated automatically using information provided by a GPS system attached to the modem (in this case it is still necessary to enter a position for the satellite via the *Edit-Rx-Carrier-Advanced-PCMA* Location screens).

The delay is required in order for the *Paired Carrier* signal processing algorithm to find a best match for its stored copy of the outgoing transmitted signal with the composite return signal, in order to subtract the unwanted near signal leaving just the far carrier. For the fastest possible acquisition time, once Paired Carrier is working, it is recommended that the actual measured satellite delay shown on the *Status-PCMA* screen is used (-/+0.5ms) to set the minimum and maximum satellite delays.

Edit-Rx-Carrier-Advanced-PCMA Location Screens

When the *Round trip delay* method for *Paired Carrier* is set to *Location* then the following screens are displayed in sequence.

Earth station lon: -180 to +180Deps
[000.00] Step 0.01Deps
New: 000.00 + = E - = W

Units: Deps
Minimum value: -180.00
Maximum value: +180.00
Step size: 0.01
Factory default: 000.00

Description: The longitudinal position of the modem (earth station). The modem front panel *Up* and *Down* arrow keys are used for setting '+' and '-', respectively.

Earth station lat: -90 to +90Deps
[00.00] Step 0.01Deps
New: 00.00 + = N - = S

Units: Deps
Minimum value: -90.00
Maximum value: +90.00
Step size: 0.01
Factory default: 00.00

Description: The latitudinal position of the modem (earth station). The modem front panel *Up* and *Down* arrow keys are used for setting '+' and '-', respectively.

Satellite lon: -180 to +180Deps
[000.00] Step 0.01Deps
New: 000.00 + = E - = W

Units: Deps
Minimum value: -180.00
Maximum value: +180.00
Step size: 0.01
Factory default: 000.00

Description: The longitudinal position of the satellite. The modem front panel *Up* and *Down* arrow keys are used for setting '+' and '-', respectively.

Edit-Rx-Carrier-Advanced-PCMA Delay Screens

When the *Round trip delay* method for *Paired Carrier* is set to *Delay* then the following screens are displayed in sequence.

Min delay: 0 to 300ms
[000.00] Step 0.01ms
New: 000.00

Units: ms
Minimum value: 000.00
Maximum value: 300.00
Step size: 0.01
Factory default: 000.00

Description: The minimum satellite round trip delay. This value directly affects the modem acquisition time. Once Paired Carrier is working, in order to minimize the acquisition time, it is recommended to use the actual measured satellite delay value shown on the *Status-PCMA* screen and set the minimum delay to this value minus 0.5ms.

Max delay: 0 to 300ms
[000.00] Step 0.01ms
New: 000.00

Units: ms
Minimum value: 000.00
Maximum value: 300.00
Step size: 0.01
Factory default: 000.00

Description: The maximum satellite round trip delay. This value directly affects the modem acquisition time. Once Paired Carrier is working, in order to minimize the acquisition time, it is recommended to use the actual measured satellite delay value shown on the *Status-PCMA* screen and set the maximum delay to this value plus 0.5ms.

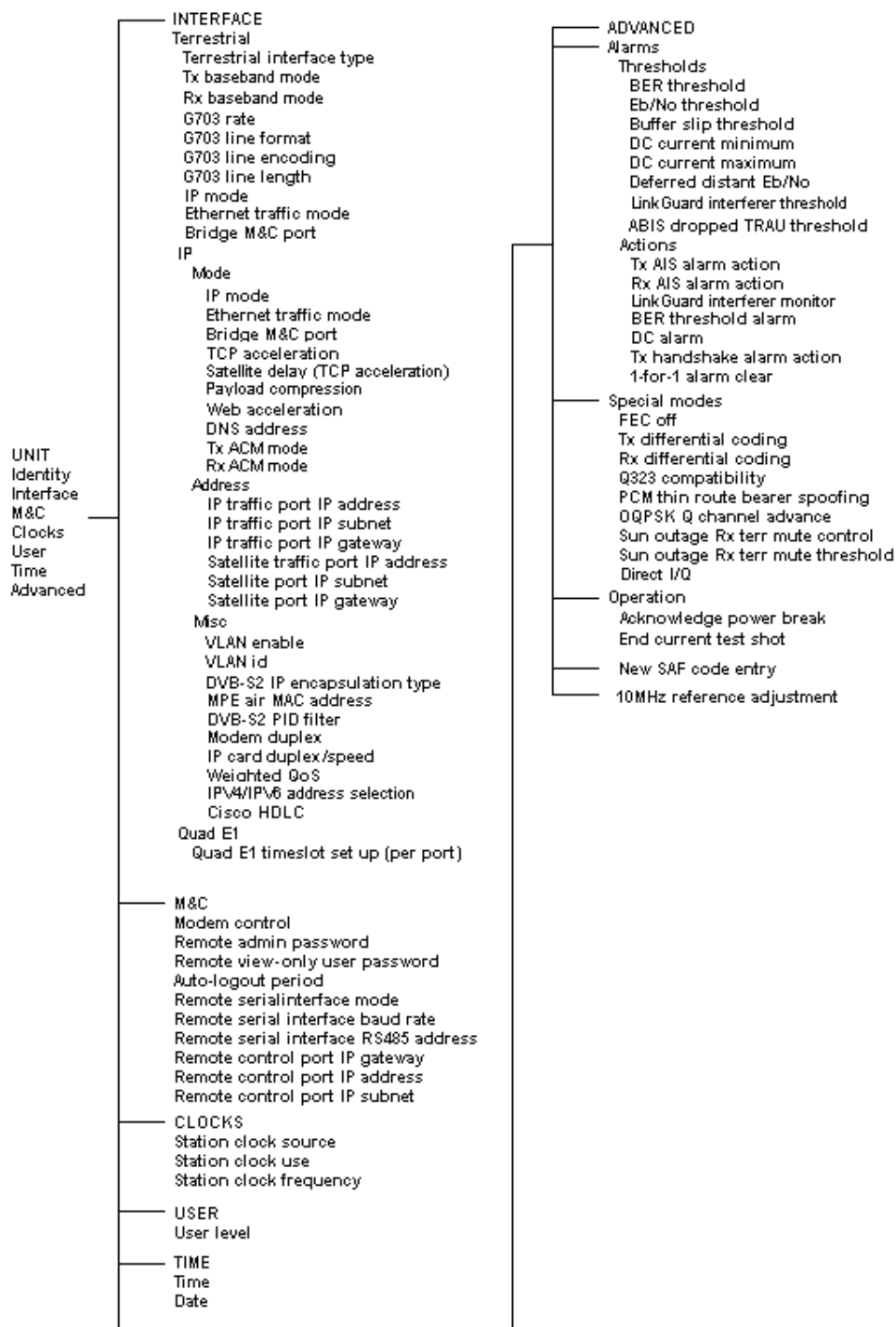
Edit-Rx Rx=Tx Screen

Rx values track Tx: [Off]
1:Off
2:On

Factory default: Off

Description: Controls whether specific Rx configuration parameters mirror the equivalent Tx parameters. Exceptions include the IF frequency, spectral inversion, clocking and timeslots, as well as parameters that have no Tx equivalent, such as buffer size and sweep control. This feature can be used to simplify the configuration for duplex links. When switched off, the Rx configuration retains its values and does not return to the values prior to tracking being switched on.

1.19.3.3 Edit-Unit Menu



Front Panel Edit-Unit Menus

1:Identity	2:Interface	3:M&C
4:Clocks	5:User	6:Time
7:Advanced		

The *Edit/Unit* menu contains the following options:

- *Identity*. This is a user-assigned field that is typically the unique modem name, number or location.
- *Interface*. This submenu allows the selection and set up of the terrestrial interface.
- *M&C*. This submenu controls remote M&C settings including passwords, interfaces and timeouts.
- *Clocks*. This controls the station clock source to be used in place of the internal 10MHz reference.
- *User*. This allows the selection of one of two user modes, namely, *basic* which restricts user access to just a subset of the most common modem controls, whereas *advanced* mode allows the user to access all options. This is not intended to be a security measure – it merely removes options from view when not necessary and can therefore simplify modem use.
- *Time*. This allows the time and date to be set.
- *Advanced*. This submenu controls alarm thresholds, special modes and allows the entry of SAF codes to activate additional software features in the modem.

1.19.3.3.1 Edit-Unit-Modem Identifier Screen

Modem identifier:	
[Paradise Quantum modem]
Paradise Quantum modem	

Factory default: (Depends on modem model.)

Description: User-assigned field typically the unique modem name, number or location.

1.19.3.3.2 Edit-Unit-Interface Menu

1: Terrestrial	2: IP	3: Quad E1
----------------	-------	------------

This menu contains the following options:

- *Terrestrial*. This allows the selection of the terrestrial interface that is routed through to the main traffic channel of the modem.
- *IP*. This allows set up of the terrestrial and satellite IP ports including mode and addressing.
- *Quad E1*. This is used to set up the ports on a Quad E1 or Sat-ABIS terrestrial interface card.

Please see the note below pertaining to some options that have been removed from this menu.



1) Edit-Unit-Interface-RF-IF Port Impedance Option

Note that this option is no longer available, or required, on Paradise modems, even when software upgrading older modems. The line impedance (50 or 75 Ohms) is matched without the need for any user input.

2) Edit-Unit-Interface-ESC Interface Option

3) Edit-Unit-Interface-Aux Interface Option

Note that these options are now available only via the Edit-Tx-Baseband-Advanced-Overhead screens described in Chapter 14.

Edit-Unit-Interface-Terrestrial Screen

Terrestrial interface type: [RS422] New: RS422
--

Options:

RS422

Available at data rates of up to 10Mbps.

LVDS

Available at all data rates.

RS232

Available at data rates of up to 100kbps.

V.35

Available at data rates of up to 10Mbps.

G.703

Available at data rates of T1, E1, T2, E2, T3 and E3.

IP

Available at all data rates. When the P3714 IP Traffic card is fitted then this will be enabled and the IP Traffic port on the base modem will be disabled.

With the IP Traffic card fitted, on selection of *IP* as the terrestrial interface, the user will be asked to enter an IP address, subnet mask and default gateway for the IP Traffic card.

HSSI

Available at all data rates.

Quad E1

Once selected, the Tx and Rx paths of the Quad E1 card can be set up using the *Edit-Tx-Interface* screen (Section 7.3.3.1.8) and the *Edit-Rx-Interface* screen (Section 7.3.3.2.9), respectively.

MultiMux

A derivative of the Quad E1 interface, if the 'mux' SAF is available. This allows combinations of terrestrial data to be multiplexed to one aggregate satellite carrier using the *Edit-Tx-Interface* screen (Section 7.3.3.1.8) and the *Edit-Rx-Interface* screen (Section 7.3.3.2.9), respectively.

Available Mux modes are:

Quad E1 + RS422

Quad E1 + RS232

Quad E1 + V.35

Quad E1 + IP

Quad E1 + RS422 + IP

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Quad E1 + RS232 +IP

Quad E1 + V.35 + IP

(see following table for a full list of combinations and clocking options)

Eurocom D1

Sat-ABIS

**Factory
default:**

RS422

Description: Selects the terrestrial interface to be used for Tx/Rx traffic.

Note that the Quad E1 MultiMux feature supports a number of different combinations of terrestrial inputs and clocking modes as shown below.

QUAD E1 MultiMux Mode	Supported Interfaces				Tx Clocking Modes				
	1	2	3	4	E1	Rx	Internal	Station	EIA530
E1	E1 port 1	E1 port 2	E1 port 3	E1 port 4	Yes	-	-	-	-
E1+IP	E1 port 1	E1 port 2	E1 port 3	IP	Yes	-	-	-	-
E1+RS422	E1 port 1	E1 port 2	E1 port 3	EIA530 (RS422)	Yes	-	-	-	-
E1+V35	E1 port 1	E1 port 2	E1 port 3	EIA530 (V35)	Yes	-	-	-	-
E1+RS232	E1 port 1	E1 port 2	E1 port 3	EIA530 (RS232)	Yes	-	-	-	-
E1+RS422+IP	E1 port 1	E1 port 2	EIA530 (RS422)	IP	Yes	-	-	-	-
E1+V35+IP	E1 port 1	E1 port 2	EIA530 (V35)	IP	Yes	-	-	-	-
E1+RS232+IP	E1 port 1	E1 port 2	EIA530 (RS232)	IP	Yes	-	-	-	-
RS422+IP	-	-	EIA530 (RS422)	IP	-	Yes	Yes	Yes	Yes
V35+IP	-	-	EIA530 (V35)	IP	-	Yes	Yes	Yes	Yes
RS232+IP	-	-	EIA530 (RS232)	IP	-	Yes	Yes	Yes	Yes

Quad E1 MultiMux Configurations and Clocking Options

After selecting the terrestrial interface, a number of different screens from amongst the following will be displayed, depending on the terrestrial interface type.

Edit-Unit-Interface-Terrestrial-IP Screens

These allow the IP mode (bridging/routing), Ethernet mode (acceleration, compression, etc.) to be set, along with the option to bridge the two Ethernet ports on the base modem together. See the detailed description of these options under **Edit-Unit-Interface-Terrestrial-IP Mode Screens**.

Edit-Unit-Interface-Terrestrial-G.703 Data Rate Screen

G.703 data rate: [T1]

1:T1	2:E1	3:T2
4:E2	#:T3	#:E3

Options:

T1

Requires terrestrial data rate to be 1.544Mbps.

E1

Requires terrestrial data rate to be 2.048Mbps.

T2

Requires terrestrial data rate to be 6.312Mbps.

E2

Requires terrestrial data rate to be 8.448Mbps.

T3

Requires terrestrial data rate to be 44.736Mbps.

E3

Requires terrestrial data rate to be 34.368Mbps.

Factory default: *T1*

Description: Sets the data rate being used in relation to the G.703 interface.

Edit-Unit-Interface-Terrestrial-G.703 Line Format Screen

G.703 line format: [Unbalanced]
1:Unbalanced
2:Balanced

Options:

Unbalanced

Balanced

Factory default: *Unbalanced*

Description: Sets the G.703 line format.

Edit-Unit-Interface-Terrestrial-G.703 Line Encoding Screen

G.703 line encoding: [AMI]
1:AMI #:B3ZS #:B6ZS
4:B8ZS #:HDB3

Options:

AMI

B3ZS

B6ZS

B8ZS

HDB3

Factory default: *AMI*

Description: Selects the different line coding available for the required data rate. The objective is to limit the number of contiguous zeros transmitted on the G.703 line. This is necessary with G.703 as with AMI a `mark` (logic one) is sent as a pulse on the line, and a `space` (logic zero) is set as the **absence** of a pulse on the line. If there are too many contiguous spaces the G.703 receiver fails to recover the clock properly (as there are no incoming pulses for a while) and it causes data errors. HDB3 and B8ZS for example, are both methods of ensuring that no more than three or eight zeroes respectively occur on a G.703 line by substituting strings of more than this number of zeroes with another code, in turn this code is detected at the end of the G.703 line and replaced with the correct number of zeroes again.

Edit-Unit-Interface-Terrestrial -G.703 Line Length Screen

G.703 line length: [133m]		
1:133m	2:266m	3:399m
4:533m	5:655m	

Options:

133m

266m

399m

533m

655m

Factory default: *133m*

Description: Allows the signal to be pre-compensated to cope with differing lengths of standard `ABAM` cable. If in doubt, select option 1, less than 133 feet by default (no compensation). Screen only available when T1 or T2 is selected.

Edit-Unit-Interface-IP Menu

IP:	1:Mode
	2:Address
	3:Misc

This menu has the following options:

- *Mode*. This controls the various IP features such as bridging, routing, acceleration and compression.
- *Address*. This is used to set up the IP terrestrial and satellite traffic addresses.
- *Misc*. This submenu controls miscellaneous IP-related options such as VLAN, IPV6 and line speed/duplex settings.

Edit-Unit-Interface-IP-Mode Screens

When this option is selected, the following sequence of screens is displayed in turn.

Edit-Unit-Interface-IP-Mode IP Mode Screen

IP mode:
[Bridge mode]
New:[Routing mode]

Options:

Bridge mode

Select this mode for ordinary Ethernet over satellite bridging, i.e. point-to-point systems. In this mode, the Layer 2 Ethernet bridge builds up bridging information based on the replies it receives back, allowing it to ascertain which network segments devices are located on.

Routing mode

IP packets are forwarded based on the contents of the modem's routing table. The routing table can be populated by manually entering routes and/or by turning on one (or more) of the supported dynamic routing protocols. The dynamic routing protocols enable the modem to automatically populate the routing table based on information forwarded by other routers in the network. The modem operates as a two port router in this mode. See the TCP/IP white paper at <http://www.paradisedata.com/whitepapers.php> for more details.

Factory default:

Bridge mode

Description: The routing option is only applicable if an IP Traffic card is fitted. See the TCP/IP white paper at <http://www.paradisedata.com/whitepapers.php> for further details on routing mode operation.

Edit-Unit-Interface-IP-Mode Ethernet Mode Screen

Ethernet mode: [Brouting mode] New: Bridge mode

Options:

Bridge mode

Select this mode for ordinary Ethernet over satellite bridging, i.e. point-to-point systems. In this mode, the Ethernet bridge builds up bridging information based on the replies it receives back, allowing it to ascertain which network segments devices are located on.

Hub

Sets up a modem to work as a point-to-multipoint bridge hub. All modems at the hub site should be configured to this mode. Bridging rather than brouting should be used in point-to-multipoint systems that have a direct return path via satellite.

Remote

Sets up a modem to work as a point-to-multipoint remote site. All modems connected to a point-to-multipoint bridge network that are situated at remote sites (i.e. not on the hub) should be configured to this mode.

Header Compression

This is a bridging point-to-point mode where UDP and IP packet headers are compressed in order to save satellite bandwidth. The bandwidth savings depend on the particular packet sizes being used. This feature supports header compression at terrestrial throughput rates of up to 2Mbps via the base modem and throughput rates up to 16896kbps when the IP Traffic card is fitted.

Mesh

The mesh mode supports networks where there is one carrier per site and multiple Rx-only modems for receiving from other sites. It is implemented as a variation of the point-to-multipoint bridging mode (hub operation). Partial mesh networks are also supported.

Brouting mode

Select this mode for all point-to-multipoint or unidirectional IP systems where there is an indirect return path (i.e. not via satellite). Both the Tx and Rx modems should have brouting enabled. In this mode, the Ethernet bridge in the Tx modem does not expect to receive replies and simply transmits all Ethernet frames over satellite other than those destined for itself.

TCP acceleration mode

This mode provides bridging of non-TCP packets combined with acceleration of TCP packets using a Performance Enhancing Proxy (PEP) that overcomes performance problems associated with using standard TCP over satellite.

TCP acceleration mode + Header Compression

Only applicable if an IP traffic Interface card is fitted. This mode provides bridging of non-TCP packets, acceleration of TCP packets and header compression.

Remote + TCP Acceleration

This mode supports point-to-multipoint TCP acceleration. The remote modems should be set to this mode and VLAN filtering should also be enabled.

Hub + TCP Acceleration

This mode supports point-to-multipoint TCP acceleration. The hub Tx modem should be set to this mode and VLAN filtering should also be enabled on this modem. Note that hub Rx-only modems in a point-to-multipoint TCP acceleration system should be set to *Hub* mode (not *Hub + TCP Acceleration*) and that the Rx-only modems should have VLAN filtering disabled.

Hub + Header Compression

This implements point-to-multipoint header compression. The hub Tx modem should be set to this mode and VLAN filtering should also be enabled on this modem. Note that hub Rx-only modems in a point-to-multipoint header compression system should be set to *Hub+Ethernet Header Compression* mode (not *Hub + Header Compression*) and that the Rx-only modems should have VLAN filtering disabled.

Remote + Header Compression

This mode supports point-to-multipoint header compression. The remote modems should be set to this mode and VLAN filtering should also be enabled.

Hub + TCP acceleration + Header Compression

This implements point-to-multipoint TCP acceleration and header compression. The hub Tx modem should be set to this mode and VLAN filtering should also be enabled on this modem. Note that hub Rx-only modems in a point-to-multipoint header compression system should be set to *Hub+Ethernet Header Compression* mode (not *Hub + Header Compression*) and that the Rx-only modems should have VLAN filtering disabled.

Remote + TCP acceleration + Header Compression

This mode supports point-to-multipoint TCP acceleration and header compression. The remote modems should be set to this mode and VLAN filtering should also be enabled.

Hub + Ethernet Header Compression

This implements point-to-multipoint header compression. The hub Rx-only modems in a point-to-multipoint header compression system should be set to this mode and should have VLAN filtering disabled.

Bridged TCP acceleration

This mode supports point-to-point TCP acceleration but unlike *TCP acceleration mode* the original Ethernet frames are preserved over satellite. This allows TCP acceleration of any number of VLANs. Uniquely, It also supports acceleration of MPLS streams. Note that in this mode, for ease of use, there is no need to enter an IP address for the IP Traffic card unlike the standard *TCP acceleration mode*. Consequently it is not possible to ping the IP Traffic card in this mode or to telnet into it (even if an IP address has been assigned prior to entry to the mode). Since the TCP data is effectively bridged over satellite, there is also no need to set up static routes or gateways in order to use the bridged TCP acceleration mode. Any UDP packets will be bridged over satellite in this mode.

**Factory
default:**

Bridge mode

Description: This allows selection of the mode of operation of the modem Ethernet bridge. See Section 8.12 for further details of bridge operation.

Edit-Unit-Interface-IP-Mode Bridge M&C Screen

Bridge M&C:[Off] 1:Off 2:On
--

Options:

Off

In this mode, the Remote M&C Ethernet interface will not be included in the Ethernet bridge, thereby keeping IP traffic and M&C traffic separate. When separate, the two Ethernet connectors on the base modem are no longer interchangeable. Note that care should be taken in selecting this mode for a remote modem – if the two cables have been mixed up then M&C communications with the modem will be lost.

On

In this mode, the Remote M&C Ethernet interface is included in the Ethernet bridge, thereby allowing IP traffic and M&C traffic to be via either one cable or via two cables with them being interchangeable in relation to the two physical Ethernet ports on the base modem.

Factory default:

On

Description: Controls whether the Ethernet M&C interface is included in the Ethernet bridge or whether the Remote M&C and IP traffic interfaces are isolated from each other.

Edit-Unit-Interface-TCP Acceleration Screen

TCP acceleration:
[No TCP acceleration]
New:[No TCP acceleration]

Options:

TCP acceleration mode

This mode provides routing of non-TCP packets combined with acceleration of TCP packets using a Performance Enhancing Proxy (PEP) that overcomes performance problems associated with using standard TCP over satellite.

No TCP acceleration

TCP acceleration is turned off.

Factory default:

No TCP acceleration mode

Description: This option is available in routing mode. In bridging mode, acceleration is selected via the Ethernet mode control.

Edit-Unit-Interface-IP-Mode Round Trip Delay Screen

Round trip delay: 0 to 999ms
[520] Step 1
New: 520

Units: ms
Minimum value: 0
Maximum value: 9999
Step size: 1
Factory default: 520

Description: This allows a satellite round trip delay to be entered. This is used only in conjunction with the modem's TCP acceleration feature. It is used to set 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). When TCP acceleration is operating at its maximum throughput level, this helps to maintain the throughput at a steady level, avoiding perturbations that can otherwise occur.

Edit-Unit-Interface-IP-Mode Payload Compression Screen

Payload compression: [Off]
1:Off
2:On

Options:

Off

Payload compression of IP packets is switched off.

On

Payload compression of IP packets is switched on.

Factory default: *Off*

Description: The IP payload compression feature implements IP payload compression of TCP and UDP packets to RFC 1951 (the 'DEFLATE'

algorithm). This typically halves the size of the payload for packets that are not already compressed. Note that payload compression is not a standalone feature and is available only when TCP acceleration and/or header compression is active. Since the bandwidth saving is statistical, it is important to determine what saving is achieved empirically using representative data in order to avoid potential data loss. This can be done by gradually reducing the satellite bandwidth once compression is active until the point is reached when some packet loss occurs (or additional delay occurs in the case of TCP packets).

Edit-Unit-Interface-IP-Mode Web Proxy Screen

Web acceleration:[Off] 1:Off 2:On
--

Options:

Off

In this mode, all HTTP requests to web servers pass through the modem as normal (with no special processing).

On

In this mode, the modem stores web pages returned from web servers as a result of requests made by users from their web browsers. Once the web page has been received by the modem, the modem parses through the page checking for in-line objects such as images. These images do not form part of the web page and are requested separately by the web browser. If the web page contains multiple embedded images or objects then it can take multiple times the satellite round trip time to fetch these since browsers will typically request them serially through a single TCP connection (or possibly two) to the web server. The modem will request all of the images in parallel so that they are available at the modem nearest the web browser when the browser makes the requests for the additional images, significantly reducing the time it takes to display a typical web page. It is necessary to switch the Web Proxy on only at the modem at the web browser side of the satellite link.

Factory default:

Off

Description: Enables acceleration of HTTP requests.

Edit-Unit-Interface-IP-Mode DNS IP Address

DNS IP addr:
[000.000.000.000]
New:[000.000.000.000]

Factory default: 0.0.0.0

Description: Sets the IP address of the DNS server to be used when the Web Proxy in the modem is switched on. The DNS server is used to resolve the IP address associated with any domain name used in the web browser. The DNS server IP address is normally included as part of the network connection details on Windows PCs.

Edit-Unit-Interface-IP-Mode Tx/Rx ACM Mode Screens

Tx ACM mode: [Off]
1: Off
2: On

This screen is displayed when the Tx service is set to DVB-S2. It controls DVB-S2 ACM in the Tx path. Note that a similar screen is then displayed for ACM in Rx. Enabling ACM in Rx causes the modem to automatically insert regular Es/No information into the modem's carrier (with no material effect on bandwidth). This is used to control the carrier modcod selection of the other modem. Other than *Off/On*, there are no other ACM user controls. ACM status information is available on the *Status-Traffic* screen by pressing the *Down* arrow.

Options:

Off

Disables ACM in the Tx path.

On

Enables ACM in the Tx path.

Factory default:

Off

Description: Controls DVB-S2 ACM in the Tx path (ACM in Rx is similarly set on the

screen following this). See Section 8.12.14 for a full description of ACM.

Edit-Unit-Interface-IP Address Screens

When this option is selected, the following sequence of screens is displayed in turn.

Edit-Unit-Interface-IP-Address Traffic Port IP Address Screen

Traffic port IP address:
[0.0.0.0]
New: [010.000.070.002]

Factory default: 0.0.0.0

Description: Sets the IP address for the base modem IP traffic port or the IP Traffic card if this is fitted. Both of the Ethernet ports on the IP Traffic card use this same address and can be used interchangeably. Unlike the base modem Remote M&C port, DHCP is not supported and therefore an address must be manually entered. The traffic port IP address is not directly used in straight bridging mode (although the address must be a valid one for the local network in point-to-point bridging mode). The IP address is however used in modes using TCP acceleration and header compression. See Section 8.12 for more details of IP addressing.

Edit-Unit-Interface-IP-Address Traffic Port IP Netmask Screen

Traffic port IP netmask:
[255.255.255.255]
New:[255.255.000.000]

Factory default: 255.255.255.255

Description: Sets the IP subnet mask for the base modem IP traffic port or the IP Traffic card if this is fitted.

Edit-Unit-Interface-IP-Address Traffic Port IP Gateway Screen

Traffic port IP gateway: [0.0.0.0] New:[010.000.070.003]
--

Factory default: 0.0.0.0

Description: Sets the IP address of a default gateway for the base modem IP traffic port or the IP Traffic card if this is fitted. 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 with TCP acceleration, brouting and header compression. An address of 0.0.0.0 means that the gateway is not set. In straight bridging mode it is not normally necessary to set this gateway as the bridge automatically learns the location of each device.

Note that there are two gateways that can be defined in the modem. The *Traffic Port IP Gateway* is used exclusively in relation to the IP Traffic card. The *Remote Control Port IP Gateway* (on the *Edit-Unit-M&C-IP* menu) will be used in relation to the M&C network and the Remote M&C Ethernet port. See Section 8.12 for more details of IP addressing.

Edit-Unit-Interface-IP-Address Satellite Port IP Address

Satellite port IP address: [000.000.000.000] New:[000.000.000.000]
--

Factory default: 0.0.0.0

Description: Sets the IP traffic address for the satellite interface when the modem is in routing mode.

Edit-Unit-Interface-IP-Address Satellite Port IP Netmask

Satellite port IP netmask:
[255.255.255.255]
New:[255.255.255.255]

Factory default: 255.255.255.255

Description: Sets the IP traffic subnet mask for the satellite interface when the modem is in routing mode.

Edit-Unit-Interface-IP-Address Satellite Port IP Gateway

Satellite port IP gateway:
[000.000.000.000]
New:[000.000.000.000]

Factory default: 0.0.0.0

Description: Sets the IP traffic gateway for the satellite interface when the modem is in routing mode.

Edit-Unit-Interface-IP Misc Screens

When this option is selected, the following sequence of screens is displayed in turn.

Edit-Unit-Interface-IP-Misc VLAN Filtering Screen

Enable VLAN filtering:[Off]
1:Off
2:On

Options:

Off

In this mode, VLAN tags are not generated or removed by the modem. This means that no filtering of traffic based on VLAN id takes place. Since each remote modem receives the same broadcast traffic, a device such as a router must be present to filter out any traffic that is intended only for other remote modems.

On

In this mode, each remote modem can be assigned a VLAN id which is used by the Hub to tag each packet destined for any device attached to a network off that particular remote modem. The tags are added by the Hub Tx modem and removed by the remote modem. The remote modem uses the tag to filter out unwanted data that has been broadcast indiscriminately to all remote modems.

Factory default:

Off

Description: Controls whether VLAN tags are being used to implement point-to-multipoint filtering of traffic at remote modems to filter out unwanted broadcast traffic. This option is only available in Hub and Remote Ethernet traffic modes (since it is only used in point-to-multipoint mode where there is a direct return path).

Edit-Unit-Interface-IP-Misc VLAN ID Screen

VLAN ID:0 to 4094
[0000] Step 1
New: 0000

Units: None
Minimum value: 0
Maximum value: 4094
Step size: 1
Factory default: 0

Description: Sets a specific value of VLAN id. This is required only for remote modems – assigning a VLAN id to a Hub modem has no effect. The VLAN id is used to uniquely identify each remote modem. It is used to filter wanted from unwanted IP packets in point-to-multipoint systems where there is a direct return path and VLAN tags are not already being used in relation to the data entering the modems from the terrestrial network. VLAN ids of remote modems are automatically learnt by the Hub and all traffic destined for a particular remote modem is tagged at the Hub allowing it to filter wanted traffic. The VLAN tags are removed by

the modems prior to onward transmission.

Edit-Unit-Interface-IP-Misc Encapsulation Type Screen

IP encapsulation type: [MPE] New:[ULE]
--

Options:

MPE

Selects Multi-Protocol Encapsulation as the protocol for encapsulating IP packets and Ethernet frames into MPEG2 transport stream packets for transmission over satellite. This protocol is widely supported and is therefore useful for interoperability.

ULE

Selects Ultra-Lightweight Encapsulation as the protocol for encapsulating IP packets and Ethernet frames into MPEG2 transport stream packets for transmission over satellite. This protocol uses less overhead than MPE and should be used in preference if possible.

PXE

Selects proprietary Paradise eXtreme Encapsulation as the protocol for encapsulating IP packets and Ethernet frames into MPEG2 transport stream packets for transmission over satellite. This protocol uses considerably less overhead than either MPE or ULE but requires Paradise modems to be used at both ends of the link. It is always used automatically when SmartLink (which is also proprietary) is operational.

Factory default:

MPE

Description: Sets the protocol to be used when encapsulating IP packets and Ethernet frames into MPEG2 transport packets for transmission over satellite when using DVB-S2. DVB-S2 satellite frames do not directly support the transmission of IP but they do support the transmission of MPEG2 packets. IP packets are of potentially varying sizes and therefore when placing these into fixed 188-byte MPEG2 packets, a protocol is required to deal with the issues of packet fragmentation and padding, as well as of protocol identification (IPV4, IPV6, Ethernet frames, etc.).

Edit-Unit-Interface-IP-Misc MPE MAC Address Screen

MPE MAC address:
[00:00:00:00:00:00]
New: [00:11:29:00:F0:23]

Factory default: 0.0.0.0

Description: This is used for receive filtering of MPE packets. Note that this can be a virtual MAC address and does not need to be the actual address of the receiver's IP port – the receiver will simply match whatever MAC it is set to filter on. (There is currently no modulator equivalent support to allow a MAC address to be added to MPE packets as it is assumed the packets are being generated by a non-Paradise modulator – a Paradise modulator will always set the MPE MAC address to all zeros or the modulator's MAC address, depending on whether it is in bridging or routing mode.)

Edit-Unit-Interface-IP-Misc Encapsulation PID Screen

Encapsulation PID: 768 to 1023mins
[970] Step 1
New: 970

Units: None
Minimum value: 768
Maximum value: 1023
Step size: 1
Factory default: 970

Description: When encapsulating Ethernet frames or IP packets into MPEG2 packets, this specifies the PID value to be entered into the MPEG2 packets that are being created. Note that the value is in decimal. (The PID can then be used for filtering MPEG2 packets on the receive side.)

Edit-Unit-Interface-IP-Misc QOS Scheme

Weighted QoS:[Off] 1:Off 2:On
--

Options:

Off

In this mode, no prioritization is made between different IP packets entering or leaving the modem.

On

In this mode, the modem implements IEEE 802.1p packet prioritization. This allows for 8 classes of data to be specified as part of a 3-bit field within the layer 2 IEEE 802.1q VLAN header. The packets must already be tagged at the point of entry to the modem. Priority 7 is typically used for network-critical traffic such as dynamic routing protocol packets; priorities 5 and 6 for video and voice, etc. The modem uses the priority tag to decide how to process each packet. The options are:

- **Strict priority queuing:** packets are queued for transmission based solely on their priority – highest will always be sent first.
- **Fair-weighting queuing:** higher priority transmitted first but lower priority packets are given a percentage of the bandwidth to stop total starvation.

The implementation of IEEE 802.1p is as follows:

- The 8 QoS priority levels are mapped to three TCP/IP queues in the modem.
- Packets with highest QoS priority (level 7) are sent to high priority TCP/IP queue.
- Delay-sensitive packets (QoS levels 6 and 5) are sent to the medium priority queue.
- The remainder (QoS levels 4 to 0) are sent to the low priority TCP/IP queue.
- For strict priority queuing, all packets in high priority queue are processed before any in medium priority queue which in turn are processed before any in the low priority queue.

For fair-weighting queuing, for every 4 packets sent from high priority queue, 2 are sent from medium queue and 1 from low priority queue.

Factory default:

Off

Description: Enables IEEE 802.1p IP packet prioritisation.

Edit-Unit-Interface-IP-Misc Modem Duplex Screen

Modem duplex:
[Half duplex]
New:[Full duplex]

Options:

Half duplex

Selects half duplex mode for the base modem terrestrial IP traffic interface. This is the safest mode to use if unsure. It must be selected when the modem is connected using an Ethernet hub where more than one hub port is being used. The base modem will either transmit or receive but not both at the same time. If another device transmits at the same time then in half duplex mode the modem will detect this and handle the situation correctly.

Full duplex

Selects full duplex mode for the base modem terrestrial IP traffic interface. This should only be used when the modem is connected directly to an Ethernet switch or a PC (i.e. when there are only two devices on the segment of the network that can potentially transmit at the same time). In full duplex mode, the base modem will transmit and receive at the same time. However, it cannot detect corruption of transmissions therefore it is essential that no more than two devices are on the network segment (the so-called 'collision domain').

Factory default: *Half duplex*

Description: Sets the duplex mode for the base modem terrestrial IP traffic interface.

Edit-Unit-Interface-IP-Misc Traffic Card Speed/Duplex Screen

Traffic card speed/duplex:
[Auto]
New:[1000M full duplex]

Options:

Auto

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface.

10M half duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 10Mbps half duplex as the only option available.

10M full duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 10Mbps full duplex as the only option available.

100M half duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 100Mbps half duplex as the only option available.

100M full duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 100Mbps full duplex as the only option available.

1000M half duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 1000Mbps half duplex as the only option available.

1000M full duplex

In this mode the IP Traffic card will auto-negotiate both the speed and duplex setting for the interface but as part of the negotiation will 'advertise' 1000Mbps full duplex as the only option available.

10M half duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 10Mbps half duplex operation.

10M full duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 10Mbps full duplex operation.

100M half duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 100Mbps half duplex operation.

100M full duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 100Mbps full duplex operation.

1000M half duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 1000Mbps half duplex operation.

1000M full duplex (fixed)

In this mode the IP Traffic card interface will be fixed to 1000Mbps full duplex operation.

**Factory
default:**

Half duplex

Description: Sets the speed and duplex for the IP Traffic card interface. Changes will be effective immediately but if an auto-negotiated mode is selected then the Ethernet connection to the IP Traffic card may have to be briefly disconnected in order for the change to take effect. See the preceding description of the *Edit-Unit-Interface-Terrestrial-IP Modem Duplex Screen* for further general information about what duplex setting is most appropriate. (Although some of the available options appear somewhat similar, the implementation of auto-negotiation varies between different manufacturers and consequently Paradise has extended its support in this area to cater for as many combinations as has been found to be needed.)

Edit-Unit-Interface-IP-Misc Bridge Filtering Screen

Bridge filtering:[Off] 1:Off 2:On
--

Options:

Off

In this mode, the bridge will forward all traffic not destined for the local subnet to the default gateway if one has been specified. If the default gateway is a router, then this allows the router to be set up to filter data in whatever way is appropriate.

On

In this mode, the bridge will discard all traffic other than that destined for the local subnet. This can be useful in preventing network loops from occurring. A network loop can be created, for example, in a point-to-multipoint scenario where there are multiple Rx-only modems with a common indirect return path and a default gateway is specified that causes data not destined for a particular Rx modem to be routed out of the gateway and back to the sender through the return path.

Factory default:

Off

Description: Controls whether the Ethernet bridge filters out all traffic other than for the local subnet.

Edit-Unit-Interface-IP-Misc Cisco HDLC Screen

Cisco HDLC: [On] 1:Off 2:On
--

Factory default: *Off*

Description: In routing mode, controls whether Cisco HDLC is used to encapsulate IP packets being transmitted over satellite. This mode

can be used to receive and output the IP stream as a serial stream to a Cisco serial router.

Edit-Unit-Interface-Quad E1 Menu

Interface: 1:Port 1	2:Port 2
3:Port 3	4:Port 4

This menu has options for configuring the Tx and Rx side of each of the four terrestrial E1 ports on either a Quad E1 or a Sat-ABIS interface card. If neither card is fitted then this menu will not be available. Selection of an E1 port on this menu will lead through the following set of options, depending on whether it is a Quad E1 or Sat-ABIS card. Note: the Quad E1 interface can use either an IBS framed service (fixed 6.7% overhead) or Closed Network or Closed Network plus ESC (configurable overhead with minimum of 0.39%). See Section 8.10 for maximum overhead baud rates for Quad E1.

Edit-Unit-Interface-Quad-E1-Tx Data Rate Screen

Tx data rate: 0 to 2048000bps [0000000] step 64000bps New: 0000000

Units: bps
Minimum value: 0
Maximum value: 2048000
Step size: 64000
Factory default: 0

Description: Sets the terrestrial bit rate for the relevant Quad E1 port. This must be configured in multiples of 64kbps.

Edit-Unit-Interface-Quad-E1-Tx Mode Screen

Port 1 mode:[Other]		
1:Off	2:E	3:A
4:Abis	5:Ater	6:Other

Options:

Off

The specified port on the Quad E1 card is not being used and is therefore disabled.

E

The specified port on the Quad E1 card is being used between a PSTN (Packet Switched Telephone Network) and MSC (Mobile Switching Centre).

A

The specified port on the Quad E1 card is being used between a BSC (Base Station Controller) and MSC (Mobile Switching Centre).

Abis

The specified port on the Quad E1 card is being used between a BSC (Base Station Controller) and BTS (Base Transceiver Station).

Ater

The specified port on the Quad E1 card is being used between a TRAU (Transcoding and Rate Adaption Unit) and BTS (Base Transceiver Station).

Other

The specified port on the Quad E1 card is not being used in any of the above situations. This option allows timeslots for the particular port on the Quad E1 card to be configured manually.

Factory default:

Off

Description: This selects the operating mode for the particular terrestrial port on the Quad E1 card. The options represent interfaces between different components within a GSM system. The selection is used to default timeslot settings for the particular port, in accordance with the type of interface. Selecting *Other* always the timeslots for the particular port on the Quad E1 card to be set up manually.

Edit-Unit-Interface-Quad-E1-Tx Number of Timeslots Screen

Port 1 no. timeslots: 0 to 32
[0] Step 1
New: 0

Units: None
Minimum value: 0
Maximum value: 32
Step size: 1
Factory default: 0

Description: This sets the number of timeslots dropped off the terrestrial bearer and sent over the satellite in relation to the specific terrestrial port of the Quad E1 card.

Edit-Unit-Interface-Quad-E1-Tx Dropped Timeslots Screen

Port 1 dropped timeslots:
[0-2]
New: 0-2

Units:
Minimum value: 0
Maximum value: 31
Step size: 1
Factory default: 0

Description: Controls which terrestrial timeslots are dropped (i.e. multiplexed into the satellite frame). Timeslots cannot be reordered when being used with the Quad E1 card. Timeslots can be entered as individual numbers separated by commas or as an inclusive range denoted by the first and last timeslot numbers in the range with a hyphen between them. For example, '0,17,18-31'.

Note that on this screen the *Down* arrow key is used to enter a comma and the *Up* arrow key is used to enter a hyphen. The 0 key pressed together at the same time as the *Right* arrow key deletes the character at the cursor.

If the number of timeslots that are entered differ from the number entered on the previous screen then the new value will not be accepted and the modem will continue to display this screen until a valid value is entered.

Edit-Unit-Interface-Quad-E1-Tx Dropped Timeslot Idle Code Screen

Port 1 dropped timeslots:
[Leave on bearer]
New: Leave on bearer

Options:

Leave on bearer

The Tx data remains on the bearer and will be accessible to downstream equipment unless Rx data is inserted over it.

Replace with Idle code

The Tx data is replaced with Idle code.

Factory default:

Leave on bearer

Description: Controls whether dropped timeslots are replaced with Idle code in relation to the specific port on the Quad E1 card. If the Rx data is to be inserted into the same timeslots as the Tx data has been dropped from then the Rx data will replace the Tx data and therefore this setting is irrelevant.

Edit-Unit-Interface-Quad-E1 Interface Loopback Screen

Interface loopback: [Off]
1:Off
2:On

This menu controls whether loopback is enabled for the specific E1 port of the Quad E1 card. When on, the modem's front-panel Test LED will go amber and a local and remote loopback to terrestrial and satellite ports will be enabled.

Edit-Unit-Interface-Quad-E1-Rx Mode Screen

See the description of the Quad E1 Tx Mode screen.

Edit-Unit-Interface-Quad-E1-Rx Number of Timeslots Screen

See the description of the Quad E1 Tx Number of Timeslots screen.

Edit-Unit-Interface-Quad-E1-Rx Inserted Timeslots Screen

This is similar to the Quad E1 Tx Dropped Timeslots screen but controls the specific timeslots that are inserted into the E1 bearer on the receive side of the link.

Edit-Unit-Interface-Quad-E1-Rx Generate Bearer Screen



Port 1 generate bearer:
[Loop (auto-originate)]
New: Originate

In relation to the specific port of the Quad E1 card, this controls the origination of a terrestrial bearer from the Insert MUX. It allows a choice of auto-originating the bearer if the bearer fails or originating the bearer at all times.

1.19.3.4 Edit-Unit-M&C Menu

1:Control	2:Password	3:Timeout
4:Interface	5:Baud	6:RS485 addr
7:Gateway	8:IP addr	9:Subnet mask

This menu contains the following options:

- *Control*. This controls whether modem control is via the front panel (local), via a remote interface (Giveaway) or whether all interfaces are allowed to control the modem (Takeaway).
- *Password*. This displays a screen that has options to change the two system passwords (*Admin* and *User*).
- *Timeout*. This controls the length of time a user is logged in for without any input activity before they are automatically logged out.
- *Interface*. This specifies the remote control serial interface type.
- *Baud*. This specifies the remote control serial interface baud rate.
- *RS485 addr*. This specifies the unit's RS485 address.
- *Gateway*. This allows a default IP gateway to be specified. This acts as the next hop when forwarding IP data not destined for the modem or local subnet.
- *IP addr*. This option sets the IP address for the remote control interface.
- *Subnet mask*. This sets the remote control port IP subnet mask.

Edit-Unit-M&C-Control Screen

Modem control:
[Giveaway]
New: Takeaway

Options:

Local
Giveaway
Takeaway

Factory default: *Giveaway*

Description: Controls modem ownership. In Local mode only the front panel can be used to control the modem. In Giveaway mode, the first user to issue a command gains control of the modem until a manual or automatic log out occurs. Pressing the MAIN key gives away control of the Modem. (Allowing, for example, a Web user or M&C via RS485 / RS232 to have

exclusive control of the Modem.) In Takeaway mode, the modem accepts commands from any interface at any time (relying on clear operational procedures to prevent conflicting requests).

Edit-Unit-M&C-Password Screen

Remote admin password:

Factory default: *paradise*

Description: Modem password for remote admin user login (login name is *admin*). The admin user can both view and control the modem. Only one admin user can be logged in at a time.

Edit-Unit-M&C-View Only Password Screen

Remote view-only user password:

Factory default: *paradise*

Description: Modem password for remote view-only user login (login name is *user*). Multiple view-only users can be logged in at the same time.

Edit-Unit-M&C-Timeout Screen

Auto-logout period:1 to 720mins
[060] Step 1mins
New: 060

Units: mins
Minimum value: 1
Maximum value: 720
Step size: 1
Factory default: 5

Description: Specifies the period of time without any user input activity after which a user is logged out. This is true even for the local user interface (this has an implicit login when the operator first presses a key). In Giveaway mode, logging out causes ownership of the modem to be lost.

Edit-Unit-M&C-Interface Screen

Remote M&C Interface:
[RS232]
New: RS232

Options:

RS232

RS485

IP – Local

Only available when IP over ESC has been selected. This pushes the serial M&C data across to the distant end Modem via the IP ESC for use at the remote serial ports. This link is a serial extension for control of distant end equipments.

IP – Remote

This allows the serial M&C data, received via IP from the local Modem to be used at the distant end serial ports. Uses TCP port 6703. This link is a serial extension for control of distant end equipments. Please refer to following pinout definition table. Note that this mode is deprecated and *IP – Remote (Rem M&C)* should be used

instead.

IP – Remote (Rem M&C)

This allows the serial M&C data, received via IP from the local Modem to be used at the distant end serial ports. (Compared to *IP – Remote* mode, this setting changes the direction of the driven lines from the distant end Modem to account for RS485 cabling differences). Uses TCP port 6703. This link is a serial extension for control of distant end equipments. Please refer to following pinout definition table.

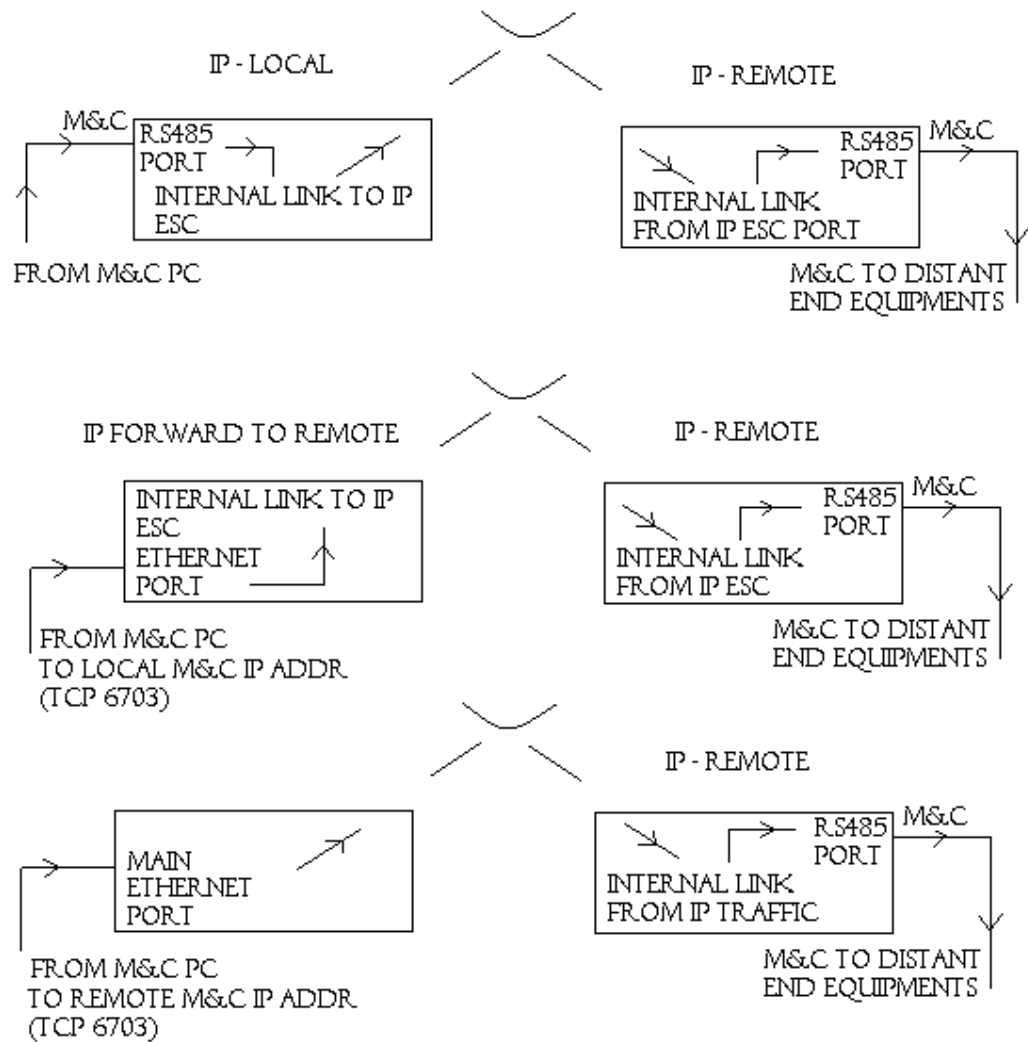
IP – Forward to Remote

Only available when IP over ESC has been selected. This takes advantage of the local IP address and forwards M&C information directly to the remote Modem. Uses TCP port 6703. This link is a serial extension for control of distant end equipments.

**Factory
default:**

RS232

The following diagrams show how the M&C interfaces may be configured using the IP – Local, IP - Remote and IP - forwarding options to facilitate distant end M&C. Please note, the first two options form a pipe to transfer messages to the distant end equipments and if M&C of the Modems is necessary then an alternative provision must be made. The third diagram is an alternative illustration of IP-Remote and can be facilitated by IP over the main data channel / multimux etc.



Description: Specifies the remote control serial interface mode.

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The table below highlights the change in RS485 pinout when *IP-Remote* or *IP-Remote (Rem M&C)* is selected. Please refer to chapter 11 for full connector pinouts.

Pin	Signal name	Direction	Name-RS485	
			Paradise IP - Remote	Paradise IP – Remote (Rem M&C)
1	Shield/Gnd		Shield/Gnd	Shield/Gnd
3	Master-B	+ to modem	RX-B	TX-B
4	Slave-B	+ from modem	TX-B	RX-B
5	Shield/Gnd		Shield/Gnd	
6	Slave-A	- from modem	TX-A	RX-A
9	Master-A	- to modem	RX-A	TX-A

Edit-Unit-M&C-Baud Rate Screen

Baud rate:
[9600 baud]
New: 9600 baud

Options:

110 baud
150 baud
300 baud
600 baud
1200 baud
2400 baud
4800 baud
9600 baud
19200 baud
38400 baud
57600 baud
76800 baud
115200 baud

Factory default: *9600 baud*

Description: Specifies the remote control serial interface baud rate.

Edit-Unit-M&C-RS485 Address Screen

RS485 address:0 to 255
[1] Step 1
New: 1

Units:

Minimum value: 1
Maximum value: 255
Step size: 1
Factory default: 1

Description: Specifies the unit's RS485 address.

Edit-Unit-M&C-Gateway Screen

Remote control port IP gateway:
010.000.070.002
[010.000.070.002]

Factory 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 with TCP acceleration, brouting and header compression. An address of 0.0.0.0 means that the gateway is not set.

Edit-Unit-M&C-IP Address Screen

Remote control port Ethernet IP address:
010.000.070.001
[010.000.070.001]

Factory default: 10.0.70.1

Description: Sets the IP address for the remote control interface. The same IP address is used by the modem for traffic purposes, when configured for IP traffic. Note that entering an IP address of 0.0.0.0 causes the modem to dynamically request an IP address from a DHCP (Dynamic Host Control Protocol) 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/Config/Unit* screen. Note that the IP address may take a short period before it appears as the request to the DHCP server is made every minute until a reply is received. Note that when the IP

address is changed, any device such as a PC that was previously communicating with the modem may take several minutes to recognize the new address unless the ARP table on the device is flushed (the ARP table is used to match IP addresses and MAC addresses).

Edit-Unit-M&C-IP Subnet Mask Screen

Remote control port IP netmask:
[255.255.000.000]
New: 255.255.000.000

Factory default: 255.255.0.0

Description: Sets the remote control port IP subnet mask. The same IP subnet mask is used by the modem for traffic purposes, when configured for IP traffic.

Edit-Unit-Clocks Screen

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

Options:

None
BNC
RS422

Factory default: *None*

Description: Controls the station clock source to be used in place of either the internal 10MHz reference or to replace only the Rx reference clock.

Edit-Unit-Clocks-Station Clock Use Screen

Station clock use:
[Replace internal 10MHz clock]
New: Replace internal 10MHz clock

Options:

Replace internal 10MHz clock

Do not replace 10MHz clock

Factory default: *Replace internal 10MHz clock*

Description: Controls the function of the station clock i.e. whether it replaces the internal 10MHz reference clock or not (which is used as the main clock for the modem's internal processing). Note that the decision on whether to use the station clock for Tx and/or Rx clocking purposes is controlled by the Tx and Rx clock source menu options (under *Edit/Tx/Clocks* and *Edit/Rx/Clocks*) – these options become available when a station clock source is selected and are independent of whether station clock replaces the internal 10MHz clock.

Edit-Unit-Clocks-Station Clock Frequency Screen

Station clock freq:1000 to 10000kHz
[1000] Step 1kHz
New: 10000

Units: kHz
Minimum value: 1
Maximum value: 10000
Step size: 1
Factory default: 10000

Description: Indicates to the modem the frequency of the station clock input reference used for Tx and Rx clocking purposes. If the station clock is being used to replace the internal 10MHz reference then this screen is not shown as the station clock must provide exactly 10MHz in this case.

Edit-Unit-User Level Screen

User level: [Advanced]
1: Basic
2: Advanced

Options:

Basic

Advanced

Factory default: *Advanced*

Description: Enables or disables advanced menu options. By selecting the basic setting, many menus and options become unavailable, thereby simplifying the menu structure when the more advanced modem features are not required.

Edit-Unit-Time Screen

Date & time:
[14:41:45 06/04/2005]
14:41:45 06/04/2005

This option allows the current time and date of the modem to be set in the format *HH:MM:SS DD/MM/YYYY*. The time is maintained even while the modem is switched off.

Edit-Unit-Advanced-Alarms-Thresholds-Deferred Alarm BER Threshold Screen

BER threshold: 9.9E-15 to 1.0E-2
[1.0E-4] Step 0.1E-15
New: 1.0E-4

Units:

Minimum value: 9.9E-15

Maximum value: 1.0E-2

Step size: 0.1E1

Factory default: 1E-4

Description: Sets the error-rate threshold above which a deferred alarm will be generated. This alarm can be switched off or on using the *BER threshold alarm* option of the *Edit-Unit-Advanced-Alarms-Actions* menu.

Edit-Unit-Advanced-Alarms-Thresholds-Rx Eb/No Deferred Alarm Threshold Screen

EbNo threshold:0 to 99dB
[03.0] Step 0.1dB
New: 03.0

Units: dB

Minimum value: 0.0

Maximum value: 99.0

Step size: 0.1

Factory default: 3.0

Description: Sets the Eb/No threshold below which a deferred alarm will be generated.

Edit-Unit-Advanced-Alarms-Thresholds-Buffer Slip Deferred Alarm Screen

Buf slip threshold:0 to 9999hrs
[0000] Step 1hrs
New: 0000

Units: hrs
Minimum value: 0
Maximum value: 9999
Step size: 1
Factory default: 0

Description: Sets the threshold period for consecutive buffer slips above which a deferred alarm is generated. A setting of 0 (zero) disables this alarm.

Edit-Unit-Advanced-Alarms-Thresholds-BUC PSU Alarm Screen

DC current min:0.1 to 6A
[0.10] Step 0.01A
New: 0.10

Units: A
Minimum value: 0.1
Maximum value: 6
Step size: 0.01A
Factory default: 0.1

Description: On L-band modems, 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.

Edit-Unit-Advanced-Alarms-Thresholds-AUPC Deferred Distant AlarmScreen

Deferred distant E: 0.1 to 9.9dB
[0.1] Step 0.1dB
New: 0.1

Units: dB
Minimum value: 0.1
Maximum value: 9.9
Step size: 0.1
Factory default: 0.1

Description: When AUPC is active, sets the trip threshold at which a fault is declared when the distant end Eb/No is outside the limit.

Edit-Unit-Advanced-Alarms-Thresholds-Dropped TRAU Count Threshold Screen

TRAU threshold: 0.0 to 9999.0
[9999.0] Step 1.0
New: 10.0

Units: None
Minimum value: 0.0
Maximum value: 9999.0
Step size: 1.0
Factory default: 9999.0

Description: Sets the error-rate threshold for dropped TRAU frames above which a dropped TRAU alarm will be generated when using the Sat-ABIS interface card.

Edit-Unit-Advanced- Alarms-Thresholds-LinkGuard Threshold Screen

LinkGuard int threshold: 0.0 to 9.9dB
[0.1] Step 0.1dB
New: 0.1

Units: dB
Minimum value: 0.0
Maximum value: 9.9
Step size: 0.1
Factory default: 1.5

Description: Sets a power spectral density threshold used to monitor for any signal under the received carrier. If the detected level of interference exceeds the threshold then an Rx traffic warning alarm is raised. See Section 8.17 for more information on LinkGuard™.

Edit-Unit-Advanced-Alarms-Actions Screens

A number of screens are available that control the following. Note that these are not described further, with the exception of the LinkGuard™ screen.

- *Tx/Rx AIS.* These control the action taken with respect to Alarm Indication Signal detection. AIS can be ignored or set to raise an alarm, regenerate AIS and send a backward alarm where possible.
- *LinkGuard.* This is used to switch LinkGuard™ threshold monitoring on and off. When on, LinkGuard™ will automatically check whether the level of interference is above the user-set threshold and initiate an alarm warning if it is. The threshold can be set via the *Edit-Unit-Advanced- Alarms-Thresholds-LinkGuard Threshold* screen.
- *BER.* Controls whether the BER threshold alarm is enabled.
- *BUC PSU.* Controls whether the combined over/under-current, over-temperature alarm for the Tx DC switch is considered a fault or not.
- *Handshaking.* Controls the action taken when a terrestrial handshake signal is activated. It can be ignored or set to raise an alarm.
- *Clr 1:1 Alm.* Allows the user to temporarily clear a modem alarm that is preventing a 1:1 changeover.

Edit-Unit-Advanced- Alarms-Thresholds-LinkGuard Threshold Monitoring Screen

<p>LinkGuard threshold monitoring: [Off]</p> <p>1:Off</p> <p>2:On</p>
--

Factory default: Off

Description: Controls regular monitoring of the signal under the received carrier for a level of interference that exceeds the set power spectral density threshold. If the threshold is exceeded then an Rx traffic warning alarm is raised. Once enabled, the monitoring is continuous and


does not rely on the LinkGuard™ signal-under-carrier web graph being viewed. Note that the monitoring process may slow the processor down. See Section 8.17 for more information on LinkGuard™.

Edit-Unit-Advanced-Special Modes FEC Off Option

Factory default: *On*

Description: Allows the user to disable the inner FEC. Under all normal operating conditions a FEC must be enabled. If the FEC is switched off then the demodulator may not be able to resolve potential phase ambiguities (repeatedly making and breaking the RF input to the modem may or may not resolve this).

Edit-Unit-Advanced-Special Modes Tx/Rx Differential Coding Screens



Tx differential coding: [On]
1:Off
2:On

Factory default: *On*

Description: If *FEC off* is selected, then further menus are displayed that allow control of whether differential coding is enabled or not (only the Tx differential coding screen is shown above). Under all normal operating modes both the FEC and differential coding must be *On*.

Edit-Unit-Advanced-Special Modes Q323 Compatibility Screens

The Q323 interface card was a modified version of the standard Q302 G703 card, which could be fitted to P300 series modems. The following menu screens allow Quantum and Evolution series modems to be compatible with P300 series modems fitted with Q323 interface cards. No additional hardware is required in the Quantum or Evolution modem for this compatibility.

The Q323 function allows E1 framed data to be modified to solve interaction problems with AIS data.

Invert Data (Q323 Switch 1) : [Off]

1:Off

2:On

Options:

Off

Normal, non Q323 operation.

On

TS1-31 is inverted.

**Factory
default:**

Off

Description: Controls whether TS1-31 Data is inverted through the modem.

Note: this is the same as SW3-1 within the Q323 definition.

TS0 bit 0 CRC4 (Q323 Switch 2) : [Off]

1:Off

2:On

Options:

Off

TS0 transparent

On

TS0 Bit 0 overwritten with
CRC4.

**Factory
default:**

Off

Description: Controls whether TS0 is transparent or whether TSO is overwritten with CRC4 multiframe. Note: this is the same as SW3-2 within the Q323 definition.

TS16 Transparent (Q323 Switch 3) : [Off]

1:Off

2:On

Options:

Off

If Switch 1 is ON, then TS16 inverted.

On

If Switch 1 is ON, then TS16 transparent.

Factory default:

Off

Description: Controls whether TS16 is inverted or transparent. Note: this is the same as SW3-3 within the Q323 definition.

Invt bit 1,2,5,6 (Q323 Switch 4) : [Off]

1:Off

2:On

Options:

Off

If Switch 1 is ON, then all bits are inverted.

On

If Switch 1 is ON, then bits 1, 2, 5 and 6 are inverted.

Factory default:

Off

Description: Controls whether all bits are inverted or bits 1, 2, 5 and 6 are inverted. Note: this is the same as SW3-4 within the Q323 definition.

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P300 equivalence is shown below:

Option	OFF	ON
SW3-1	Normal operation	TS1-31 modified
SW3-2	TS0 transparent	TS0 Bit 1 overwritten with CRC4
SW3-3	TS16 modified	TS16 transparent
SW3-4	TS1-31data inversion	TS1-31 bit mask inversion

SW3-3 and SW3-4 have no effect if SW3-1 is OFF.

The following modes are supported.

SW3:

1 2 3 4	Mode	Description
0 0 0 0	Transparent	Card functions as standard Q302
0 1 0 0	Transparent + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 0 0	TS1-31 Invert	Data through the modem is inverted
1 1 0 0	TS1-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 0 1	TS1-31 Bit Invert	Data bits 1, 2, 5 and 6 are inverted
1 1 0 1	TS1-31 Bit Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 1 0	TS1-15, 17-31 Invert	Data through the modem is invertedTS16 - Channel Associated Signaling support
1 1 1 0	TS1-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 1 1	TS1-15, 17-31 Bit Invert	Data bits 1, 2, 5 and 6 are inverted TS16 - Channel Associated Signaling support
1 1 1 1	TS1-15, 17-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1

1 = switch on, 0 = switch off

When transparent TS16 options are selected and the P300/Quantum/Evolution are in drop and insert mode, the modems must be set to maintain timeslot identities if TS16 is part of the drop and insert group.

Edit-Unit-Advanced-Special Modes Spoof Screen

This option allows full connectivity of a PCM bearer to be `spoofed` even if the link is connected over satellite via a `thin route` (i.e. less than the full PCM bearer using Drop & Insert). If enabled the following features of the PCM system appear transparent end-to-end:

1. AIS (all ones)
2. Backward Alarm
3. CAS Backward alarm (G.732 only)

Note that when enabled, AIS is forced over the whole PCM bearer and so this option should not be used with cascaded Drop & Insert, where AIS from the second modem in a cascade would cause the inserted data from the first in the cascade to be lost.

Spoof 2M AIS & BA transparency

[Yes]

New: [No]

Options:

No

Normal, non spoof operation.

Yes

Spoof 2M AIS and BA

**Factory
default:**

No

Description: Controls whether thin route spoofing is enabled or not.

Edit-Unit-Advanced-Special-Modes-Rx Mute Screen

Mute on sync loss: [Off]

1:Off

2:On

Options:

Off

Do not mute the terrestrial output on loss of demodulator lock.

On

Mute the terrestrial output on loss of demodulator lock.

Factory default: *Off*

Description: This adds support for sun outages. Typical the demodulator will go in and out of lock several times during a sun outage. This option allows the terrestrial output to be muted below an associated user-defined Eb/No threshold (see next screen) to prevent multiple 'disturbances' on the terrestrial input, which can potentially be a point of contention in relation to service level agreements, where a single sun outage event appears as multiple disruptions to the service. The muting of the output is recorded as an alarm in the log.

Edit-Unit-Advanced-Special-Modes-Rx Mute Threshold Screen

Rx mute threshold: 0 to 99dB
[3.0] Step 0.1dB
New: 03.0

Units: dB
Minimum value: 0.0
Maximum value: 99.0
Step size: 0.1
Factory default: 3.0

Description: User-defined Eb/No threshold used in sun outages to mute the terrestrial output (see previous screen).

Edit-Unit-Advanced-Operation-Ack Pwr Brk Screen

This allows the transmit carrier to be restored following a mains power failure, if the transmit carrier control has been set to 'on-mute if outage'. Please see *Edit-Tx-Carrier* menus.

Edit-Unit-Advanced-Operation-End Demo Screen

This allows the modem demonstration 'test shot' features to be turned off, therefore effectively losing the remaining balance of demonstration time left and returning the modem to a state whereby it is using only permanent SAF features that have been set.

Edit-Unit-Advanced-SAF Code Screen

New SAF code:

Factory default: None

Description: Encrypted code for enabling Software Activated Features. Enter 0 to enable a free 10-day test shot of all features. Three test shots are available and may be activated singly or together (one after another) to

give up to a 30-day test period.

Edit-Unit-Advanced-Adj Ref Screen

Only applicable on L-band modems.

Adjust 10MHz reference:
[080]
080

This allows the frequency of the internal 10MHz reference to be adjusted by using the up and down arrows. This can be adjusted off line by setting the modem to CW. Use a calibrated spectrum analyser set to count mode, or frequency counter and adjust the modem output for exactly 10MHz.

1.19.3.5 Edit-Memories Menu

Memories: **1:Store**
 2:Recall
 3:Erase

This menu contains the following options:

- *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 option allows configuration memories to be deleted.

Note that one configuration memory, namely *LOAD_DEFAULTS* always exists. When this is recalled then it has the effect of setting the modem back to the factory defaults. (Although the *LOAD_DEFAULTS* memory also appears under *Store* and *Erase*, these operations have no effect on this particular configuration memory.)

Note that there are restrictions on what characters can be included in the configuration memory names. Only the letters of the alphabet and numerals should be used.

1.19.3.6 Edit-Redundancy Menu

Redundancy: 1:1-for-1 2:1-for-N

This menu contains the following options:

- *1-for-1*. This controls various aspects of operation and switchover logic for modems that are being operated in 1:1 redundant pairs.
- *1-for-N*. This is used to control the set up and operation of traffic modems and the redundancy switch backup modem in 1:N redundancy systems.

Edit-Redundancy-1-For-1-Switchover Screen

Switchover: 1:Switch to standby 2:Switch to maintenance 3:Switch to service
--

Options:

Switch to standby

This option forces a modem that is on-traffic to standby. This is done by momentarily creating a fault condition that forces a switchover to occur.

Switch to maintenance

Allows the modem to be removed from the redundancy group, therefore preventing the unit being switched on line.

Switch to service

Allows the modem to enter a redundancy group and be available to come on line.

Factory default: None

Description: Forces a switch to the standby unit and allows a modem to be removed or added to a redundancy group.

Edit-Redundancy-1-For-1-Operation Screens

Receive fail switchover: [Off]
1:Off
2:On

This causes the modem to ignore loss of demod lock, which would otherwise cause a switchover to the standby modem.

Transmit fail switchover: [Off]
1:Off
2:On

This causes the modem to ignore loss of incoming data to the modulator that would otherwise cause a switchover to the standby modem.

Setting both transmit and receive fail switchovers to *Off* effectively configures the unit to switch on unit faults only and ignore all traffic faults.

Edit-Redundancy 1-For-N Menu

Virtually all of the options on this menu are only available if the modem is acting as the backup modem in a 1:N redundancy switch. Please see separate redundancy switch operating manual for further details. The one menu option that is relevant to traffic modems in a 1:N redundant system is described below.

Edit-Redundancy-1-for-N Traffic Modem 1:N Address Screen

1:N address : 1 to 16
[01] Step 1
New : 01

Options:	<i>Address range 1 to 16</i>
Minimum value:	1
Maximum value:	16
Step size:	1
Factory default:	<i>None</i>

Description: Sets the 1:N RS485 address for the modem to communicate with a

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redundancy switch. Note: the modems position within the redundancy switch system dictates the 1:N address. Please see separate redundancy switch operating manual.

1.19.4 View Menu

In general, the *View* menu provides access to a summary of the information entered via the *Edit* menus. Consequently, these menus are not described in detail here.

View:	1:Unit	2:SAF
	3:Monitor	4:Alarms
	5:Log	6:Config

The menu contains the following options:

- *Unit*. This submenu contains manufacturing information such as model number, serial number, software version, firmware version and details of the modem hardware configuration.
- *SAF*. This displays details of which software activated features are currently active, which are disabled, the number of SAF test shots remaining and the remaining SAF test shot period before the temporary SAF features time out.
- *Monitor*. This provides access to transmit, receive and unit information that is continually updated, including the data rates at different points in the transmit and receive processing chain, power supply levels, modem internal temperature and modem loopback status.
- *Alarms*. This provides access to transmit, receive and unit current alarm information. Note that entering 0 clears any existing latched alarm.
- *Log*. This provides access to the system log. This includes a list of all notable events that have occurred including alarms. Entries are timestamped. Note that entering 0 clears the log.
- *Config*. This provides access to summaries of the transmit, receive and unit settings.

1.19.5 Test Menu

Test:	1:Loopback	2:BER test
	3:RF	4:IDR
	5:IP	

The menu contains the following options:

- *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.

- *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.
- *RF.* 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.
- *IDR.* This provides a simple tone generator at 1 KHz @ 0dBm level either towards the satellite or from satellite.
- *IP.* 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).

Test-Loopback Screen

Loopback:
[Off]
New: Off

Options:

Off
Interface
Interface (local and remote)
Framer/deframer (local)
RS (local)
FEC (local)
IF (local)

Factory default: *Off*

Description: Allows a number of loopbacks to be selected to aid fault diagnosis and resolution of system level problems.

IF (local) is used to loopback transmit to receive internally within the modem.

Interface (local and remote) is used to loopback receive to transmit and is normally set on one of the pair of modems (usually the remote modem).

The other modes are more specialized and cause a loopback at various points within the Tx/Rx processing chains.

In general it is not a good idea to loopback IP data to itself. This will cause the modem to retransmit on its terrestrial port packets that it has received and this can confuse intelligent switches, which conclude that the original sending device has moved and is now on a different port, which can cause traffic storms! If it is necessary to test modems that have an IP interface, it is recommended to change the terrestrial interface selected to be a serial interface (which is fitted on all modems) and to perform the loopback test and then change the interface back to IP.

Test-BER Test Menu

BER test:	1:Tx
	2:Rx
	3:Results

This menu contains the following options:

- *Tx*. This allows the setup of the internal Pseudo-Random-Bit-Sequence (PRBS) Bit Error Rate (BER) Tester for the Tx path.
- *Rx*. This allows the setup of the internal PRBS BER Tester (BERT) for the Rx path.
- *Results*. This screen displays the BER test results and allows single errors to be injected or the test to be restarted.

The internal BER tester is available as a SAF option. It provides the ability to monitor the BER of the Rx satellite path even while the main data channel of the link is carrying normal traffic. It allows a test pattern to be sent and received in the main channel or in parallel with the main channel using the ESC or Aux overhead channels.

It can operate independently or in conjunction with external BER equipment. The test patterns are Fireberd compatible. For example, the internal BER tester could be used to inject a PRBS test pattern and measure the Rx BER at one end of the link, while at the other end a Fireberd is connected to the corresponding main data (or overhead) port.

Note that the following BER test screens apply to Tx and Rx but only the Tx screens are shown.

Test-BER-Tx Screen

Tx:	1:Mode
	2:Channel
	3:Pattern

This menu contains the following options:

- *Mode*. This is used to switch the BER tester on and off.
- *Channel*. This option allows the BER test pattern to be injected in either the main traffic channel of the modem or in an overhead channel.
- *Pattern*. This allows a choice of bit patterns to be selected for injection into the traffic stream.

Test-BER-Tx-Mode Screen

BER mode:
1:Off
2:On

Options:

Off

Switches the BER tester off.

On

Switches the BER tester on.

Factory default: *Off*

Description: Controls the BER test mode.

Test-BER-Tx-Channel Screen

BER channel: [Main channel] New: Main channel

Options:

Main channel

This substitutes the selected PRBS test pattern in place of the Tx main traffic channel.

ESC channel

This selects the ESC channel as the path into which the PRBS test pattern is injected. This is valid in IBS/SMS, IDR and Closed Network plus ESC. The ESC channel must be configured before it can be used. In IBS/SMS and Closed Network plus ESC, the Async ESC channel is used and can be configured to provide rates of up to 4.6% of the main data rate for BER testing. When the ESC channel is selected in IBS/SMS and Closed Network plus ESC, the Async ESC is disabled and whatever bandwidth was assigned to it is used synchronously for BER testing. In IDR mode, the 8kbps synchronous ESC channel is used (which can also be used in an asynchronous mode).

Aux channel

This selects the Aux channel as the path into which the PRBS test pattern is injected. This is valid in IBS/SMS and IDR modes. The Aux channel must be configured before it can be used. In IBS/SMS, the overhead assigned to the mandatory Intelsat low-rate oversampled Aux channel is used by the BER tester to provide a synchronous test channel of 0.2% of the main data channel rate. If an IDR option card is fitted, then in IBS/SMS mode, the Aux channel can be used synchronously to use all available overhead not already in use by the ESC channel – this can provide a channel of up to 4.4% of the main data rate. In IDR mode, the Aux channel can be configured to provide 32kbps or 64kbps (in place of one or both 32kbps ADPCM audio ESC channels) which can then be used for BER testing.

Factory default:

Main channel

Description: Controls the channel through which the BER test patterns are transmitted.

Test-BER-Tx-Pattern Screen

BER pattern: [PRBS 15] New: Alt 10
--

Options:

Alt 10, All 1, All 0, PRBS 20-0151, PRBS 15, PRBS 11, User, QRSS, PRBS 23, PRBS 20-0153, PRBS 19, PRBS 9, PRBS 7, PRBS 6, 3 in 24, 1 in 16, 2 in 8, 1 in 8, 1 in 4, Alt 1100

Selects the desired test pattern. The pattern is a pseudo random sequence of 1s and 0s of the specified length that repeats continuously. The *User* pattern allows a user-defined pattern to be entered.

Factory default:

PRBS 20-0151

Description: Selects the PRBS BER test pattern.

Test-BER-Tx-Results Screen

BERT:Sync OK	Time:40.0mins
Loss#:1	Errors:3
BER:1.0E-6	

The *BERT* shows the instantaneous test pattern synchronisation status. When the Rx path is synchronised to the incoming Tx test pattern then this will display 'Sync OK' and when synchronisation is lost it will display 'NO SYNC'.

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

The *Loss#* field is a count of the number of times that pattern synchronisation has been lost since the test started.

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

The *BER* field indicates Bit Error Rate, computed from the number of bit errors divided by the number of bits received.

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Note that pressing 1 on the key pad while on this screen will inject an error and that pressing 2 will restart the test.

Pressing the *Down* arrow key at any point displays the following screen.

Results:	1:Inject error
	2:Restart test

The *Inject error* option can be used to inject a single error into the bit pattern, which has the effect of incrementing the number of bit errors by one. Note that pressing 1 on the key pad while on the results screen has the same effect.

The *Restart test* option is used to restart the BER test including clearing all of the error counts. Note that pressing 2 on the key pad while on the results screen has the same effect.

Pressing the *Back* key returns the display to the previous results screen.

Test-RF-CW Screen

Modulator CW: [Off]
1:Off
2:On

Factory default: *Off*

Description: 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.

Test-Modulator-RF-Alternate 1,0 Screen

Modulator alternate 1,0: [Off]
1:Off
2:On

Factory default: *Off*

Description: Selecting Tx alt 1,0 causes an alternating 1,0,1,0pattern 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.

Test-Wide Spectrum Screen

Enable wide spectral graph: [Off] 1:Off 2:On

Factory default: *Off*

Description: Selecting the wide spectral graph prevents the Demod from locking, and is therefore implemented as a test mode. At four times the symbol rate, it allows viewing of a wider frequency range than the standard modem web spectral graph. Note: a superwide graph (showing 50MHz of spectrum) which does not prevent the Demod from locking.

Test-IDR Screen

IDR:	1: Tx tone on	2: Tx tone off
	3: Rx tone on	4: Rx tone off

Options:

Tx tone on
Rx tone on
Tx tone off
Rx tone off

Factory default: *Tx tone off*
 Rx tone off

Description: Selecting IDR *Tx tone on* enables a 1KHz 0dBm level tone to be generated towards the satellite in both audio channels.

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Selecting *IDR Rx tone on* enables a 1KHz 0dBm level tone to be generated towards the terrestrial equipment in both audio channels. Note that these are toggle on/off functions and when disabled will be shown as hashed out (#).

1.20 Web User Interface

The modem includes an embedded web server that allows full monitoring and configuration of the modem via a web browser (available on port 80). Secure connections via HTTPS (port 443) are also supported. Microsoft Internet Explorer V6.0 and above is supported as standard. Paradise Datacom has a policy of avoiding the use of non-standard browser extensions in its software wherever possible but cannot guarantee correct operation with any other browser, although from time-to-time we do check operation with other popular browsers.

In general, the web menus are structured in a similar way to those on the front panel LCD display. Consequently, this section explains only those features of the web interface that are different.



NOTE THAT USING IP LOOPED BACK THROUGH THE MODEM CAN CONFUSE ETHERNET SWITCHES ON THE NETWORK AND CAUSE PACKET STORMS THAT MAY BRING YOUR NETWORK DOWN. THIS IS BECAUSE THE SWITCH WILL SEE THE PACKETS LOOPED BACK THROUGH THE MODEM AS AN INDICATION THAT THE NETWORK DEVICES THAT ORIGINALLY TRANSMITTED THOSE PACKETS HAVE MOVED TO A DIFFERENT SWITCH PORT AND WILL THEREFORE RETRANSMIT ALL RECEIVED PACKETS AGAIN AD INFINITUM!

1.20.1 Logging In and Out

The philosophy behind user levels, login and control of the modem is explained in Section 7.1.

To connect to the web server from a web browser, ensure a suitable Ethernet cable is connected into the Remote M&C RJ45 socket on the rear of the modem and 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 below) a user name and password (with the default modem configuration these are *admin* (or *user* for view-only mode) and *paradise* respectively. These details are sent in an encrypted form back to the modem. It is recommended that passwords are changed from their default values.



Web User Interface Login Screen

On successfully logging in, the user will be presented with the following screen.



Web Server Welcome Screen

The "view only access" message may be displayed depending upon login conditions.

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On entering the web site, the user will then be presented with the following status screen:

Setup	
Tx	Rx
IF carrier frequency <input type="text" value="70.0000"/> MHz	IF carrier frequency <input type="text" value="70.0000"/> MHz
Tx data rate <input type="text" value="2048000"/> bps	Rx data rate <input type="text" value="2048000"/> bps
Tx symbol rate <input type="text" value="2060720"/> Symbols/s	Rx symbol rate <input type="text" value="2060720"/> Symbols/s
Traffic	
<input type="text" value="Transmit path OK since 6:39:0 on 24/8/1928"/> <input type="text" value="Rx fault: FEC Decoder synchronisation lost"/>	
Demodulator	
Rx Eb/No <input type="text" value="****"/> dB	
Final BER <input type="text" value=">1.0E-2"/>	
Rx power level <input type="text" value="****"/> dBm	
Rx buffer fill status <input type="text" value="****"/> %	
Rx frequency offset <input type="text" value="0.000"/> Hz	
Buffer slips <input type="text" value="Over : 0 Under : 0"/>	
AUPC	
Remote Eb/No <input type="text" value="0"/> dB	
Current AUPC Tx power level offset <input type="text" value="0"/> dB	

For contact details and on-line handbook, see <http://www.paradisedatacom.com>

Modem Status Screen

The line of buttons across the top of the display give access to the major modem functions, while the tabs give access to individual features. 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 summary section on the left of the display is always present and provides basic modem information. The Help area is used to provide help on context-sensitive features – it is triggered by moving the cursor over an item such as a display label, which is then described within the Help box. The LED mimic on the left of the screen depicts the modem front panel LED indicators.

A typical Edit screen that demonstrates the most common types of user entry is shown overleaf. It shows a mixture of drop-down boxes, where a selection is made from the options that are presented, and edit boxes, where a numeric or text value is entered. Tool tip help is available by moving the cursor over any display label. Help information includes details of minimum and maximum valid values. 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 – when the box changes back to its standard background color then this indicates that the modem has implemented the change.

The screenshot displays the Paradise Datacom Quantum Series web interface. The top navigation bar includes links for STATUS, EDIT, VIEW, TEST, HELP, and LOGOUT. The left sidebar shows a SUMMARY section with modem details (ID: Paradise modem, Serial No: 999, Mode: In control, Control: Shared) and a UNIT STATUS section with indicators for RX TRAFFIC, TX TRAFFIC, TEST MODE, and TX CARRIER. The main content area is divided into tabs: Tx, Rx, Unit, and Memory. The 'Unit' tab is active, showing sub-tabs for Identity, Interface, M & C, Clocks, Time, User, Advanced, and Upgrade. The 'Interface' sub-tab is selected, displaying configuration for the Serial interface (Baud rate: 9600 baud, RS485 address: 1, Serial interface mode: RS232) and the Ethernet interface (Remote control port Ethernet IP address: 10.0.70.147, Remote control port IP subnet mask: 255.255.0.0, Remote control port Ethernet IP gateway: 0.0.0.0). Below these, the 'Giveaway / Takeaway mode' section shows 'Modem control' set to 'Takeaway' and 'User auto-logout period' set to 5 mins. At the bottom, there are fields for 'New password' and 'New password confirmation' for both 'Admin' and 'User' roles, with a note that the minimum length is 6 characters.

Typical Screen Showing Edit Boxes and Drop Down Boxes

A user can logout at any time by clicking on the *logout* button. This brings up the following message box (note that responding Yes will automatically close the Internet Explorer session).



Logout Confirmation Screen

1.20.2 Graphing Features

One of the novel aspects of the modem is the ability to use it as a *spectrum analyser* to view the Rx signal spectrum and as an *oscilloscope* to view the I and Q channel Rx signal constellation. Other graphs provide time-based logging (for up to one month) of key modem parameters such as Rx Power Level, Eb/No, etc. In fact, all of the information presented on the graphs can be retrieved from the modem in order to, for example, generate monthly Quality of Service reports regarding modem availability and operational performance.

Graphing requires the Java Runtime Environment (JRE) to be installed on the PC that is being used for viewing (since the graphing is done by a Java applet). The JRE can be downloaded from various web sites including <http://www.java.com>. Graphs will not display

properly if an incompatible/older version of the JRE is installed (see the web page Help box for more information).

The first time that a graph is displayed, the following message will pop up. This is because the Java applet requires privileges to run and therefore includes a security certificate. The applet does not write any information to storage on the PC and is not harmful in any way; you should select Yes in order to be able to view graphs.



Java Applet Security Warning Screen

1.20.2.1 Spectrum Graph

An example spectrum graph is shown overleaf. This can be used to check for correct modem operation. The spectrum can be viewed in one of three modes.

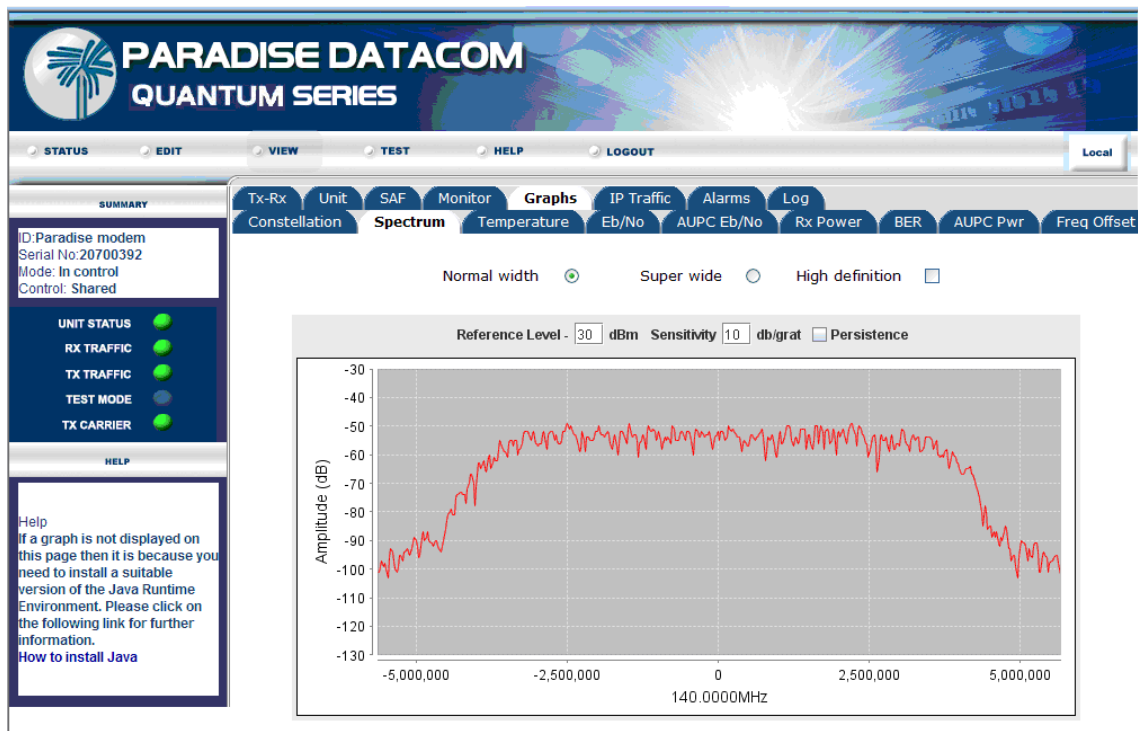
In *narrow* view, the width of the spectrum is limited to less than twice the symbol rate. This mode does not interfere with modem operation in any way.

In *wide* view, the spectrum width is nearer to four times the symbol rate and this can be used for checking for adjacent interfering carriers. **In *wide* mode, the demodulator is reprogrammed with different values to normal operation and consequently the *wide* mode of operation is only available as a special test mode (since it would otherwise interfere with any traffic).**

In *super-wide* view, which can be used without interfering with traffic, the spectrum width is set to 50MHz to allow all or a significant portion of the satellite transponder bandwidth to be monitored.

The user can adjust the reference level for the graph (i.e. the amplitude offset that appears at the top of the graph) and the amplitude resolution.

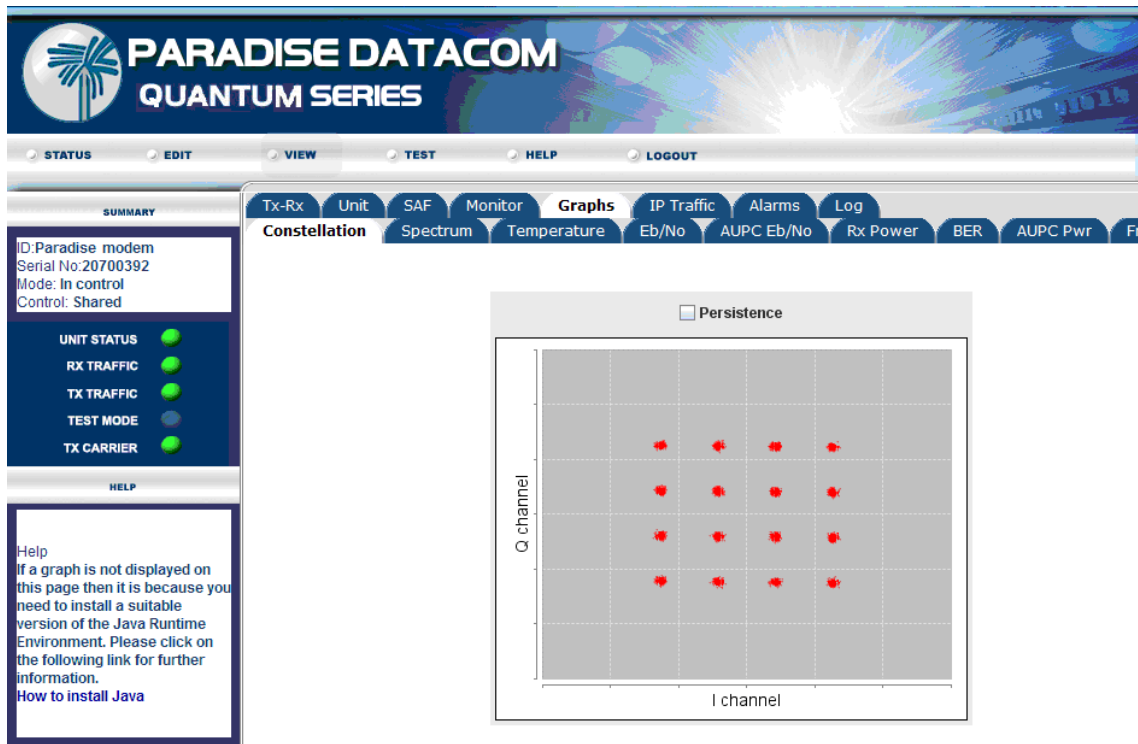
A *High Definition* setting is available by checking the tick box within the Spectrum graph. This provides four times the resolution, giving more detail within the spectral content. A persistence mode is also available. In this mode, successive spectrums are never deleted but left to build up a picture over time of all the received frequency information. This is useful for identifying transient signals such as intermittent interference, which may be present.



Signal Spectrum Graph

1.20.2.2 Constellation Graph

An example signal constellation graph is shown below. This can be used to check for correct modem operation including issues such as distortion and phase noise. A persistence mode is also available and allows the user to see the long term effects of phase noise and interference. Excessive phase noise can cause cycle skips otherwise seen as unwanted rotations within the constellation.



Signal Constellation Graph

1.20.2.3 Time-based Graphs

A number of time-based graphs can be displayed. These update approximately once per second but actual refresh rate will depend upon the Ethernet connection speed and channel loading. 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.

All of the results can be retrieved from the modem (perhaps for use in quality reports) using one of the remote interfaces – see the '*Remote M&C Specification for Quantum and Evolution Series Satellite Modems*' for more details. In fact, remote control commands can be used to start the automatic recording of any parameter within the modem, whether or not these are supported as graphs on the web interface.

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

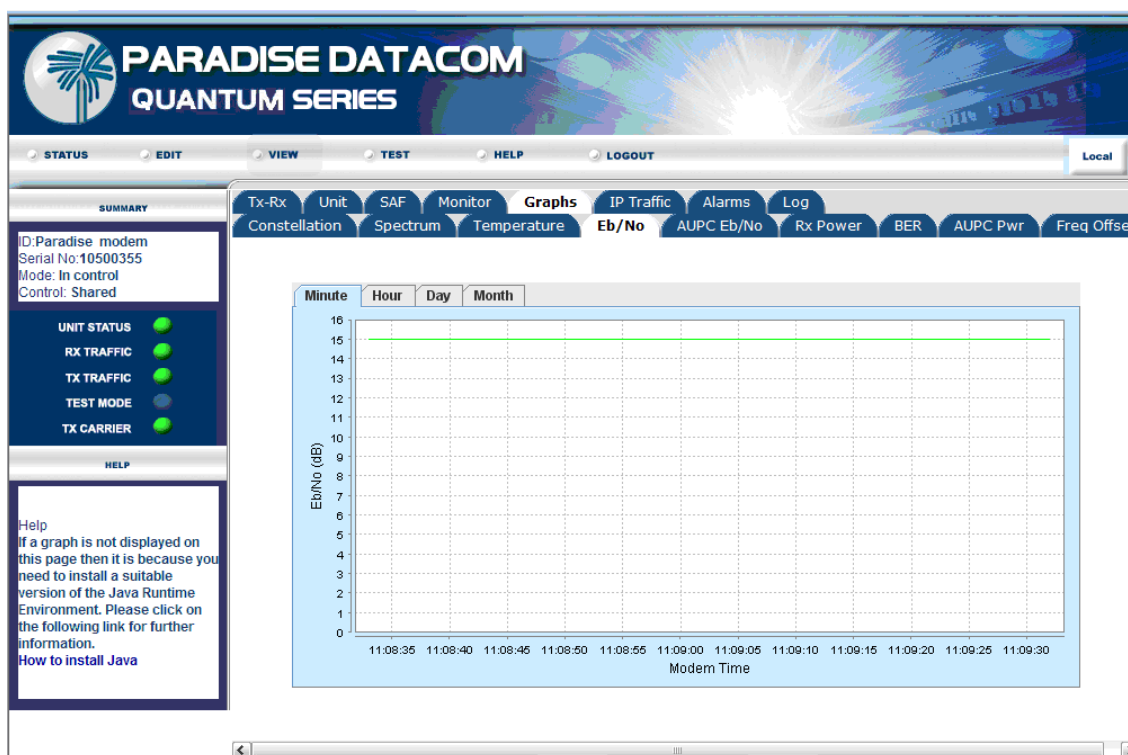
- The modem received signal Eb/No.
- The Eb/No of the distant modem being controlled via AUPC.
- The modem received power level.
- The modem final (user) BER after error correction (estimated from the FEC).
- The modem actual BER from the internal BER Tester (available as a Test function).
- The transmit power level while under AUPC control.

Quantum and Evolution Series Installation and Operating Handbook

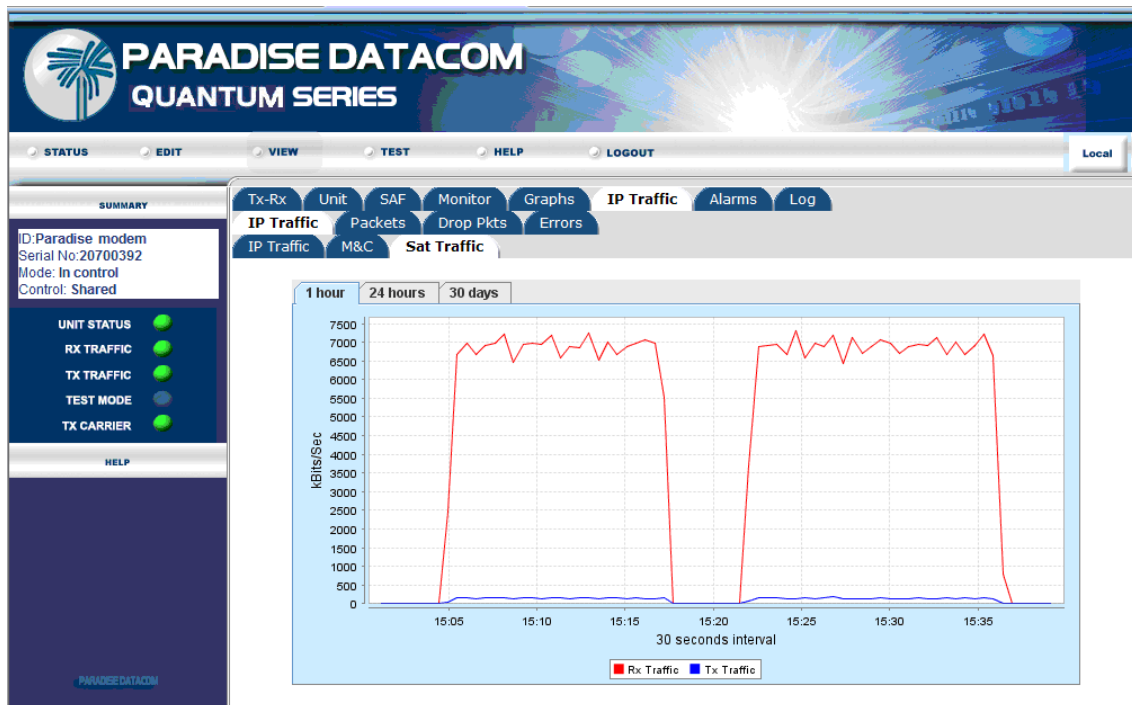
- Modem internal temperature.
- Receive frequency offset from centre frequency.

Similarly IP traffic information, IP packets, dropped packets and errors can also be displayed for both Tx and Rx. These graphs are sub-divided into IP traffic, M&C and satellite categories. If an IP traffic card is fitted then these graphs automatically relate to the IP traffic card information.

Examples of time-based and IP traffic graphs are shown below and overleaf.



Eb/No Graph



Satellite Traffic Graph

1.20.3 Configuration Memories

In common with the local user interface, the web interface allows the storing of user configurations to memory on the modem and the recall of these later. However, the web interface also allows these memories to be uploaded and downloaded to and from a PC. This in turn, allows configurations to be shared by different modems. This offers a convenient, time saving method of configuring a batch of modems by generating a configuration on one, downloading it to a PC and then uploading it to other modems in turn.

When recalling a configuration memory, the LOAD_DEFAULTS memory will reset the modem to its factory defaults. If LOAD_DEFAULTS is selected from the web user interface then the modem's current M&C IP address, netmask, gateway, giveaway/takeaway control, Modem ID and password are all retained whereas when selected from the local user interface they are not (this is in order not to break the web user interface session which could risk losing control of the modem).

The screens for downloading and uploading configuration memories are shown over the page.

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The screenshot shows the 'Download Stored Configuration' screen. The left sidebar contains a 'SUMMARY' section with modem details (ID: Paradise modem, Serial No: 999, Mode: In control, Control: Shared) and a 'UNIT STATUS' section with indicators for RX TRAFFIC, TX TRAFFIC, TEST MODE, and TX CARRIER. A 'HELP' section at the bottom provides instructions on downloading configurations. The main content area has tabs for Tx, Rx, Unit, and Memory, with 'Memory' selected. Below the tabs is a table of stored configurations.

Configuration	File Size	Date	
1.conf	1688 bytes	13 Jul 2005 15:27	<input type="radio"/>
9.conf	1688 bytes	14 Jul 2005 11:40	<input type="radio"/>
mycurrentconfig.conf	1702 bytes	14 Jul 2005 11:41	<input type="radio"/>

Download Stored Configuration

Configuration Memory Download Screen

The screenshot shows the 'Upload Saved Configuration' screen. The left sidebar is identical to the previous screen. The main content area has tabs for Tx, Rx, Unit, and Memory, with 'Memory' selected. Below the tabs is a form for uploading a configuration file.

Upload Saved Configuration

Name for new configuration

Upload Saved Configuration

Configuration Memory Upload Screen

1.20.4 Interface Configurations

The screenshot displays the Paradise Datacom Quantum Series web interface. The top navigation bar includes links for STATUS, EDIT, VIEW, TEST, HELP, and LOGOUT. The main content area is titled 'Interface' and shows configuration options for Port 1. The left sidebar contains a 'SUMMARY' section with unit status (green), RX traffic (blue), TX traffic (green), test mode (blue), and TX carrier (green). Below this is a 'HELP' section with a text box explaining the 'Paradise Traffic port Ethernet IP gateway' function. The main configuration area is divided into several sections: 'General' (Terrestrial interface type: IP, IF port impedance: 50 Ohms), 'G.703' (G.703 data rate: T1, G.703 line encoding: AMI), 'IP' (IP traffic mode: Ethernet traffic mode, Traffic port Ethernet IP address: 0.0.0.0, Traffic port IP subnet mask: 255.255.255.255, Traffic port Ethernet IP gateway: 0.0.0.0), and 'Bridge filtering' (Bridge filtering: unchecked, Web Acceleration: unchecked, Enable VLAN filtering: unchecked, Weighted QoS: unchecked). The 'Ethernet traffic mode' is set to 'Bridge mode for point-to-point IP'.

Interface Configuration Screen

Quality of Service is based on **IEEE 802.1p priority tagging**. It uses a 3-bit field within the VLAN tag as a means of prioritising packets. The modem responds to the priority level set in the VLAN tag when the packet is received.

The default is to use **strict priority queuing**, where three queues are established, with the highest priority (level 7) being sent first followed by the medium priority (levels 6 and 5) and finally packets from the low priority (levels 4 to 0) queue. However, if there is a large amount of high priority traffic this can have the effect of starving bandwidth for lower priority traffic.

Selecting **Weighted QoS** enables fair-weighted queuing. This applies a weighting to the three traffic queues where the highest priority data gets most bandwidth, but bandwidth is reserved for other lower priority data; for every 4 packets sent from the high priority queue, 2 are sent from the medium priority queue and 1 from the low priority queue.

The modem supports **IEEE 802.1q VLAN tagging**. If Ethernet frames with VLAN tags are presented to the modem when in bridge mode then these packets will be transmitted transparently along with the VLAN tags. **VLAN filtering** can also be used with point-to-multipoint topology to separate traffic flows as long as there is a return path. In point-to-multipoint operation, each remote modem receives all of the data and use of VLAN tags over just the satellite portion of the link is a useful way of being able to filter out unwanted traffic at the remotes. A VLAN id is assigned by the user to each remote modem. The hub Tx modem automatically learns what VLAN tags are associated with each remote. It also learns the location of every device connected to each remote. As data is received at the hub, the Tx modem adds a VLAN tag with the id of the remote for which it is destined. At the remote, unwanted data is filtered out and discarded. The VLAN tag is also removed from wanted packets that have been received at the remote before they are forwarded

onto the local terrestrial IP network. Note that the use of point-to-multipoint VLAN filtering relies on the modem generating and removing VLAN tags and it cannot therefore be used in situations where VLAN tags are already present in the data at the point at which it is passed to the modem for transmission.

On the menus, the **VLAN ID** option is used to set the identifier to be used with VLAN filtering. 4094 VLAN ids are available.

The **Bridge M&C** mode ensures the M&C IP interface is part of the Ethernet bridge. If deselected, then the IP traffic and M&C are kept separate.

Web Acceleration mode accelerates web browsing by prefetching web page inline objects prior to them being requested by the web browser. This feature requires the modem to be fitted with an IP traffic card. It also requires a DNS IP address to be set. Web pages comprise multiple objects which are typically fetched one or two at a time by a web browser without web acceleration and therefore a full webpage can take many times the satellite delay to be displayed. The Paradise web proxy examines webpage frames as they pass through the modem and pre-fetches all of the content before it is requested. It is therefore typically available in cache memory at the modem local to the web browser prior to the browser actually requesting the remaining content.

The **Bridge Filtering** option forms part of the Brouting traffic mode and controls whether the Ethernet bridge filters out all the traffic other than that destined for the local sub-net. If this option is switched off, then it is typically the responsibility of a router on the local network to filter out unwanted traffic.

The **One for one mode** option is applicable only to the G.703 interface. Normally the G.703 input is looped by a relay if power is removed. This is to ensure that any other traffic on the G.703 PCM bearer is not lost by a break in the bearer. However, when one-for-one mode is selected, the G.703 output goes high impedance if power is removed allowing the units 1:1 partner to carry the traffic.

1.20.5 Timeslots

Timeslot selection and reordering has been simplified by the use of edit boxes for each timeslot, as shown overleaf. The boxes allow the association of specific terrestrial timeslots with satellite timeslots.

Quantum and Evolution Series Installation and Operating Handbook

PARADISE DATACOM
QUANTUM SERIES

STATUS EDIT VIEW TEST HELP LOGOUT

SUMMARY

ID:Paradise modem
Serial No:999
Mode: In control
Control: Shared

UNIT STATUS
RX TRAFFIC
TX TRAFFIC
TEST MODE
TX CARRIER

HELP
Move the cursor over an item's label for help.

Tx Rx Unit Memory
Service Baseband Clocks Demodulation FEC Descrambler Carrier Rx = Tx
Framing Timeslots Overhead

Number of timeslots from satellite: 0

Incorrect settings in continuous mode

Maintain timeslot ID over satellite: Do not maintain TS identity

Partial insert: Normal

from satellite	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
to TS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
from satellite	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
to TS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

press enter to change values

Transmit Timeslot Selection Screen

1.20.6 System Log

The system log can be viewed using the View-Log menu tab. An example log is shown overleaf.

PARADISE DATACOM
QUANTUM SERIES

STATUS EDIT VIEW TEST HELP LOGOUT

SUMMARY

ID:Paradise modem
Serial No:999
Mode: In control
Control: Shared

UNIT STATUS
RX TRAFFIC
TX TRAFFIC
TEST MODE
TX CARRIER

HELP

Configuration Unit SAF Monitor Alarms Log

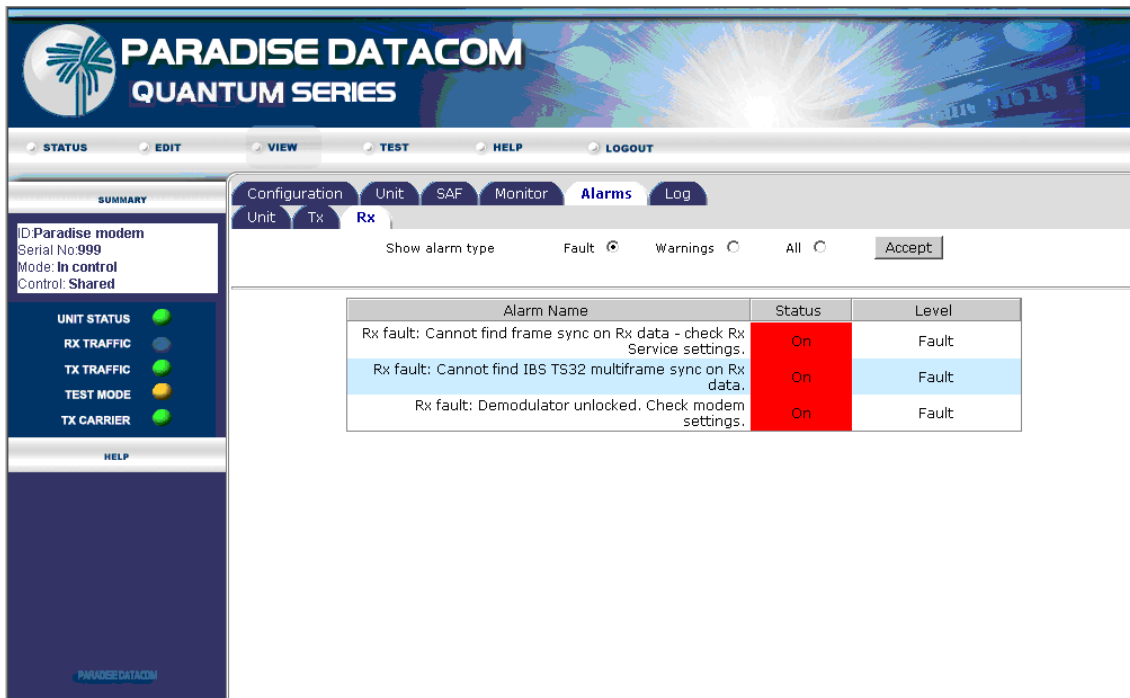
Clear.

Date	Alarm
Jul 21 16:41:34	Alarm: RxDeframerTS32SyncLossAlarm Raised
Jul 21 16:41:34	Alarm: RxDeframerSyncLossAlarm Raised
Jul 21 16:41:34	Alarm: RxDemodUnlockedAlarm Raised
Jul 21 16:41:28	Alarm: RxDeframerTS32SyncLossAlarm Cleared
Jul 21 16:41:28	Alarm: RxDeframerSyncLossAlarm Cleared
Jul 21 16:41:27	Alarm: RxDemodUnlockedAlarm Cleared
Jul 21 16:41:27	Alarm: RxDemodUnlockedAlarm Raised
Jul 21 16:41:27	Alarm: RxDeframerTS32SyncLossAlarm Raised
Jul 21 16:41:27	Alarm: RxDeframerSyncLossAlarm Raised
Jul 21 16:41:26	Alarm: RxDeframerTS32SyncLossAlarm Cleared
Jul 21 16:41:26	Alarm: RxDeframerSyncLossAlarm Cleared
Jul 21 16:41:26	Alarm: RxDeframerTS32SyncLossAlarm Raised
Jul 21 16:41:26	Alarm: RxDeframerSyncLossAlarm Raised
Jul 21 16:41:25	Alarm: RxDemodUnlockedAlarm Cleared
Jul 21 16:41:25	Alarm: RxDemodUnlockedAlarm Raised

System Log Screen

1.20.7 System Alarms

System alarms can be viewed using the *View-Alarms* menu tab. An example screen is shown overleaf.



PARADISE DATACOM QUANTUM SERIES

STATUS EDIT VIEW TEST HELP LOGOUT

SUMMARY

ID:Paradise modem
Serial No:999
Mode: In control
Control: Shared

UNIT STATUS

- RX TRAFFIC
- TX TRAFFIC
- TEST MODE
- TX CARRIER

HELP

Configuration Unit SAF Monitor **Alarms** Log

Unit Tx Rx

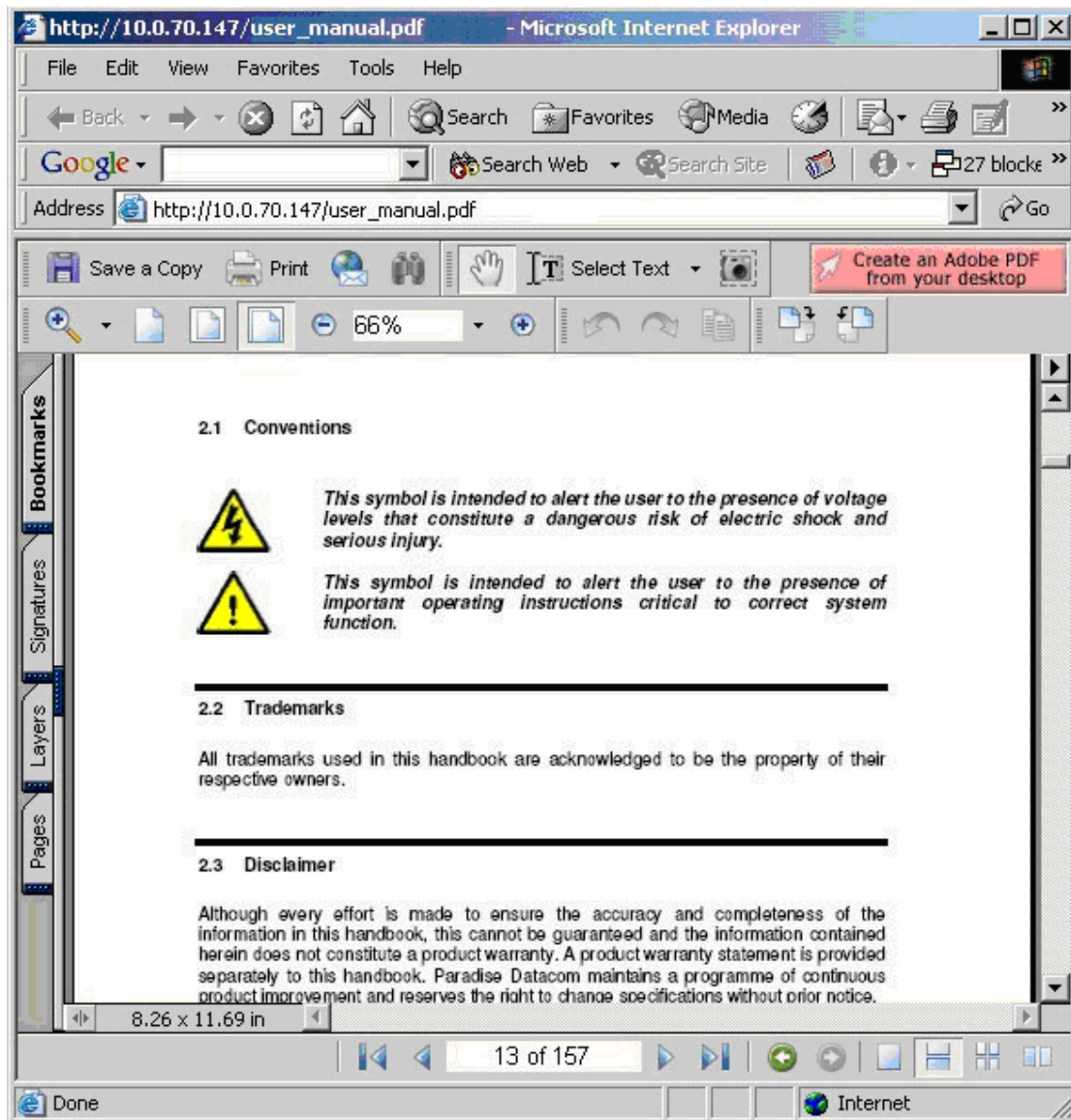
Show alarm type Fault Warnings All Accept

Alarm Name	Status	Level
Rx fault: Cannot find frame sync on Rx data - check Rx Service settings.	On	Fault
Rx fault: Cannot find IBS TS32 multiframe sync on Rx data.	On	Fault
Rx fault: Demodulator unlocked. Check modem settings.	On	Fault

System Alarms Screen

1.20.8 On-line Installation and Operation Handbook

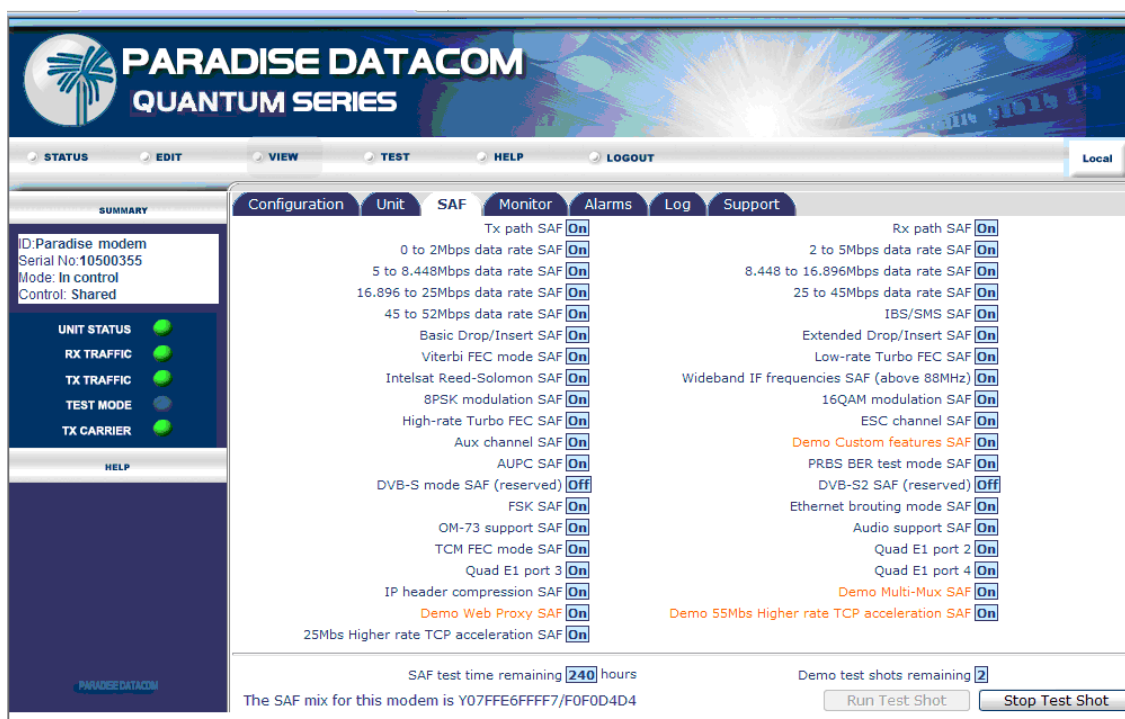
This handbook is available on-line via the Help button. The handbook appears in a pop-up window, allowing it to be kept open in the background, as shown overleaf.



On-line Installation and Operation Handbook

1.20.9 SAF Screen

The features available can be seen from the *View-SAF* menu screen. This screen also allows a test shot to be started or stopped. If a 10 day test shot is active the word 'Demo' is added to the SAF label of each additional feature started by the test shot and the text colour is changed to amber. Permanent features are always shown in blue.



SAF Screen

1.20.10 SNMP Configuration

It is possible to enable and configure the Simple Network Management Protocol (SNMP) v1, v2c agent within the modem, through the web interface. SNMP is switched off by default. An SNMP MIB is provided on the modem and can be downloaded from the *SNMP Configuration* screen. The SNMP facilities of the modem are documented in the *'Remote M&C Specification for Quantum and Evolution Series Satellite Modems'*. The SNMP configuration screen (found under the *Edit-Unit-M&C-Advanced* menu tab) is shown overleaf. 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 can be used to define which source IP addresses 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 are triggered.

SNMP Configuration Screen

1.20.11 Remote Software Upgrade

1.20.11.1 Overview

It is possible to update the software and firmware within the modem via the Remote M&C Ethernet web user interface (upgrades via the serial M&C port are not supported). Please read the notes overleaf before proceeding.



Note that to successfully upgrade a modem using Internet Explorer running on a Windows Vista PC, you must turn Protected Mode OFF on the PC.

Upgrades are provided as a single compressed zip file. These can be used to either upgrade or downgrade the software, the process for both operations being the same. From the screen shown overleaf, it is necessary only to browse to the location of the upgrade file and open the file. 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 modem. Feedback on the progress of the update, which typically takes around 10 minutes (depending on the speed of the link) is provided on the screen. The modem will be automatically restarted when the upgrade is complete. Note that a remote modem can be upgraded over the satellite link by setting up the IP traffic interface and browsing to the remote modem's IP address in order to access its web server (the upgrade process then being followed as normal).

In the event that an upgrade is unsuccessful (for example, because the upload to the modem was interrupted), then it is possible to enter a recovery mode. The memory on the modem is configured to include a failure recovery sector that includes a very basic file system. By keeping the *Main* key pressed down while the modem is powering up, the recovery mode is entered. (It is possible to perform the equivalent operation remotely through the serial port on the 1-for-n connector – please contact Customer Technical Support for more details.) In this mode, you can still make a connection from a web browser to the modem (using the default IP address and subnet displayed on the screen). Note that this may require the PC IP address and subnet to be changed to be compatible with the subnet being used by the modem. A very basic web page will be displayed that requests the location of the file that the modem is to be upgraded with. The upgrade will then proceed as normal and the modem will restart when the operation is complete. *If the basic web page does not display properly then it may be necessary to flush the browser cache (in Internet Explorer, this is achieved by going to the menu option tab Tools/Internet Options.../General and selecting Delete Files... from the Temporary Internet Files options).*

A software upgrade cannot be performed whilst the modem is on traffic. Once the modem upgrade process starts, normal modem functions are suspended. The modem configuration prior to upgrade is maintained and the modem will use this configuration after the upgrade.

1.20.11.2 Procedure

This procedure allows a Quantum or Evolution series modem to be upgraded with the latest version of software.

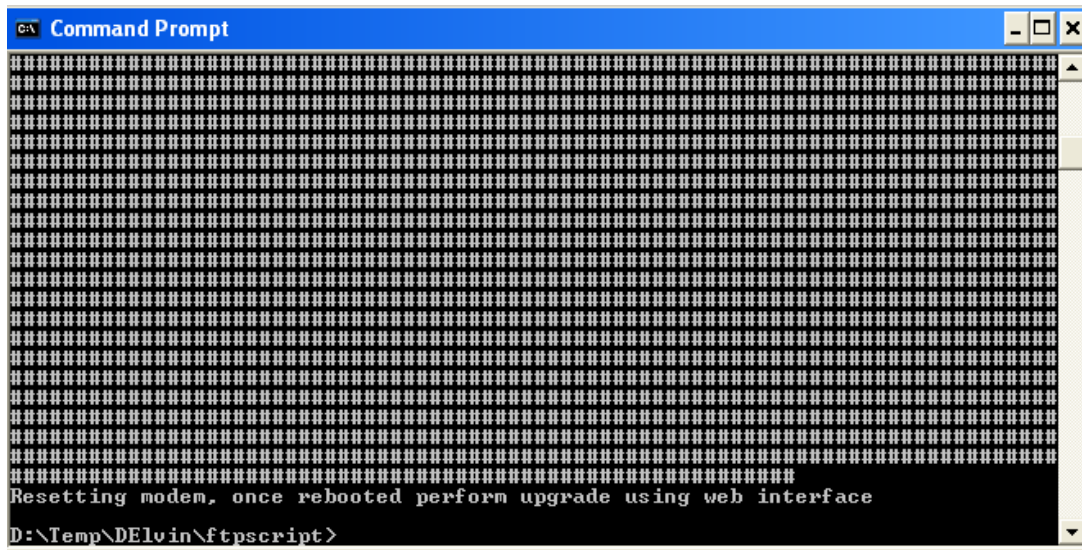


Failure to follow this procedure could render the modem **unusable!**

Method

1. The compact flash in the modem has a special piece of software called the *fallback image* that is used to recover when an upgrade fails. It is essential that this is upgraded *prior* to any upgrade or downgrade as older versions of the fallback image are less reliable with newer versions of modem software. This is done as follows:
 - a. Go to the Downloads section of the Paradise Datacom web site (<http://www.paradisedata.com>) and from the Modem Software Download section, select the 'Install Quantum/Evolution Series Modem Software' option.
 - b. Download the [fbupgrade.zip](#) file to your PC and extract the two files [fbupgrade.exe](#) and [fbimage](#) to a folder on your PC.
 - c. Connect your PC to the modem M&C Ethernet interface using a straight CAT5E Ethernet cable, ensuring the modem has an IP address compatible with the PC (i.e. on the same subnet). (The modem IP address can be set via the *Main/Edit/Unit/M&C/IP address* and *subnet mask* options.)
 - d. On your PC, open a DOS Command Prompt Window (select *Start, Run* and enter *cmd*) and change the directory to the location of the downloaded files.

- e. At the command prompt enter: *fbupgrade <modem IP address>*
- f. You should see a PC screen similar to the following after which the modem will automatically restart:



Typical screen response seen during fbupgrade

2. Download the latest modem software to your PC using the link on the web page. Please read Note 1 below at this stage.
3. From Internet Explorer, browse to the modem's *Edit/Unit/Upgrade* web page. A login is required (the default user name is *admin* and the default password is *paradise*).
4. A Java applet will appear within the page and present the user with an *Open* button. Select the *Open* button and browse to and double click the software .zip file that was downloaded. The upgrade will begin automatically. Leave the modem to upgrade and restart before attempting any further action. This will take around 10 minutes.



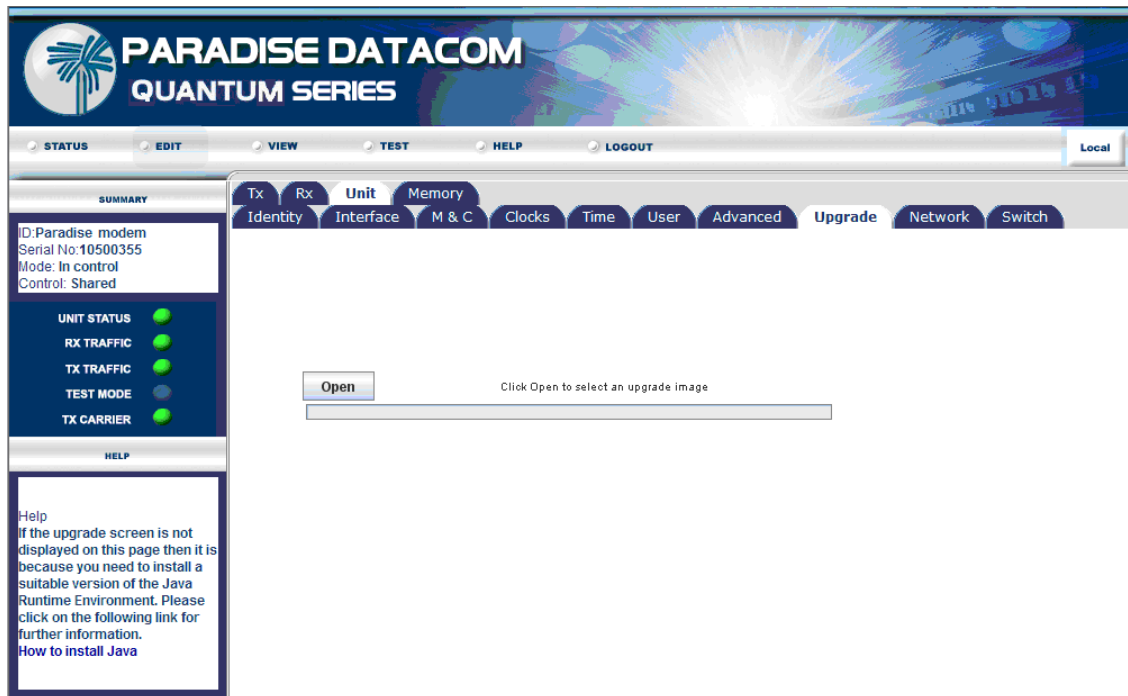
Note 1: Prior to starting an upgrade, please ensure that none of the following files appear on either the PC desktop or within the User profile directory as a result of a previous failed upgrade:

UImage CF.img.gz U-boot.bin

To check the location of the User profile directory please go to the DOS command prompt and type: **cd %USERPROFILE%**

This will display the location of the directory used by the previous upgrade. Use Windows Explorer or similar to navigate to both this directory and the desktop and ensure that all three files are deleted if present.

Also check that you have permission as a remote user to upgrade the modem by ensuring *Takeaway* mode is selected via the *Main/Edit/Unit/M&C/Control* menu option.



Remote Software Upgrade Screen

1.20.12 EZ BERT Option

The internal PRBS BER Tester allows pseudo-random bit patterns to be injected into the main traffic or overhead channel and the BER results to be monitored. Use of the ESC and AUX channels allows continuous real traffic BER performance monitoring whilst the modem carries traffic. The front panel PRBS BER tester (described in Section 7.3.5) offers a limited set of functionality. There is an enhanced PRBS BER Tester available via the web user interface. The enhanced BER Tester additionally:

- Allows PRBS BER data to be generated towards the terrestrial interface allowing the modem to be used as a stand alone PRBS BER tester in place of a Fireberd or similar.
- Supports an enhanced range of test patterns, namely:
 - PRBS $2^N - 1$ where $N = 6, 7, 9, 11, 15, 19, 20$ and 23 .
 - All 0's, All 1's.
 - Numerous sparse patterns, QRSS and user defined patterns.
 -
- Adds an elapsed time indicator, error count and an average BER figure as well as a latency figure (displayed in terms of both bits and microseconds).

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

PARADISE DATACOM
QUANTUM SERIES

STATUS EDIT VIEW TEST HELP LOGOUT Local

SUMMARY

ID:Paradise modem
Serial No:10500355
Mode: In control
Control: Shared

UNIT STATUS ●
RX TRAFFIC ●
TX TRAFFIC ●
TEST MODE ●
TX CARRIER ●

HELP

Help
Move the cursor over an item's
label for help.

Generator

Channel: Main Direction: Towards Satellite

Pattern: PRBS 20-0151

Data Invert ☐

Inject Error

Cyclic Error ☐

Elapsed Time: 00:00:25

Errors: 0

Average BER: 0.0E-06

Latency: 1552 24250us

Copy to Analyser ☐ Copy to Generator ☐

Analyser

Channel: Main Direction: From Satellite

Pattern: PRBS 20-0151

Data Invert ☐

Sync OK ● Restart

Sync Not Lost ●

Sync Lost Threshold: Auto

Counter Action on Sync Loss: Reset

EZ BERT 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 *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.

1.20.13 Modem Email Function

When providing Quality of Service reports to satellite-services end users, it would be extremely useful to be able to easily include pertinent performance information from the modem. The modem supports this by incorporating the desired status information into emails that can be sent anywhere – either to someone on the local network, or worldwide if an Internet connection is available. Performance data can even be fetched over the satellite from a remote modem and then sent by email from the local modem.

This is possible due to the modem's built-in Simple Mail Transfer Protocol (SMTP) email client. This may be used to send a variety of information from the modem either on demand or at preset intervals, including:

- Up to a month's worth of logged Rx Eb/No values
- Up to a month's worth of logged AUPC distant Eb/No values
- Up to a month's worth of logged Rx power level values
- Up to a month's worth of logged user BER values
- Up to a month's worth of logged AUPC Tx power level values
- Up to a month's worth of logged modem temperature values
- The contents of the system log (i.e. all notable 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 CSV format, which allows the data to be instantly 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 a report can be generated in a few seconds.

The type of information to be sent is selected by checking the relevant check box on the email configurator screen (see the next page). Each type of data is appended to the email in separate attachment files, for convenience. In addition to sending just the current system alarms, the modem may be requested to send all future unit faults and warnings as and when they occur.

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. Fill out the recipient's email address, subject (email title) and select the appropriate tick boxes and email reporting interval as necessary.

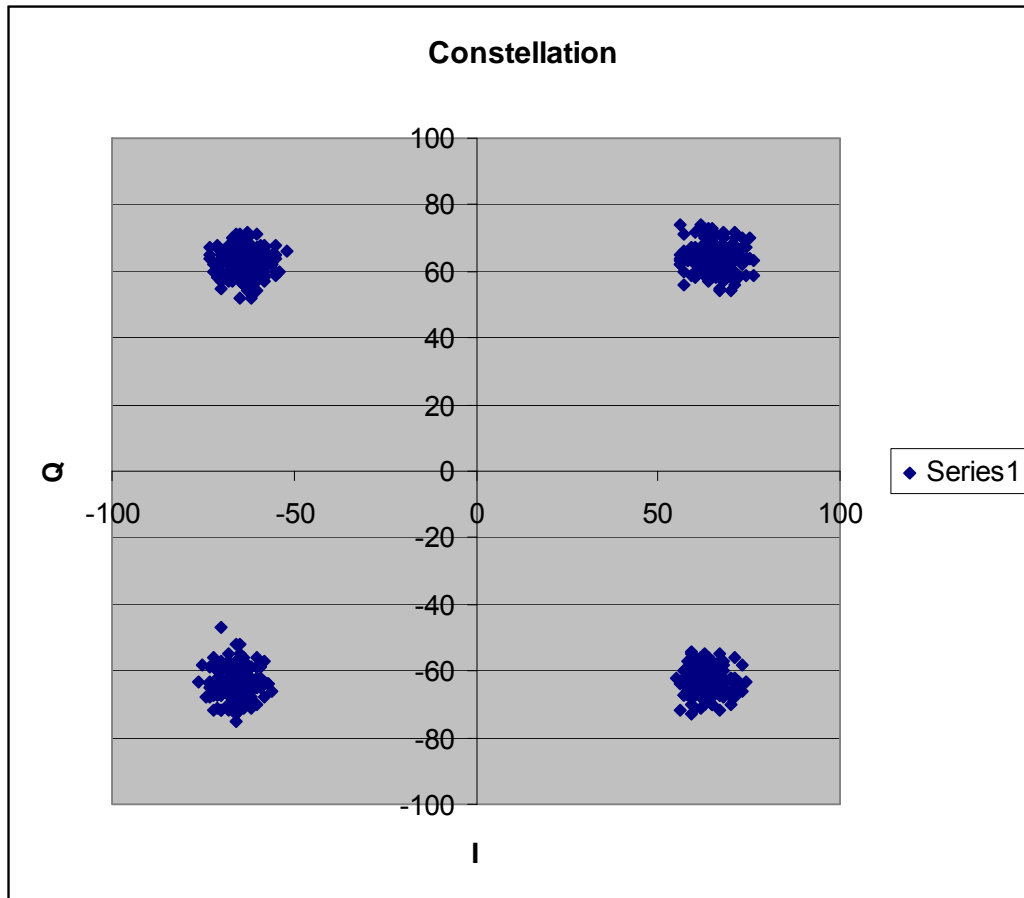
The *Reply to* address field is optional and is the address used to deliver failure notifications in the event that an email cannot be delivered to the recipient's email address.

The email configuration screen (found under *Edit-Unit-M&C-Email* menu tab) is shown below.

Email Configuration Screen

As an example of how to use email data within a spreadsheet, consider the case of graphing constellation data. This can be done through the following steps:

- Having set up the modem to a working state, 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) do the following. Double click on the email attachment *constellation.csv* and open it – this should automatically start Excel (if not, save the attachment and then open it directly from within Excel).
- 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 over the page.



Example Constellation Graph Within Microsoft Excel

It is also possible to use the email feature to request technical support. On the web user interface, select the *View* tab followed by *Support*. The support configuration screen is shown over the page. Complete the contact details and type your request and send the email. The email is automatically sent to Paradise Datacom's technical support team. Note that the SMTP email server address has to be entered on the email configuration screen for this function to work.

The screenshot displays the Paradise Datacom Quantum Series web interface. The top banner features the Paradise Datacom logo and the text "PARADISE DATACOM QUANTUM SERIES". Below the banner is a navigation bar with tabs: STATUS, EDIT, VIEW, TEST, HELP, and LOGOUT. A secondary navigation bar contains tabs: Configuration, Unit, SAF, Monitor, Alarms, Log, and Support. The left sidebar shows a SUMMARY section with the following information: ID: Paradise modem, Serial No: 10500006, Mode: In control, and Control: Shared. Below this is a UNIT STATUS section with four indicators: RX TRAFFIC (green), TX TRAFFIC (green), TEST MODE (grey), and TX CARRIER (green). A HELP button is located below the status indicators. The main content area displays the "Email Support" form, which includes fields for Name, Company, Contact telephone, and Reply email. A large text area for the message is positioned below these fields. At the bottom of the form are "Send email" and "Reset form" buttons. The Paradise Datacom logo is visible in the bottom left corner of the interface.

Paradise Datacom Customer Technical Support Enquiry Screen

1.20.14 IP Static Routes

If you wish to work with more than one subnet, the web user interface allows up to 64 static routes to be added.

The static route configuration screen (found under the *Edit-Unit-Network* menu tab) is shown over the page.

Route	Destination	Subnet mask	Gateway	
Route 0	10.0.30.1	255.255.0.0	10.0.0.10	<input checked="" type="checkbox"/>
Route 1	10.0.30.2	255.255.0.0	10.0.0.10	<input checked="" type="checkbox"/>
Route 2	10.0.30.1	255.255.0.0	10.0.0.10	<input checked="" type="checkbox"/>
Route 3				<input type="checkbox"/>
Route 4				<input type="checkbox"/>
Route 5				<input type="checkbox"/>
Route 6				<input type="checkbox"/>
Route 7				<input type="checkbox"/>
Route 8				<input type="checkbox"/>
Route 9				<input type="checkbox"/>
Route 10				<input type="checkbox"/>
Route 11				<input type="checkbox"/>
Route 12				<input type="checkbox"/>
Route 13				<input type="checkbox"/>

Static Route Configuration Screen

Each route consists of a *Destination IP Address*, *Subnet Mask* and a *Gateway Address*. There is a checkbox for each route that enables the route when checked. Note that Paradise does not recommend using DHCP to allocate the modem an M&C IP address when static routes are being used.

1.20.15 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%.

It is widely acknowledged that ROHC is the most suitable available header compression technology for use over satellite and outperforms older technologies such as Compressed Real Time Protocol (CRTP) and IP Header Compression (IHCP).

Note that because the header compression is applied only over the satellite portion of the link and results in the original packets being recreated upon receipt, the compression process is completely transparent.

It is possible to specify which data streams (routes) compression should be applied to – see the screenshot overleaf. Each route consists of a *Destination IP Address* and *Subnet*

Mask. There is a checkbox for each route that enables the route when selected. This allows the user to apply header compression to selected routes.

The following will be compressed when the feature is enabled:

- The Ethernet header will be compressed on every frame.
- IP and UDP headers will be compressed when the IP payload contains a UDP packet. (The IP header can only be compressed when the packet contains a UDP transport layer payload.)
- IP, UDP and RTP headers when the IP payload contains both a UDP and RTP packet.

PARADISE DATACOM
QUANTUM SERIES

STATUS EDIT VIEW TEST HELP LOGOUT Local

SUMMARY

ID:Paradise modem
Serial No:10500355
Mode: In control
Control: Shared

UNIT STATUS ●
RX TRAFFIC ●
TX TRAFFIC ●
TEST MODE ●
TX CARRIER ●

HELP

Help
Enter each static route values and click the checkbox. When all the routes have been entered click the button to create the routes. The modem may take 30 - 40 seconds to complete this task.

Header Compression Configuration

	Destination	Subnet mask	
Route 1	10.0.30.1	255.255.0.0	<input checked="" type="checkbox"/>
Route 2			<input type="checkbox"/>
Route 3			<input type="checkbox"/>
Route 4			<input type="checkbox"/>
Route 5			<input type="checkbox"/>
Route 6			<input type="checkbox"/>
Route 7			<input type="checkbox"/>
Route 8			<input type="checkbox"/>
Route 9			<input type="checkbox"/>
Route 10			<input type="checkbox"/>
Route 11			<input type="checkbox"/>
Route 12			<input type="checkbox"/>
Route 13			<input type="checkbox"/>
Route 14			<input type="checkbox"/>

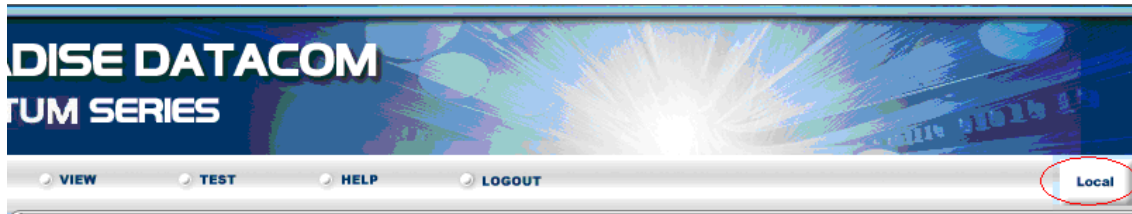
Click to apply routes

Header Compression Configuration Screen

1.20.16 Fetching Web Pages from a Remote Modem

When a framed service is selected, it is possible to use the ESC channel to fetch web pages from a remote modem, thereby allowing M&C control of the remote modem via the normal web interface.

Because the ESC channel is low rate, the modem implements this feature in a very efficient manner. Instead of fetching each entire web page, the local modem sends commands over the ESC channel to fetch the required data, which it then populates into a locally generated web page before sending this onto to the web browser. The selection of Local or Remote mode is made through the toggle switch on the right hand top corner of each web page as shown below.

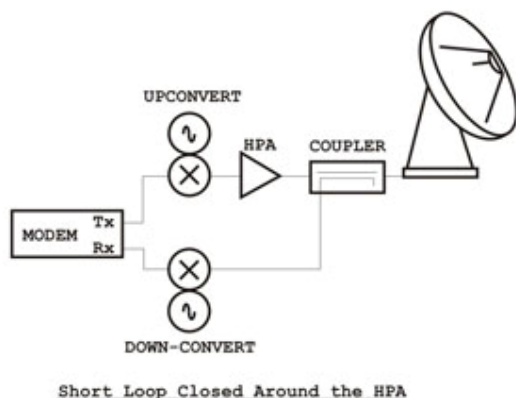


Local/Remote Modem Web Interface Toggle Switch

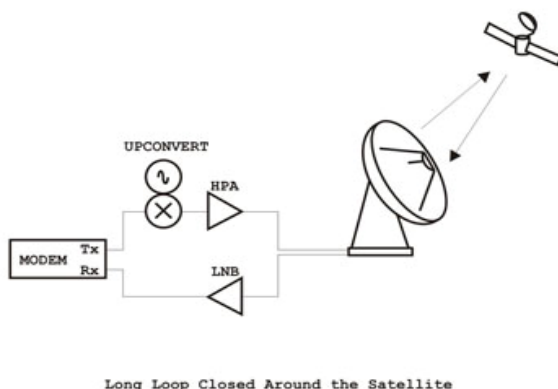
1.20.17 Adaptive Signal Pre-distorter

This feature, which is controlled from the web user interface, enables 16QAM constellations to be adaptively predistorted to counter the effects of AM-AM and AM-PM nonlinear distortion in the communications path (i.e. transponder and/or HPA). Predistortion has two major advantages:

- It allows 16QAM to be used in some links where only QPSK or 8PSK was feasible before, thereby saving bandwidth
- It allows the back-off level of the uplink HPA to be reduced, thereby liberating more power into the uplink or alternatively allowing a lower power HPA to be used.



The predistorter is adaptive, i.e. no prior knowledge of the nonlinearity is required. The transmit constellation is adaptively tuned to optimize the Rx constellation. The predistorter operates in a closed loop that contains the nonlinear amplifier(s) to be compensated. For example, the loop could be closed around the up-link HPA by feeding the down-converted HPA signal back into the modem's demodulator.



Alternatively, for some applications, it may be feasible to simply demodulate the received satellite signal, thereby allowing ground and space segment nonlinearities to be out-tuned. Since the predistorter only has visibility of its own transmit and receive signals, it is best suited to single channel per HPA or single channel per transponder applications.

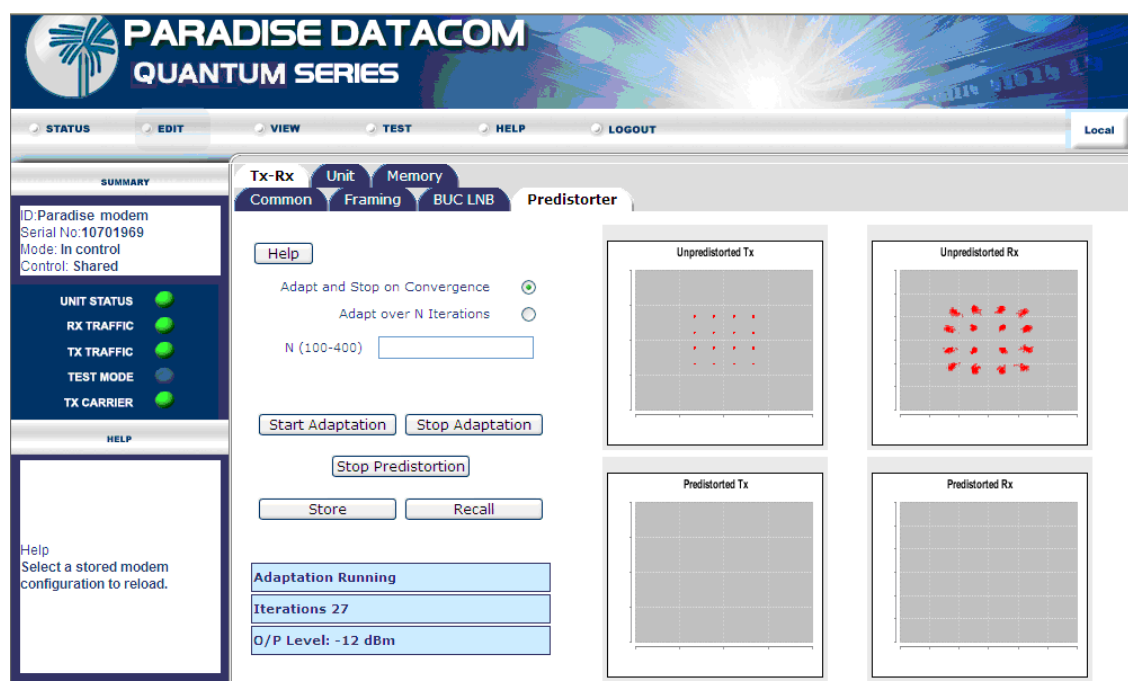
The steps involved in using the predistorter are as follows:

1. Configure the modem in a closed-loop setup as described above.
2. Ensure the modem is in 16 QAM mode for both Tx and Rx.
3. Configure the modem Tx output power to the required level in the *Edit/Tx-Rx/Common* tab.
It is recommended this level should not exceed -10dBm as some power headroom is needed for the predistorter to apply its expanding nonlinear characteristic.
4. In the *Edit/Tx-Rx/Common/Predistorter* tab, select the predistorter algorithm adaption method.
There are two choices: the algorithm can adapt and automatically stop when convergence is detected or, alternatively, the user can program the algorithm to iterate a specific number of times. Both methods work well. However, best performance is achieved if the algorithm is allowed to run for several hundred iterations.
5. Pressing the [Start](#) button will initiate the adaption process.
This starts with a special undistorted 16QAM constellation being transmitted into the channel. The signal is used to sound the link for the presence of spectral inversions and receive constellation phase ambiguities. *Note that while this constellation is*

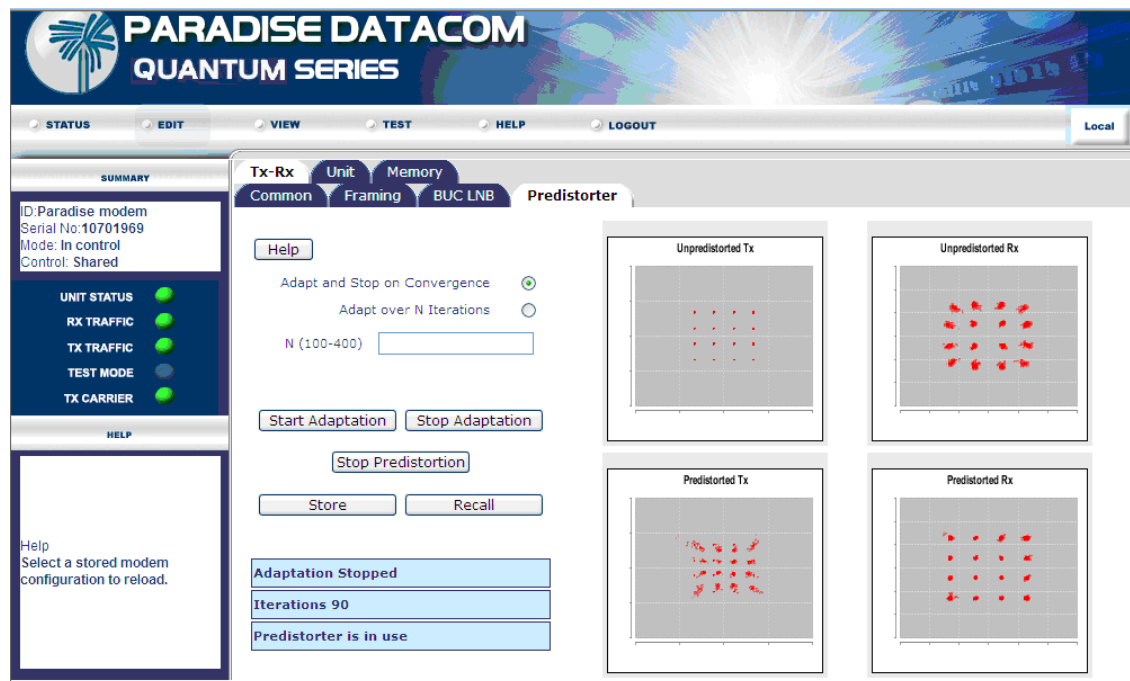
being transmitted, Tx traffic may be disrupted. Once the channel has been sounded, a conventional unpredistorted 16QAM constellation is transmitted. The resulting demodulated constellation is captured and displayed in the top right of the predistorter monitor pane. The Tx constellation is then modified in such a way as to optimise the received constellation.

6. When the Rx EVM converges to a stationary value or when the required number of algorithm iterations has been completed, the adaption process stops. The resultant Tx constellation can then be saved allowing it to be recalled if necessary some time later. Note that it is necessary to go through this learning process whenever the operating point of the HPA is changed. Consequently, it may be convenient to generate and save the predistortion information for all HPA operating points in advance and simply select the appropriate saved configuration whenever the HPA operating point is changed.
7. The predistorted Tx constellation and resulting Rx constellation are shown bottom left and right respectively of the monitor pane.

Note that not all nonlinearities can be equalized fully. This is especially the case if the nonlinearity is being driven well into saturation, or if the nonlinearity is hard-limiting. For further information on the predistorter, please consult the white paper available at the Paradise Datacom website.



Predistorter Screen set to adapt and stop on convergence



Predistorter Screen showing convergence after 90 iterations

Chapter 8 Modem Concepts

1.21 Doppler, Plesiochronous Buffering and Clocking

There are two terms commonly used when referring to the receive buffering, namely *Doppler* and *Plesiochronous*.

Doppler: Receive Doppler buffering is required because the incoming data from the satellite is subject to Doppler shift, which occurs in an approximately 24 hour cycle. The Doppler shift is due to the satellite movement relative to the earth and is directly proportional to its station keeping accuracy. Towards the end of a satellites life when its station keeping is degraded to save fuel, the Doppler shift on incoming signals increases and buffers may have to be increased in size. The receive buffer acts as a elastic store or FIFO (First In First Out memory) gradually emptying and filling to absorb the difference over the 24 hour period. If the clock signals within the system all originate from one source, then the buffer will never be exceeded - it will simply slowly fill and empty over this 24 hour cycle.

Plesiochronous: This refers to buffering needed when there is more than one clock in the system and a buffer is required to absorb the difference between the two clocks. Typically data is placed into the buffer with one clock, and removed with another, thus causing a gradual *continuous* filling or emptying of the buffer, causing slips on a regular basis. The period between buffer slips (when it is totally full or empty) will be constant, and proportional to the difference between the two clocks.

A buffer will provide both functions - it simply depends on how the system clocking is arranged whether it provides Doppler buffering, or a combined Doppler and Plesiochronous buffering (if there are two clocks in the system). Typically a buffer used for a Plesiochronous system is set larger than a Doppler only buffer, as it has to accommodate a steady filling/emptying plus a superimposed daily cycle.

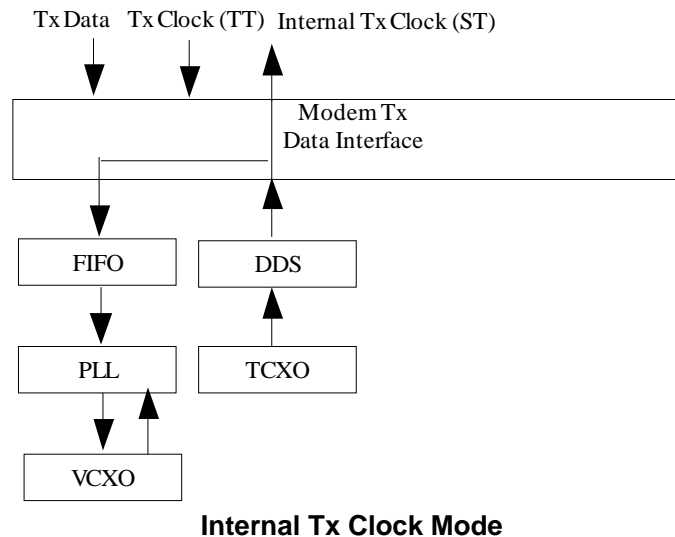
The slips, both underflows and overflows are displayed as part of the status information. Approximately equal counts indicate the buffer is too small to accommodate the incoming Doppler shift (2ms is usually sufficient). One count significantly higher than the other indicates that the buffer is slipping due to a large difference in the clock from the satellite and the buffer output clock. With typical earth station clock accuracies, buffers never need be larger than approximately 16ms.

1.21.1 Transmit Clocking

There are three transmit clocking modes that are used in the modem.

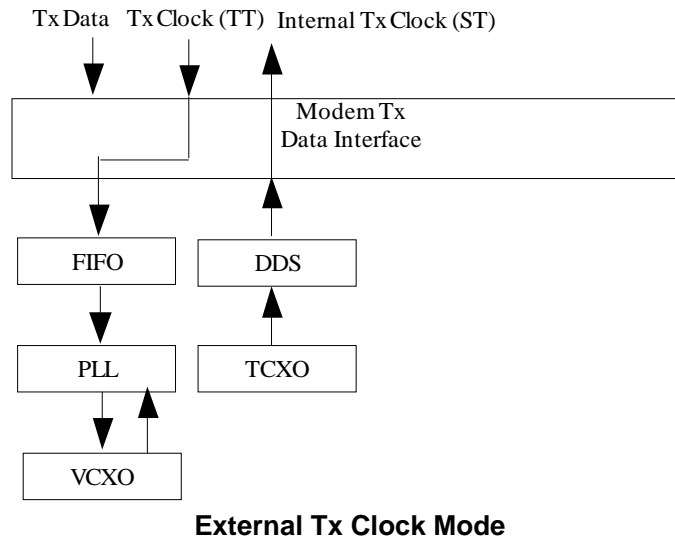
1.21.1.1 Internal Clock

When *Internal* is selected, the modem, which is always configured to be a DCE (Data Communications Equipment), supplies the clock. This is provided by the modem to the DTE (Data Terminal Equipment) via the ETC (External Transmit Clock) signal line for using in clocking the data through to the modem. It is important that the terrestrial data coming into the modem uses the ETC clock looped back through the DTE equipment.



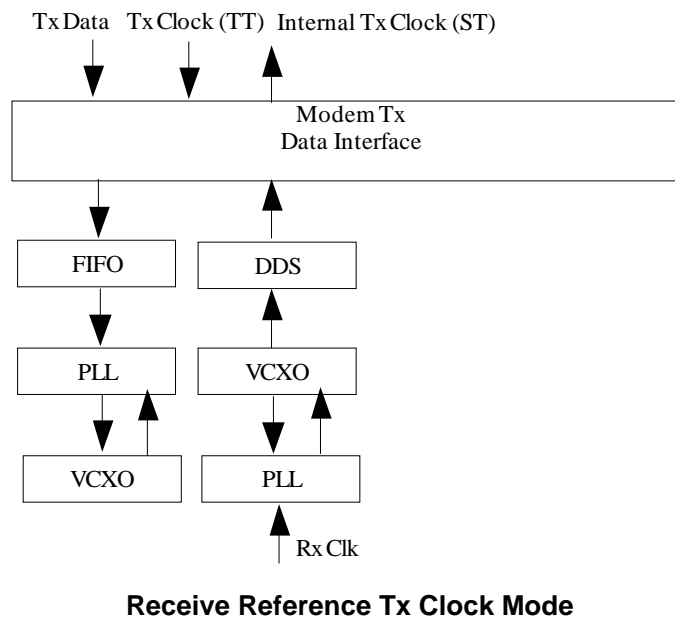
1.21.1.2 Tx Clock In

When *Tx Clock In* is selected, the DTE equipment is responsible for providing the clock. The modem provides a signal on ST (Send Timing) in this mode and requires a clock signal to be provided on TT (Terminal Timing). The ST signal is provided in order to allow the DTE to be operated with a modem supplied clock, in a similar way to when *Internal Clock* is selected but the TT and SD (Send Data) phase relationship will be correctly aligned. If the external clock is missing for any reason then the modem will substitute an internal clock. Note that the G.703 interface should always use external clocking.



1.21.1.3 Receive Reference

When *Receive Reference* is selected, it allows the modem to provide an ST clock to the DTE that is locked to the receive satellite signal. The timing is actually phase locked to the Rx data rate but at the frequency of the Tx data rate. This is to allow asymmetric operation. The DTE then synchronises the data going into the modem (SD) to this clock. If the external clock is missing for any reason then the modem will substitute an internal clock.

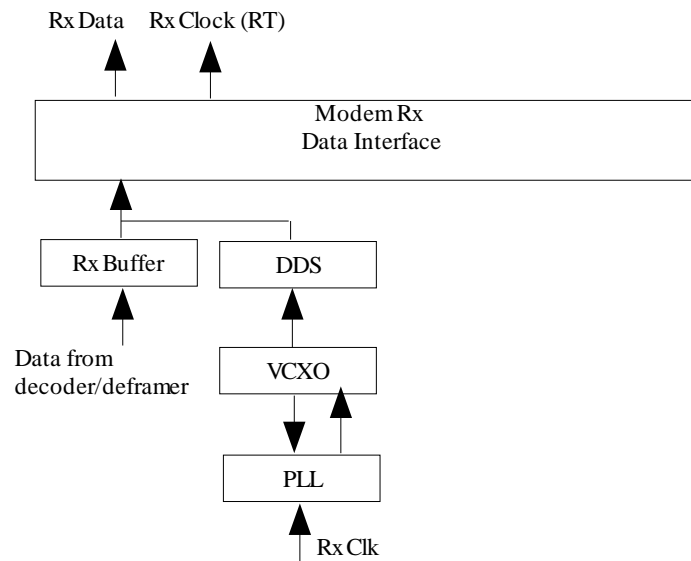


1.21.2 Receive Clocking

There are four receive clocking modes that are used in the modem.

1.21.2.1 Satellite

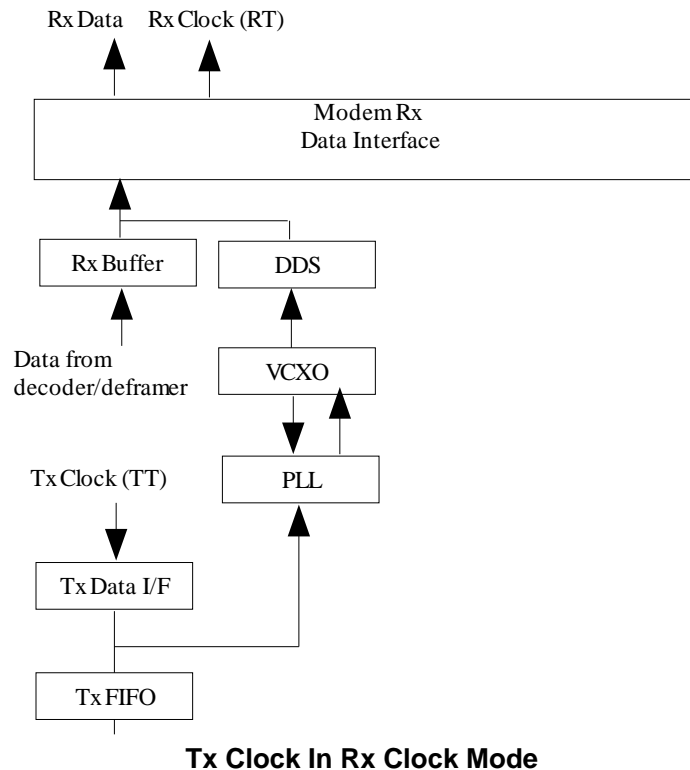
When *Satellite* is selected, the modem disables the Rx Doppler buffer and derives a clock from the incoming satellite signal. This means that the signal will be subject to Doppler/plesiochronous offsets.



Satellite Rx Clock Mode

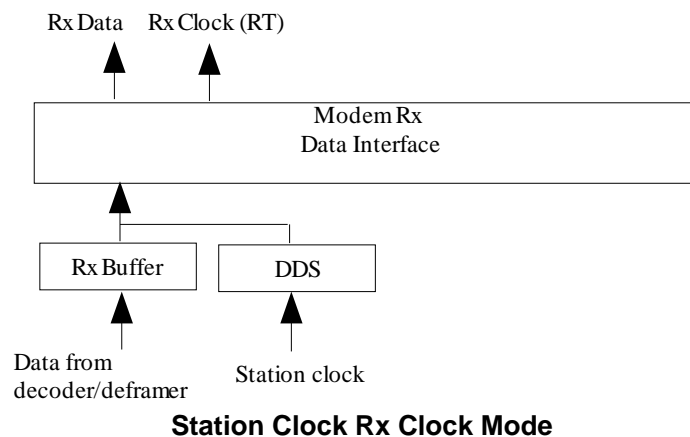
1.21.2.2 Tx Clock In

When *Tx Clock In* is selected, the Rx clock and data are phase locked to the Tx data rate frequency but at the Rx data rate. The clock and data appear on RT (Receive Timing) and RD (Receive Data) respectively. The Rx Doppler buffer is enabled and the output clock for the buffer is derived from either ST or TT.



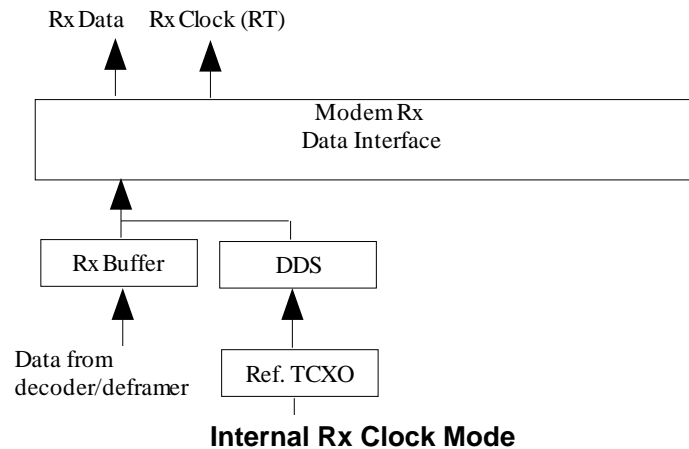
1.21.2.3 Station Clock

When *Station* is selected, the modem's Rx timing is phase locked to the station clock input but is run at the Rx data rate frequency. The Rx Doppler buffer is enabled. The clock and data appear on RT (Receive Timing) and RD (Receive Data) respectively. The station clock input can be configured to provide a clock just for Rx path processing or it can be used to replace the modem's internal 10MHz clock (used for all internal processing). The station clock frequency need not equal the modem's internal 10MHz clock frequency when it is being used to provide just Rx path clocking – it can be set anywhere between 1kHz and 10MHz.



1.21.2.4 Internal Clock

When *Internal* is selected, the modem's Rx timing is phase locked to the modem's internal clock but is run at the Rx data rate frequency. The Rx Doppler buffer is enabled. The clock and data appear on RT (Receive Timing) and RD (Receive Data) respectively.



1.21.3 Guidelines for Clocking Configuration

The following need to be ascertained:

- Incoming Rx carrier:
 - Is your Tx clock looped back to you at the distant end?
 - If not, what is the accuracy of the clock transmitted by the distant end?
- Outgoing Tx carrier:
 - Are you looping the incoming Rx clock (Tx Clock = Rx, or clock looped by the equipment or cables your end)?
 - If not, what is the accuracy of your Tx clock?

The various Tx and Rx clocking modes of the modem are described in the following sections.

1.21.3.1 Clock Loop At One End

The end *with the clock loop* requires Buffer disable (Rx Clock = *Satellite*). If there is either a cabled clock loop or the equipment loops the Rx clock back to the modem Tx input then set Tx clock = *Tx Clk In*. If there is no physical clock loop set the Tx clock = *Rx*.

The end *without the loop* requires the buffer active and set for 2 x Doppler shift only as there is no Plesiochronous effect with a clock loop. The Buffer size required depends on the satellite orbit (or rather the accuracy with which it's position is maintained), currently 2ms (end to end) buffering is enough for the Doppler shift from 1 satellite hop on current Intelsat satellites. For 2 x Doppler shift 4ms is required.

Quantum and Evolution Series Installation and Operating Handbook

Set the Tx and Clock modes as follows to use the clock listed:

Clock from the interface / terrestrial network: Tx Clock = *Tx clk in*, Rx Clock = *Tx clk in*.

Modem internal clock

Rx Clock = *Internal* and feeds the clock to the terrestrial equipment. If the Rx output clock is externally looped by equipment or internally then set Tx Clock = *Tx Clk In*. If the Rx output clock is not returned to the modem Tx input by the equipment or the cable then set Tx Clock = *Rx Clk*.

Station clock

Rx Clock = *Station*, Tx Clock as for 'Modem Internal Clock' above.

Satellite

This is not possible - with clock loop at the distant end, Rx satellite clock is *already* a copy of our Tx clock we cannot loop it again.

1.21.3.2 No Clock Loop

If there is no clock loop, then both ends need the buffer active to cope with the normal Doppler effect, plus the plesiochronous effect (i.e. the difference between the clocks at each end). Apply the following rules to both ends.

1.21.3.3 Clock from the interface / terrestrial network

If the modem has a station clock (which also drives the network which the Rx output feeds), then select Rx Clock = *Station*. If there is no station clock then set Rx Clock = *Tx Clk In* (which as the Tx clock comes from the network, is presumably derived from the same master clock which clocks the network). Set the Tx Clock = *Tx Clk In*.

1.21.3.4 Other clock modes

These require careful consideration based on the exact situation. If you have questions relating to this subject, and are willing to at least draw a diagram of the system you are implementing then you are welcome to contact us by fax for advice for your exact application.

1.21.3.5 Determining Buffer Size

Use the following calculation to determine the buffer size required for *any* application:

Where:

- Lc is the local clock accuracy (e.g. 1×10^{-9}),
- Rc is the remote clock accuracy (e.g. 1×10^{-11})
- Ms is the Minimum slip period in days (e.g. 40 days)

then the required Plesiochronous Buffer size (middle to end) in seconds is:

$$\text{Buffer size (Bs)} = \text{Ms} \times 24 \times 60 \times 60 \times (\text{Lc} + \text{Rc}).$$

Simplifying, allowing a factor of two (end to end buffer, not middle to end) and allowing 2mS for the Doppler shift gives:

$$\text{Bs} = .002 + 172800 \times \text{Ms} \times (\text{Lc} + \text{Rc}) \text{ seconds.}$$

Using the example figures above gives 0.00898 seconds, requiring 9ms to absorb the plesiochronous effects. To this must be added any Doppler requirement (i.e. 2ms for each satellite hop).

1.21.3.6 G.703 Clock Extension

The modem can extend a G.703 (T1 or E1) timing reference to the distant end of a satellite link, regardless of actual data rate of that link.

This is achieved via a G.703 clock extension feature that propagates a high stability reference from the *hub* to the *remote*. It is necessary for a high stability E1/T1 reference signal from a GPS receiver to be fed to only the **hub** modem (via the G.703 balanced or unbalanced connectors) thereby saving the cost of multiple GPS receivers at the remote sites.

The remote modem can then generate a T1/E1 signal synchronized to the local modem's GPS signal (via the satellite clock) making use of the G.703 balanced or unbalanced connectors. This signal can then be used for synchronizing the remote site equipment.

Furthermore, even if a GPS receiver is not present in the network the remote modem can *still* synthesize a T1/E1 synchronization signal; in this case the synchronization signal will be locked to the satellite clock.

Tx Operation

This is a special case of Internal Tx Clock. When internal clock is selected *and* the selected terrestrial interface is *not* G703 then a further question is asked:

Forward the G703 clock as a clock reference?

Options:

OFF
E1
T1

Factory default: OFF

Description: Allows a high stability reference signal to be transferred across satellite.

If the user selects *Off* then the internal data rate clock generated by the modem is locked to the modem's internal high stability clock reference. This is the same as the original internal clock mode of operation.

However, if the user selects *T1/E1* then the internal data rate clock generated by the modem is locked to the T1/E1 timing signal applied to the G703 interface.

NOTE: this mode is only accessible when the user selects internal clock and the selected Terrestrial interface is NOT G703

Rx Operation

This is a special case of *Satellite clock*. When the user selects *Satellite clock* and the selected terrestrial interface is *not* G703 the user is asked a further question:

Generate a G703 clock reference from satellite clock?

Options:

OFF

E1

T1

Factory default: OFF

Description: Allows a high stability reference signal to be proogated over satellite.

Any selection on this screen will result in the generated Rx clock for the Rx data path being requested at the Rx data rate and being locked to the satellite signal.

However, if the user selects *T1/E1* then the modem will *also* generate an Alt1/0 timing reference signal at either T1 or E1 on the appropriate G703 port.

Note that this mode is only accessible when the user selects satellite clock and the selected Terrestrial interface is NOT G703 (T1 is not available when EIA530 mode is used as the same physical connector is required for T1 balanced operation).

Please refer to Paradise application note 002 (available from the Paradise web site) for further information.

1.22 Framing and Drop/Insert Overview

1.22.1 IBS/SMS Framing

IBS/SMS Service Features

The Intelsat definition of IBS framing (IESS 309) is intentionally very similar to Eutelsats SMS framing (EESS 501 'SMS QPSK/FDMA System Specification'), as they are both designed to allow common equipment to provide for both services. Where a reference is made to IBS framing the text applies equally to SMS framing.

Standard Features (specified in IBS/SMS definitions)

The addition of standard IBS framing increases the data rate by exactly 1/15th (approx 6.7%). IBS framing is added to provide the following extra features compared to 'closed network' links:

- ⊗ A synchronous scrambler that replaces the self-synchronising (V.35) scrambler used in most closed network links. The closed network V.35 scrambler outputs 3 errors for every error received and thereby increases the error rate by a factor of 3. The IBS/SMS synchronous scrambler does not multiply errors and therefore gives a factor of three BER performance increase over the V.35 scrambler.
- ⊗ A backward alarm facility that raises a local deferred alarm if the distant end modem cannot receive data transmitted from this station (i.e. there may be a Tx problem at this end of the link).
- ⊗ A *low rate* oversampled asynchronous ESC channel (1/2000th the data rate) that is available on the Aux port of the modem. This results in asynchronous rates of less than 110 Baud at greater than 256kbps.
- ⊗ A TS32 multiframe sequence to allow the transmission of satellite encryption control vectors and three 8-bit carrier IDs (referred to as Station, Channel, and Spare ID).
- ⊗ Overhead channels to convey Channel Associated Signalling (CAS) corresponding to an extra 2kbps per 64kbps transmitted by use of a separate CAS multiframe sequence (in TS16/48).
- ⊗ Timeslot ID maintenance, which maintains the identity of individual data streams when multiplexed together into one aggregate rate carrier (e.g. two independent 64kbps circuits in one 128kbps carrier).

Additional Features (Paradise products)

In addition to the basic Intelsat definition above, the modem provides the following additional features in IBS/SMS mode:

- ⊗ A high rate ESC channel carried in spare parts of the overhead. This allows up to 68% (22/32nd) of the overhead to be used for ESC providing a 2400 Baud ESC with a 64kbps carrier, and proportionally higher ESC rates with higher data rate carriers.
- ⊗ In addition to the Intelsat low rate oversampled async ESC Channel (on the shared ESC/Aux port) the modem when fitted with the IDR option also provides a clock so the port may be used as a synchronous Aux channel. The overhead usage can be varied from the one bit per frame (TS32 bit 1) defined by Intelsat, up to 21 bits per frame, providing a synchronous Aux channel at up to 4.3% of the main data rate. This may be

used for example with external or internal BER testers to provide a continuous measurement of the live BER.

IBS/SMS Definition

Frame Format

IBS framing is a derivative of the framing used on 2048kbps PCM bearers within Europe specified in ITU-G.732. G.732 specifies a frame of 32 timeslots (each timeslot is 8 bits of data) and the timeslots are labelled TS0 - TS31. TS0 and TS16 are reserved for special functions, leaving the remaining 30 timeslots available for data, ie 30 data timeslots with 2 overhead timeslots, a ratio of 32/30 or an increase of 1/15th. G.732 uses an awkward definition of having even and odd numbered frames with TS0 having different functions in even and odd frames. Thankfully the IBS specification parted from the G.732 definition at this point and instead of having even and odd frames of 32 timeslots, it defined one longer frame equivalent to an even then an odd G.732 frame. An IBS frame therefore has 64 timeslots, with special functions for TS0, TS16, TS32 (same as G.732 TS0 odd), and TS48 (same as G.732 TS16 odd), which leaves 60 timeslots available for normal data.

An IBS Frame is constructed as follows:

TS0 consists of a spare bit (X), followed by a 7 bit frame alignment word ie [X0011011].

TS16 & TS48 are defined to convey Channel Associated Signalling (CAS, when required), and are normally forced to all ones [11111111] when CAS is not being transmitted. CAS is covered separately later.

TS32 conveys the low rate ESC (E), the Backward Alarm (B), and the TS32 Multiframe sequence (M). If IBS satellite link encryption is in use (very, very rare) then it also conveys the encryption control vectors otherwise these bits are spare (X as shown). One bit is also forced to a logic 1 for frame alignment, resulting in a content of [E1BMXXXX]

A standard IBS frame then is 64 x 8 (ie 512) bits long.

TS32 Multiframe

A 64 bit multiframe pattern is placed one bit at a time into the 'M' bit of TS32. When the 64 bits have been sent (one bit at a time over 64 frames) the sequence restarts indicating the end of one multiframe and the beginning of the next. The 64-bit TS32 multiframe sequence also contains 3 eight bit user fields nominated names of Station ID, Channel ID and Spare ID. The TS32 multiframe then is 64 x 512 (ie 32768) bits long.

Synchronous IBS Scrambler

The synchronous IBS scrambler is restarted at the beginning of every multiframe. Note this is not every frame, as it requires a reasonable length of the scrambling pattern to be used to ensure the final data appears random. The scrambling pattern itself is $2^{15}-1$ (32767) bits long and runs throughout the frame. Scrambling is however disabled for TS0 & TS32 (otherwise the distant end could never find the frame sync, then TS32 multiframe sync, in order to find out where the scrambler starts).

Backward Alarm

The backward alarm is a single bit of TS32 which is connected to a summary 'Rx Fail' signal from the demodulator / deframer. If at either end of the link the Rx path fails for any reason, then this backward alarm bit of TS32 is raised on the outgoing Tx signal, indicating to the distant end that there is a Rx failure this end. This could be caused by any manner of Rx fault (LNA, downconverter, demod) at this end, but it is a warning that the fault might

equally exist at the Tx end (modulator, upconverter, HPA etc). The backward alarm is normally a 'deferred alarm', meaning it should be checked but it is not necessarily a failure of the traffic path at this end.

Low Rate ESC Channel

The low rate ESC channel is a very low rate. One bit of TS32 is allocated to carry the ESC information, and so the rate is one bit per frame (ie $1/64 \times 8$), one 512th the framed data rate or $1/480$ th the unframed rate. For example at 64kbps the ESC channel is a *synchronous rate* of 133bps. However, Intelsat did not define a synchronous interface to the channel, only an oversampled asynchronous interface (ie a data line without a clock line). This means that the Baud rate of the async channel must be one third to one quarter of the synchronous rate to ensure each Baud period of the async word is sampled 3 or 4 times (necessary otherwise the reconstructed async character cannot be read at the far end). This is a very poor use of the bandwidth, but the definition was made to allow the facility to be added to then current equipment with minimal hardware implications. The Intelsat defined limit is $1/2000$ th of the data rate, but in practice this can be pushed to about $1/1500$ th of the data rate.

Timeslot ID Maintenance

Timeslot identity maintenance is the facility to maintain the identity of individual data streams when multiplexed together into one aggregate rate carrier (eg in its simplest form two independent 64kbps circuits in one 128kbps carrier). Typically such individual data streams comprise of 64kbps data channels from 'N' timeslots of terrestrial PCM bearers, interfaced to the IBS/SMS framing via the Drop/Insert multiplexer.

Operating over satellite *without* TS ID maintenance is comparable to using an external Drop/Insert mux interfaced in our 2 x 64kbps example to the modem at 128kbps. Once demultiplexed to 128kbps the start and end boundaries of each timeslot are lost in the continuous 128kbps data stream. Without the TS ID maintenance there would be 16 different ways (2×8 bits per TS) that the two data streams could be inserted back into the terrestrial PCM bearer timeslots at the receive end. One correct way, one with channels reversed (8 bits shifted), and 14 ways (shifts of 1-7, 8-15 bits) in which parts of each channel appeared in the channel. Without TS ID maintenance then, Drop/Insert can only be useful if all the data dropped / inserted comprises one single data stream of N x 64kbps from a single source.

Note: Typically D/I is tested with a PRBS from a Firebird in all relevant timeslots, this is a guaranteed way to NOT TEST TS ID Maintenance, as it is not required for such a test (because all the data comprises one single data stream from a single source, the PRBS generator). Instead to verify TS ID maintenance insert the PRBS into any *subset* of the dropped timeslots (eg just one). If the Timeslot ID is not maintained, you are likely to get something else back in the equivalent receive timeslot instead of the PRBS (probably the idle code from one of the other dropped timeslots). If the Timeslot ID is maintained, you should *consistently* get the PRBS back in this *same* subset or single timeslot. Bear in mind that without TS ID maintenance, when dropping N timeslots, statistically it will still work one time in $8 \times N$, when the random timeslot alignment happens to be correct!

Implementation of Timeslot ID Maintenance

The requirement is to provide:

- 1) Timeslot boundary maintenance (start/end of each timeslots 8 bits) within the data stream.

- 2) Timeslot identity (ID) maintenance, ie which 8 bits relate to which timeslot (first, second, third etc) within the data stream.

The data from each timeslot appears as a set of 8 bits from each terrestrial frame. *Timeslot boundary maintenance* is provided by placing the data into the IBS frame, timeslot aligned after TS0. When TS0 is located, the next 8 bits represent 8 bits from one terrestrial timeslot, the following 8 from the next etc.

Timeslot Identity Maintenance again relies on relative position to TS0. Data from the first timeslot of the group of timeslots is always placed in the first timeslot after TS0, the second of the group in the second TS, and so forth. Once the 8 bits of data from every timeslot have been placed in the frame, the process repeats until the frame is full. For the *following* frame to be similarly formatted the timeslot data must fit into the 60 available data timeslots of the satellite frame exactly (so that the next data is from the first TS again). This brings in the following complication.

Each IBS frame has 60 timeslots available for data, and so in order to provide timeslot ID maintenance, the number of timeslots 'N' must fit into 60. This limits the values of N to:

1 Frame (ie 60 available data timeslots): N = **1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30**

Some further values are accommodated by mapping them into two frames:

2 Frames (ie 120 available data timeslots): N = **8, 24**

Finally, to support one further rate, four frame are used:

4 Frames (ie 240 available data timeslots): N = **16**

The remaining values of N cannot have Timeslot ID Maintained by groups of 1, 2, or 4 frames, these are collectively know as the 'Odd values of N':

'Odd values of N': N = **7, 9, 11, 13, 14, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 29, 31**

Most previous equipment could not provide timeslot ID maintenance for these 'odd values of N', however the modem when equipped with the Extended D/I feature uses a derivative of the IBS CAS Multiframe (see later section "CAS Multiframe") to provide timeslot ID maintenance for even these remaining values of N.

Signalling Systems Introduction: CCS, CAS & RBS

Signalling systems are used to convey call status on PCM systems, call status is information such as Busy, Idle, Ring tone, Dialling, etc.

Common Channel Signalling (CCS)

Some PCM systems use a 'Common Channel Signalling' (CCS), where a whole timeslot is allocated to carry the signalling function between the ends of the link (with protocols such as 'Signalling system No 7' etc running within that 64kbps channel). Common Channel Signalling is used on both 1544kbps (T1) and 2048kbps (E1) systems, although different signalling systems run on the common channel.

Channel Associated Signalling

Some E1 PCM systems use Channel Associated Signalling (CAS), where a low-rate data signalling channel is provided uniquely for each timeslot. ITU-G.704 defines these signalling channels as comprising of four bits (named 'abcd') that are sent every 16th frame, resulting in a channel of 2kbps. There is an individual 2kbps signalling channel for each of the 30

PCM channels (timeslots 1-15 and 16-31) and these are carried sequentially in pairs in TS16 (there is no signalling channel for TS0 nor TS16, as TS0 is reserved for the Frame Alignment Word, and TS16 carries the signalling for the other timeslots).

Robbed Bit Signalling (RBS)

Robbed bit signalling is a technique used on T1 PCM bearers whereby signalling is conveyed by stealing the signalling bandwidth from the 64kbps timeslot to which it relates. Once every 6 frames one bit (the least significant bit) of the 8 bits per timeslot is 'stolen' and used to convey signalling. In T1-D4 (which has a 12 frame terrestrial multiframe) this gives two signalling bits 'ab', and in T1-ESF (which has a 24 frame terrestrial multiframe) this gives four signalling bits 'abcd'. The frames in which the bit is robbed are synchronised to the terrestrial multiframe as follows: T1-D4: 6th & 12th, T1-ESF 6th, 12th, 18th, 24th.

Stealing the LSB every sixth frame was acceptable when PCM signals conveyed primarily PCM audio as it made a negligible difference to the audio quality. However when the PCM network was later used to convey data not just PCM encoded voice, only 56kbps of data could be conveyed (using 7 bits per timeslot), as it was difficult to guarantee the signal would not pass through a link using Robbed Bit Signalling where the 8th bit would be overwritten every 6th frame, causing errors on the 64kbps data.

Signalling Over Satellite

Common Channel Signalling (CCS)

With Common Channel Signalling, the whole 64kbps signalling channel (timeslot) must be conveyed from one end of the link to the other and typically this is done on sub primary order satellite circuits (thin routes) by selecting the timeslot carrying the CCS for Drop/Insert as with other data timeslots. Special action is required with CCS, as the equipment at both ends of the link needs to be configured for the 'thin route' over the satellite so it does not dynamically allocate traffic to a timeslot that is not passed over satellite link!

Channel Associated Signalling

The IBS specification includes an option for equipment to support CAS, and defines a mechanism whereby the CAS (the 2kbps signalling channel per timeslot) can be carried within the 6.7% IBS satellite overhead. This option is fully implemented within the modem equipped with the Extended D/I feature and is further explained in the following section on "CAS Multiframe".

Robbed Bit Signalling (RBS)

Historically PCM bearers using Robbed Bit Signalling could not be used with Drop/Insert, as over standard IBS links the location of the signalling information (ie which timeslots have a bit overwritten with signalling) was lost. Even with Timeslot ID Maintenance (which preserved timeslot sequence and timeslot start / end boundaries) RBS was still lost. To preserve RBS not only is TS ID maintenance required, but also the timeslots required placing back into the correct frames within the terrestrial multiframe (so in T1-D4 for example the timeslots containing the RBS are placed in frames 6 and 12 of the terrestrial multiframe).

Intelsat's IBS definition does not specify a mechanism to achieve this therefore the modem equipped with the Extended D/I feature uses an extension of the Timeslot ID Maintenance scheme to provide RBS support with Drop/Insert over 'thin route' satellite links. It does this by treating not just the timeslots from one frame as a group of 'N' timeslots, but the group from the whole terrestrial multiframe as a block within which timeslot identity has to be

maintained. In effect if two timeslots were dropped from T1-D4 and T1-ESF bearers with RBS support enabled, although the aggregate data rate would be only 128kbps plus 6.7% overhead, the frame and multiframe structure would be as to support $N=24$ and $N=48$ respectively ($N \times 12$ for D4, and $N \times 24$ for ESF as D4/ESF have 12/24 frames per multiframe, relative to which RBS is placed). As with the support for 'Odd values of N ', the CAS Multiframe is again used to provide support for these extended timeslot sets, and hence support the Robbed Bit Signalling.

CAS Multiframe

Intelsat have defined a satellite CAS Multiframe to allow Channel Associated Signalling to be transferred across the satellite link between E1 PCM bearers within the IBS satellite overhead. The modem equipped with the Extended D/I feature uses the CAS Multiframe definition to support CAS, and also to provide Timeslot ID Maintenance for 'Odd values of N ' ($N = 7, 9, 11, 13$, etc), which in turn allows the Modem to also support Robbed Bit Signalling (RBS). The CAS multiframe is entirely independent of the TS32 Multiframe that has already been described.

The CAS Multiframe consists of data and frame alignment words in TS16 and TS48 of the IBS frame. A CAS multiframe starts off as a unique word of [00001y11] in TS16, and comprises a further 15 signalling data timeslots in TS48 & TS16 stretching over 8 frames. When carrying CAS, the 15 signalling data timeslots carry pairs of the 'abcd' signalling nibbles from the terrestrial TS16. When not carrying CAS but where the CAS Multiframe format is being used for solely for timeslot ID maintenance for 'Odd values of N ', these 15 signalling data timeslots are available for the high rate ESC.

Similar to the 'fitting' of the main data into the 60 timeslots available for data per IBS frame, the 'abcd' signalling information has to be 'fitted' into the 30 available nibbles in the 15 signalling data timeslots in TS16 / TS48 following the CAS MF unique word in TS16. There are certain values of ' N ' for which this will work, ie where $30/N$ gives an integer. These include $N = 1, 2, 3, 5, 6, 10, 15, 30$. In these cases then the CAS multiframe is 8 frames in duration with the first frame containing CAS-MF unique word in TS16 and pairs of 'abcd' signalling nibbles in TS48, and the following seven frames contain pairs of 'abcd' signalling nibbles in TS16 and TS48.

For values of N which are not supported by an 8 frame CAS multiframe (with room for 30 nibbles of signalling), the multiframe is simply extended in length by multiples of 8 frames until it reaches a value where it can accommodate an integer multiple of the signalling information in one multiframe. Although the multiframe is extended in multiples of 8 frames giving a further 30 locations to carry signalling each 8 frames, the CAS-MF unique word is not repeated but is instead replaced by a [00000000] pack byte in TS16 of every eighth frame after the original CAS-MF unique word. This keeps the same ratio of 30 signalling nibbles every 8 frames, no matter how long the CAS multiframe actually is.

The CAS Multiframe structure is of variable length (in multiples of 8 frames), and this feature lends itself to providing timeslot ID Maintenance for 'Odd value of N ', ie values which the fixed length TS32 multiframe cannot accommodate. This is an efficient use of the overhead as when not sending signalling information 15 out of every 16 TS16/TS48 locations are still available for high rate ESC, even when the CAS multiframe is required to support 'Odd values of N ' or Robbed Bit Signalling.

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CAS MULTIFRAME SUMMARY

N	TS Identity Maintenance Method & Length of CAS Multiframe (in frames)			
	Any Drop/Insert mode without signalling	G.732 Drop/Insert with CAS	T1-D4 RBS mode	T1-ESF RBS Mode
1	TS 32	CAS = 8	TS 32	TS 32
2	TS 32	CAS = 8	TS 32	TS 32
3	TS 32	CAS = 8	CAS = 24	CAS = 24
4	TS 32	CAS = 16	TS 32	CAS = 8
5	TS 32	CAS = 8	TS 32	TS 32
6	TS 32	CAS = 8	CAS = 24	CAS = 24
7*	CAS = 56	CAS = 56	CAS = 56	CAS = 56
8	TS 32	CAS = 32	CAS = 8	CAS = 16
9*	CAS = 24	CAS = 24	CAS = 72	CAS = 72
10	TS 32	CAS = 8	TS 32	TS 32
11*	CAS = 88	CAS = 88	CAS = 88	CAS = 88
12	TS 32	CAS = 16	CAS = 24	CAS = 24
13*	CAS = 104	CAS = 104	CAS = 104	CAS = 104
14*	CAS = 56	CAS = 56	CAS = 56	CAS = 56
15	TS 32	CAS = 8	CAS = 24	CAS = 24
16	TS 32	CAS = 64	CAS = 16	CAS = 32
17*	CAS = 136	CAS = 136	CAS = 136	CAS = 136
18*	CAS = 24	CAS = 24	CAS = 72	CAS = 72
19*	CAS = 152	CAS = 152	CAS = 152	CAS = 152
20	TS 32	CAS = 16	TS 32	CAS = 8
21*	CAS = 56	CAS = 56	CAS = 168	CAS = 168
22*	CAS = 88	CAS = 88	CAS = 88	CAS = 88
23*	CAS = 184	CAS = 184	CAS = 184	CAS = 184
24	TS 32	CAS = 32	CAS = 24	CAS = 48
25*	CAS = 40	CAS = 40	T1 only provides a maximum of 24 timeslots to Drop/Insert	
26*	CAS = 104	CAS = 104		
27*	CAS = 72	CAS = 72		
28*	CAS = 56	CAS = 112		
29*	CAS = 232	CAS = 232		
30	TS 328	CAS = 8		
31*	CAS = 248	CAS = 248		
32+	CAS = 8	CAS = 128		

* These are the 'Odd values of N' for which the Timeslot ID cannot be maintained by the TS 32 Multiframe.

+ N=32 is a special case normally handled as unframed 2048kbps (ie no Drop/Insert) or 1920/1984kbps (D/I with N=30/31)

1.22.2 IDR Framing

IDR Service Features

The Intelsat definition of IDR framing is in IESS 308. Eutelsat have a similar system defined in EESS 203 "Intermediate Rate Digital Carriers (IDC), Earth Station Standard" which simply cross refers back to the Intelsat IESS 308 standard for the Channel Unit Characteristics, and so the Modem equipment required for these services is identical. From here on we will refer to IDR framing, but the text applies equally to Eutelsats IDC framing.

Standard Features (specified in IDR definitions)

The addition of standard IDR framing increases the data rate by exactly 96kbps. IDR framing is added to provide the following extra features compared to `closed network` links:

- ⊗ Two Audio ESC channels, encoded as 32kbps ADPCM. As IDR is intended to replace all FDM links, these Audio ESCs replace the analog audio engineering service circuits of the FDM service.
- ⊗ An 8kbps digital ESC circuit.
- ⊗ Four independent backward alarms, to signal to up to four sites receiving a multidestinalational carrier, that there is trouble with the link in the other direction.

Additional Features (Paradise products)

- ⊗ Where many IDR carriers exist between sites, the Audio ESC on the second and subsequent carriers are not required (as the mandatory station to station ESC is met with the first carrier). The modem equipped with the IDR option allows 32 or 64kbps access to the bandwidth occupied by these audio channels on the Aux port. Allowing either one or both of the ESC channels to be replaced with either revenue bearing data, or possibly a PRBS for on-line BER measurement (with either the internal or an external BERT).
- ⊗ A far more useful *asynchronous* interface to the synchronous 8kbps digital ESC circuit, allowing for example M&C information to be conveyed providing the possibility to provide distant end control via the satellite channel.
- ⊗ The use of 16kbps ADPCM instead of 32kbps, allowing both audio ESC's to be compressed into 32kbps not 64kbps. This allows either:
 - ⌞ All normal IDR facilities in a 64kbps overhead
 - ⌞ All normal IDR facilities *plus* a 32kbps Aux channel in the normal 96kbps overhead (which allows an internal or external PRBS test to run in parallel with the traffic to monitor the service quality)
- ⊗ Reduced IDR facilities with 64kbps or 32kbps overhead.

1.23 Automatic Uplink Power Control



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

1.23.1 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 distant-end signal to noise ratio (E_b/N_0) and automatically adjusting the local power output of the satellite link to maintain the specified distant-end E_b/N_0 .

Distant E_b/N_0 monitoring is performed by sending messages through the asynchronous ESC channel (which is carried over the satellite multiplexed with the main data channel). An asynchronous ESC channel is available in Closed Network (Minimum Overhead), IBS/SMS and IDR modes. AUPC requires dedicated use of the ESC channel and while the ESC channel is being used for AUPC then it is not available for other purposes.

The modem can be set to either just monitor the distant E_b/N_0 or to maintain it at a specified level. As well as being able to view the distant E_b/N_0 and BER estimate, a deferred alarm can be set to activate if the distant E_b/N_0 falls below a user-set threshold and the distant-end E_b/N_0 can be recorded regularly in the local-end traffic log.

To maintain the distant E_b/N_0 , a target E_b/N_0 level has to be set along with a maximum transmit power level for the local end. When the target E_b/N_0 is exceeded by more than a pre-defined tolerance, the transmit power is adjusted to bring the distant E_b/N_0 back to the target value. The power will continue to be adjusted automatically until the E_b/N_0 settles on the target value. The use of a tolerance value prevents continual transmit power variations under normal minor thermal noise variations. The rate at which adjustments are made is automatically controlled in such a way as to prevent rapid power variations. If the satellite link is lost, then the transmit power will freeze at its current level until the link is restored.

1.23.2 Configuring AUPC

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

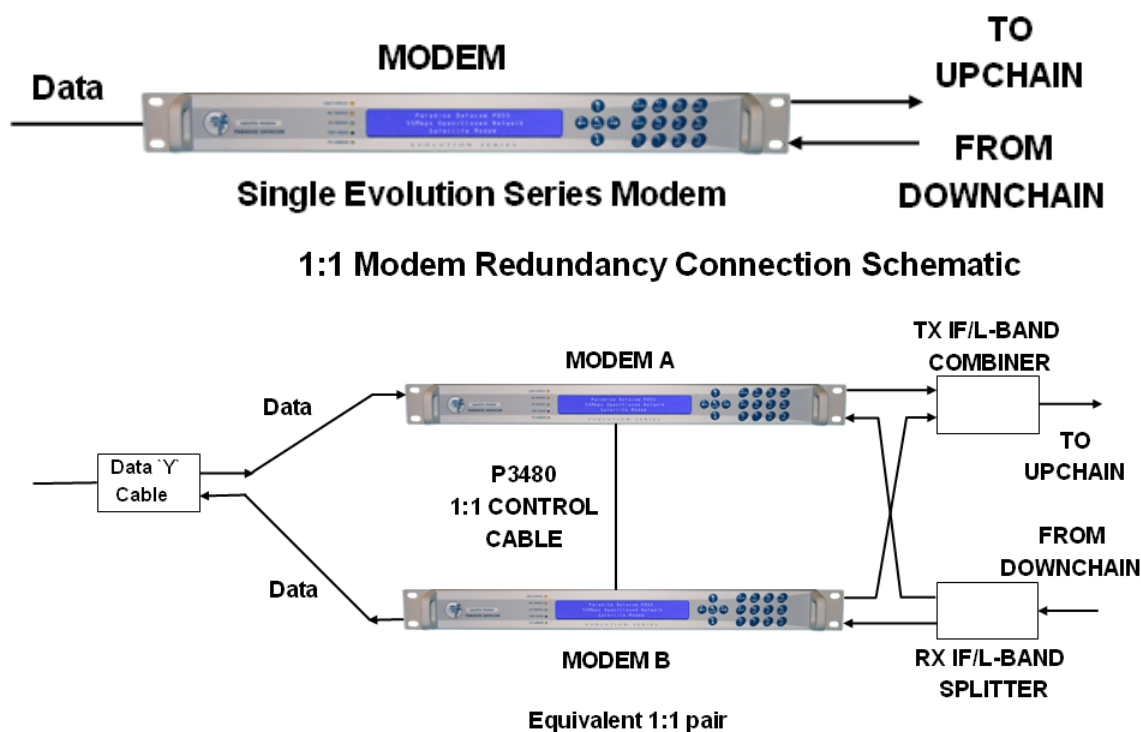
1. Prior to switching on AUPC, configure the modems at both ends of the link and ensure the basic satellite link is operating correctly.
2. Set the transmit power to achieve the distant E_b/N_0 expected under clear-sky conditions. The ESC channel is automatically configured during AUPC operation and any user ESC channel settings are ignored. However, use of the ESC channel by the AUPC function will change the bandwidth of the signal and may have a slight affect on the E_b/N_0 . To counteract this, configure the ESC channel to a nominal baud rate of 2400 when setting up.

3. Optionally set a target Eb/No minimum threshold to generate a Backward Alarm if you want an indication of when the distant Eb/No falls below the threshold.
4. Set the AUPC mode to monitor the distant Eb/No in order to determine if it is working correctly (i.e. the distant Eb/No and BER figures will be displayed). If the distant-end information is not available then the modems are not configured correctly.
5. Record the distant Eb/No under clear sky conditions and then set the AUPC mode to maintain the distant Eb/No.
6. Set a target Eb/No and set the maximum power level.
7. Review the distant Eb/No to determine if it is being maintained correctly under differing atmospheric conditions. Optionally use the web graphing feature to record the distant Eb/No and/or the AUPC delta power (this may be useful in ascertaining whether AUPC manages to maintain the Eb/No within the parameters you have set and also in being able to specify to the satellite operator the exact power being transmitted at a particular time).

1.24 1-for-1 Operation

1.24.1 Basic Theory

Any two modems will operate as a 1-for-1 redundant pair, with no other equipment except for a single interconnecting lead, two power splitter/combiners and cable forms to parallel up the 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. The diagram below illustrates how a 1-for-1 redundant pair is configured.



The pair of units, connected as shown, may be used as a direct replacement for a single unit, with all connectors and pin assignments remaining the same. A particular advantage of this arrangement is that one unit of the pair may be replaced without interrupting traffic. To enable the parallel operation of all the interfaces, the off-line unit provides no terminating load, enabling the correct impedance to be maintained even when the two modems are connected in parallel.

All interfaces have the facility to disable their outputs (either by making the outputs high impedance or by relay switching) thereby enabling one of a redundant pair to drive the outputs without line contention.

In the event of a catastrophic failure of one modem, the switching circuitry (which is distributed between the two units) will switch over to the operational unit.

1.24.2 Switching Philosophy

Both modems operate continuously, with each internally monitoring its operational status on a regular basis. There is no pre-assigned master and slave unit. Switchovers between units are minimised and a unit that is taken off-line due to a failure will remain off-line 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.

The modem software performs internal monitoring of operational status at a rate that prevents unnecessary switching. However, in the case of catastrophic failures, the modem hardware performs the switch immediately without waiting for the software. The logic has no memory, i.e. a unit taken off-line because of a failure will operate normally once it becomes operational again, with the proviso that no unnecessary switchovers are made between units.

1.24.3 Detected Failures

A failure is defined as either a failure detected by a unit or a catastrophic power failure. In these circumstances, the modems will switch over if one unit remains operational. If both units fail simultaneously (through external circumstances) then no switch over takes place. Both unit and traffic faults can cause a switch over. Traffic faults that are external to the equipment and that affect both units simultaneously do not result in any switch over.

1.24.4 Manual Switchover

The modem user interfaces support manual switching of control from the operational unit to the standby unit, assuming the standby unit is working normally. This is achieved by momentarily simulating a failure in the operational unit.

1.24.5 1-for-1 Setup Procedure

To set 1-for-1 operation between two modems, the following steps need to be performed:

1. Check that both modems have the same software issue.
2. Connect a 4-way screened cable between the 9-pin 1-for1 connectors on the two modems - this forces one modem to adopt the 1:1 standby mode.

3. Connect the data interfaces in parallel and configure the two units alike. Suitable adapter cables are available from Paradise Datacom for all of the standard interfaces.
4. 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.
5. Connect the two transmit IF ports to the input ports of a suitable power splitter/combiner of the correct impedance (50Ohm or 75Ohm) 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 splitter/combiners, the power level at the output of each modem needs to be increased by approximately 3.5dB.
6. Connect the two receive IF ports to the two output ports of a suitable powersplitter/combiner of the correct impedance (50Ohm or 75Ohm) 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.
7. 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 operational (i.e. does not indicate any fault). (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.)

1.25 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 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 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.

Each feature is given an acronym by which it is referred to on the user interfaces, etc. A full list of modem SAF features available at the time of publication of this handbook is shown in Section 6.3 (please contact your supplier or Paradise Datacom Sales for the most up to date list). Please check with your supplier or Paradise Datacom whether a particular feature requires a hardware option card to be fitted.

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

1.26 Software Upgrading

It is possible to update the software and firmware within the modem via the Remote M&C Ethernet connection web user interface (upgrades via the serial M&C port are not supported). See the section on Remote Software Upgrade within the Web User Interface description.

1.27 Partial Insert and Multi-destinational Working

Partial Insert is only available if the Extended D/I feature is available. In a typical scenario, there may be a 2048kbps incoming carrier, containing say 8 timeslots (512kbps) for this destination. When set to *Normal* the full 2048kbps has to be received and passed to the terrestrial. When set to *Partial*, only the 8 timeslots for this destination are selected and inserted onto the insert mux bearer avoiding overwriting *all the data* on the bearer.

This technique can be applied to lower rate carriers also. For example, suppose four destinations require mesh connectivity at 384kbps (6 x 64kbps, although asymmetric operation up to any rate is possible). Each site has a modulator transmitting 1152kbps (3 x 384kbps), and three demodulators receiving the 384kbps from the other sites. The satellite bandwidth requirement is for four 1152kbps carriers, not twelve 384kbps carriers (ie the same aggregate rate, but possibly lower overall bandwidth when carrier spacing is taken into consideration):

- A single T1 or E1 bearer is looped through three modems, one operating as Tx/Rx, and two others in Rx only. In this example we will assume it is a T1 PCM bearer.
- The Tx data for all destinations arrives at the single Tx modem in each site on the T1 bearer in 18 timeslots. Note that the ability to re-order the Tx and Rx timeslots means the data can be in *any* timeslots and in any order.
- Each of the four sites transmits a 1152kbps (3 x 384kbps carrier) and all four destination sites receive the three carriers from the other destinations.
- At each site all three modems are configured for Rx Partial Insert, and the data for all but this site is discarded leaving a 384kbps to be inserted onto the looped T1 bearer by each Rx modem. In this way the data from each site for this destination can be re-inserted into the original timeslot from which the Tx data was dropped.

Without Partial Insert if each Rx modem inserts *all the received data* (18 timeslots) onto the T1 bearer, then the second Rx modem could just about insert its 18 timeslots without

stamping on the 6 timeslots for this destination from the first Rx modem. However Rx modem 3, still has 18 timeslots to insert, but 12 of the timeslots on the T1 bearer now contain receive information from Rx modems 1 and 2, and so Rx modem 3 cannot insert all its data without losing data from another destination. The traditional alternative without Partial Insert is to use separate bearers for each Rx modem and a DACCS to sort out the data, but it is lower cost and less equipment to configure and maintain if the DACCS is not required at all.

Partial Insert becomes *mandatory* for multi-destinational working when the total receive data at any one destination exceeds the capacity of the PCM bearers.

Note that the modem can provide multi-destinational operation at aggregate carrier rates below 1544 kbps using the IBS overhead, but *with four backward alarms*. This means that multidestinational working down to 64kbps between nodes become practical (i.e. it does not require the 96kbps IDR overhead on the links to get multidestinational backward alarm facilities).

1.28 Choosing Optimum Custom Reed-Solomon Values

Complete variable code rate Reed-Solomon is available if both the Intelsat Reed-Solomon and `Custom Features` features are both available. (Note that there is nothing special about the Intelsat values other than that they were approved by Intelsat. They were chosen because one modem manufacturer could not generate clocks which were not a multiple of 8kHz and these non-optimum values make the satellite clock an 8kHz step).

Where maximum error correction capability is required chose `t` as high as possible (eg 10), and choose `n` as low as possible (eg 60) to maximise the number of bytes than can be corrected per codeword without adding too much overhead. In this extreme example it can correct one byte in six (t/n), but the overhead is 50% (overhead n/k, and $k = n - 2t$, so $k = 40$, gives overhead = $60/40$). *Optimum* values may in certain applications mean minimum delay (particularly at low data rates) and the final paragraph of this section deals with this aspect.

Due to the synchronisation method used for the interleaver and de-interleaver (Intelsat specified) on 2 codewords (blocks of `n` data bytes) out of 16 the error correction capability is slightly reduced by the equivalent of `t`=1. It is therefore best to avoid choosing a very low value of `t` so this intermittent reduction in error correcting capability is minimised. Note that in theory error correction codes (100,90,5) and (200,180,10) are equivalent (they can correct 5 bytes in 100 and 10 in 200 respectively), but the effect of the interleaver synchronisation words will be more noticeable (equivalent to a loss of `t`=1) when `t`=5 (20% loss) as opposed to `t`=10 (10% loss).

On the negative side the longer the codeword, the proportionally higher the delay through the encoder / decoder and interleaver / deinterleaver. The delay of the combined encoder and decoder is approximately $8 \times (2 \times n - k + 60)$ bits, and the interleaver & deinterleaver a further $(8 \times n \times \text{depth})$ bits (if calculating the delay, use the data rate inc framing and Reed-Solomon). Intelsat recommend an interleaving depth of 4 for rates less than 1544kbps, and 8 for rates of 1544kbps and above.

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Practical values for Reed-Solomon code rate will depend on the amount of overhead the circuit can tolerate. For overheads between 1.6% and 30% the table below gives practical values of (n, k, t) with the error correction at its maximum.

% o/h	Optimum (n,k,t)	% o/h	Optimum (n,k,t)	% o/h	Optimum (n,k,t)
1.6	(254,250,2)	11	(202,182,10)	21	(115,95,10)
2	(204,200,2)	12	(187,167,10)	22	(111,91,10)
3	(206,200,3)	13	(174,154,10)	23	(107,87,10)
4	(208,200,4)	14	(163,143,10)	24	(103,83,10)
5	(210,200,5)	15	(153,133,10)	25	(100,80,10)
6	(247,233,7)	16	(145,125,10)	26	(97,77,10)
7	(245,229,8)	17	(138,118,10)	27	(94,74,10)
8	(243,225,9)	18	(131,111,10)	28	(91,71,10)
9	(242,222,10)	19	(125,105,10)	29	(89,69,10)
10	(220,200,10)	20	(120,100,10)	30	(87,67,10)

For other values of overhead (o/h expressed as 1.xx), maximise `t` then:

$$n = \text{Round}((2 \times o/h \times t) / (o/h - 1))$$

$$k = n - 2t$$

If `n` is greater than 255, reduce `t`.

For some applications, particularly when operating with lower data rates, a reduction in the processing delay associated with Reed-Solomon FEC is the prime goal. In such circumstances use the `Custom Features` feature and select shorter codewords to reduce the encoder / decoder & interleaver / de-interleaver delay. For example switching from Intelsat standard values of n, k, t = 126, 112, 7 to 64, 56, 4 provides approximately the same correction ability (7 in 126 = 5.5% and 4 in 64 = 6.25% respectively) with similar overheads (126/112=12.5%, 64/56=14.3%) but with interleaving & decoder delays reduced from 5632 to 3104 bits (156ms to 85ms at 32kbps).

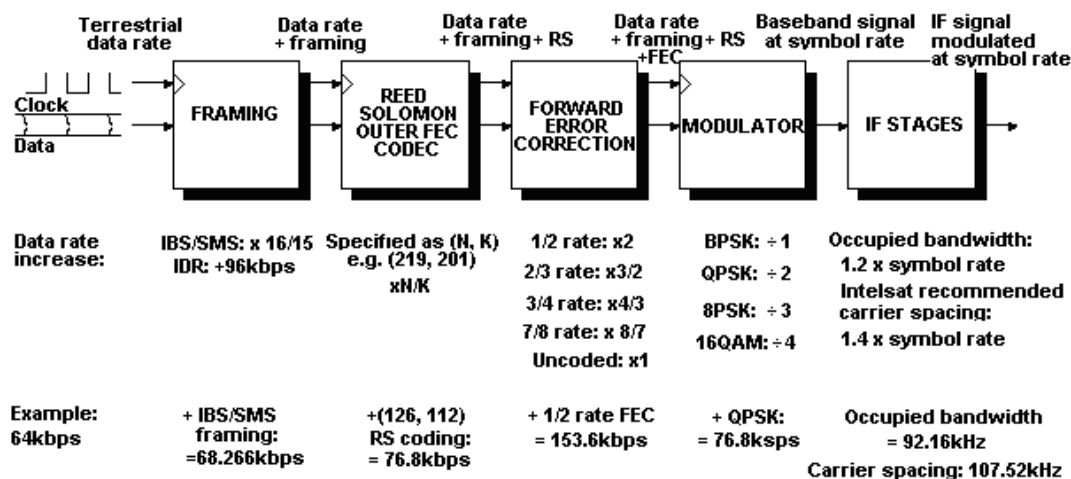
1.29 Data and Symbol Rates

The normal constraint for a modem is the range of *Symbol Rates* over which the modem can operate correctly. The Symbol Rate range however is not of initial interest to most modem users, as they first need to know if the modem can operate at the terrestrial *Data Rate* they require. This section briefly explains the relationship between Data Rates and Symbol Rates.

The *Data Rate* is normally the frequency of the clock used on the terrestrial port however if Drop/Insert is active the Data Rate is 64kbps times the number of timeslots dropped/inserted.

As the modem uses PSK (Phase Shift Keying) the *Symbol Rate* is the rate of *phase changes* on the carrier. Each phase change represents a new symbol to the demodulator, and depending on the modulation scheme that symbol may convey one (BPSK), two (QPSK), three (8PSK), or four (16QAM) bits of information.

The diagram below shows how the symbol rate is built up from the data rate.



Relationship Between Data Rate and Symbol Rate

You will see that with 1/2 rate FEC and QPSK (a common combination), the Symbol Rate is the same as the Data Rate (assuming no Framing or Reed-Solomon). This is a useful combination to check on any data sheet, as this will give you the Symbol Rate limits of the modem, from which the Data Rate limits in all other modes and combinations can normally be derived.

1.30 Determining Maximum ESC Baud Rates

Should you wish to determine the exact maximum ESC Baud rates, in order to change the overhead allocation to achieve specific ESC rates with specific overheads, then the following sections may be useful.

1.30.1 IBS

For Standard IBS the *exact* maximum continuous rate is:

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Baud Rate = (Main data rate/15) x (O/H bits allocated/32) x (Bauds per Character/9)
where:

Main data rate: The main modem data rate, eg 64000bps (/15 gives total overhead)

O/H bits allocated: The number of bits of the overhead allocated to the ESC, for example if the ESC is set in P230 mode, then 20 bits (TS16 bits 1-8, TS48 bits 1-8 & TS32 bits 4-8) are available (/32 give the proportion of the overhead allocated to the ESC)

Bauds per Character: The number of Baud periods per character (eg for async character format 8,N there are 10 Baud periods per character: start + 8 data bits + stop (/9 as 9 *synchronous* bits are always used for each character).

Note that if the CAS Multiframe is active *to transfer G.732 CAS*, then TS16 and TS48 are not available. Note also that if the CAS Multiframe is active *without CAS*, i.e. to maintain the timeslot ID for an 'Odd value of N' or if RBS signalling is active, then only 7 out of 8 of every TS16 are available for ESC, as TS16 has to carry the 'CAS MF unique word' or 'pack byte' every 8th frame. In this case simply consider TS16 as providing 7 bits of overhead not 8.

For Custom IBS modes this is unchanged unless Minimum Overhead mode is selected, in which case the overhead will vary up or down from the standard 1/15th to accommodate whatever Baud rate is set on the ESC Rate screen.

In all IDR modes, the ESC channel is an 8kbps synchronous channel, and if the ESC port is set to provide an async interface the *exact* maximum continuous async rate is:

$$\text{Baud Rate} = 8000 \times (\text{Bauds per Character}/9)$$

Where "Bauds per Character" is the number of Baud periods per character (eg for async character format 8,N there are 10 Baud periods per character: start + 8 data bits + stop (/9 as 9 *synchronous* bits are always used for each character). This results in a maximum of 9777Baud with 11 Baud periods per character (eg start + 8 + parity + stop), and 8888Baud with 10 Baud periods per character (eg start + 8 + stop), as used with Paradise M&C protocols. So when set for [8 bits No Parity] or [7 bits with Parity] the maximum standard Baud rate is 4800 Baud. When set for [8 bits with Parity] the maximum standard Baud rate is 9600 Baud.

1.30.2 Closed Network Plus ESC

1.30.2.1 Overhead Rates

The following table shows example overhead rates for different async ESC Baud rates at a variety of main channel data rates. The table was generated (using a modem) with the async character format set for 8 bits no parity, the overhead percentages will vary slightly for async character formats different from this.

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Figures: Overhead rate with backward alarm (/ Overhead rate without backward alarm, if different)

	Main data channel rates						
ESC rates	9.6kbps	16kbps	64kbps	256kbps	512kbps	1024kbps	2048kbps
2400 Baud	33.3%	20%	5% / 4.8%	1.25% / 1.19%	0.62% / 0.59%	0.39% *	0.39% *
4800 Baud	100%	50%	10%	2.5% / 2.38%	1.25% / 1.19%	0.62% / 0.59%	0.39% *
9600 Baud	n/a	100%	20%	5% / 4.76%	2.5% / 2.38%	1.25% / 1.19%	0.62% / 0.59%
19200 Baud	n/a	n/a	50%	10%	5% / 4.76%	2.5% / 2.38%	1.25% / 1.19%
38400 Baud	n/a	n/a	100%	20%	10%	5% / 4.76%	2.5% / 2.38%

The formula for deriving the overhead rate is moderately complex, and relies on many different parameters. For other mixes of data rate and async settings the simplest way to determine the overhead is to enter the parameters into a modem and then select *View/Config/Tx-Rx*. This screen shows the exact overhead percentage. Information on the framed data rate, the data rate including any Reed-Solomon encoding and the final symbol rate including the effects of the 'inner' FEC and modulation can be found under *View/Monitor/Tx-Rx*.

1.31 Tutorial on Carrier/Noise and Eb/No Measurements

This brief tutorial explains what the terms mean and how to measure and interpret the figures you see. The diagram on the following page summarises the situation. A table is included that converts between values measured on a spectrum analyser and actual Eb/No values.

Derivation of Eb/No from (C+N)/N

It is possible to describe the **Carrier / Noise** ratio within the Rx system at an arbitrary reference point, eg at the input to the demodulator, at the input to the Forward Error Correction decoder (FEC), at the input outer Reed-Solomon FEC decoder, or even at the terrestrial data interface. Many of the terms in common usage represent this Rx Carrier / Noise ratio at these different reference points.

It is common to measure **(Carrier + Noise) / Noise** at the demodulator input on a spectrum analyser. A measurement is made that contains atmospheric noise and is then converted back to Carrier / Noise. In the equation below the term (C+N)/N is the (Carrier+Noise) / Noise ratio read from the spectrum analyser.

$$\frac{\text{Carrier}}{\text{Noise}} = \frac{C}{N} = 10 \log_{10} (10^{\frac{(C+N)/N}{10}} - 1) = \frac{E_s}{N_0}$$

We can express this same Carrier / Noise ratio at the input of the demod in terms of the Energy per *Symbol* / Noise power density, which is written as **E_s / N₀**. Because 'Carrier / Noise' is a ratio of two powers measured in the same bandwidth (the resolution bandwidth of the analyser), this is the same as E_s / N₀.

Within the demodulator, each *Symbol* is converted back into the *Transmitted Bits*. For BPSK each Symbol represents only 1 Transmitted Bit, for QPSK or OQPSK each Symbol represents 2 Transmitted Bits, and for 8PSK each Symbol represents 3 Transmitted Bits. The expression **E_t / N₀** (or **E_{bt} / N₀**) represents the Carrier to Noise ratio referenced to this *Transmitted Bit* rate. For QPSK and 8PSK the *Transmitted Bit* rate is higher than the *Symbol* rate, and so E_t / N₀ (ie the Carrier / Noise referenced to Transmitted Bit rate) is lower than the E_s / N₀ (the Carrier / Noise referenced to the Symbol rate), as this same power is referenced to a higher bit rate. Allowing for the change in bit rate in the demod gives:

$$\frac{E_t}{N_0} = \frac{E_s}{N_0} - 10 \log_{10}(\text{No of Bits / Symbol})$$

Next in the demod chain comes the FEC Decoder. The receive Carrier / Noise referenced to this point is referred to as **E_{Dec} / N₀**. In the FEC Decoder the bit rate is reduced as the data is decoded to provide corrected data at a lower rate. Because the data rate reduces

through the FEC Decoder E_{Dec} / N_o is higher than E_t / N_o as the same power is referenced to a lower bit rate. Allowing for the change in bit rate in the FEC decoder gives:

$$\frac{E_{Dec}}{N_o} = \frac{E_t}{N_o} - 10 \log_{10}(FEC \text{ Code Rate})$$

Following the FEC Decoder (the 'inner FEC', ie TPC, Viterbi or TCM) comes the Reed-Solomon 'Outer FEC' Decoder (if active). This 'Outer FEC' RS Decoder operates similarly to the 'Inner FEC' Decoder, reducing the bit rate as it corrects errors and finally generating the Composite Information Bit Rate at its output. The Carrier / Noise expressed at this Composite Information Bit Rate is referred to as the E_b / N_o (or E_{bi} / N_o or E_i / N_o with 'i' and 'b' referring to *Information* and *Bit* respectively). Again because the data rate reduces through the RS Decoder E_b / N_o is higher than E_{Dec} / N_o as the same power is referenced to a lower bit rate. Allowing for the change in bit rate in the RS Decoder gives:

$$\frac{E_b}{N_o} = \frac{E_{Dec}}{N_o} - 10 \log_{10}(RS \text{ Code Rate} = (\frac{k}{n}))$$

It is this E_b / N_o that is typically displayed on the front panel of Modem equipment.

Finally, after the RS Decoder comes Deframing and baseband processing such as Drop/Insert. IBS/SMS or IDR deframing does decrease the bandwidth, but the bandwidth reduction effects of deframing are ignored as Intelsat chose to define the mandatory modem performance in terms of E_b / N_o , specifying that this relates to the *Composite* Information Bit Rate (ie it includes framing). Baseband processing has no effect on bandwidth and is totally ignored.

Practical Implications of Displayed E_b/N_o

Practically this means the following:

For a constant Tx Power, you will get the same displayed E_b/N_o whatever the settings of Modulation Inner FEC, and Outer (RS) FEC, as the E_b/N_o display compensates for these parameters. The bandwidth will vary and so will the Carrier/Noise at the input of the demod, but the displayed E_b/N_o will be steady as it compensates for these parameter changes.

When comparing BER performance for different Modulation/FEC schemes against E_b/N_o , the plotted E_b/N_o already accounts for the changes in Carrier/Noise caused by the different Modulation and FEC settings. Any BER difference you see with different schemes is a real difference - it is not necessary to further compensate for the changes in Carrier/Noise this change induces.

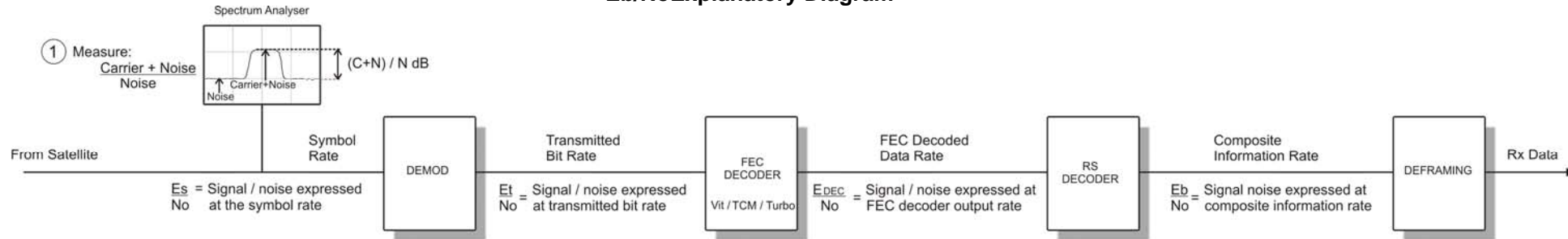
You do however have to be aware of Bandwidth considerations. You might find a Modulation/FEC scheme which gives an exceptional BER for a given E_b/N_o , but it will of little practical value if the bandwidth it requires occupies a whole transponder.

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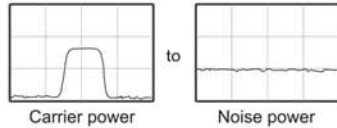
When you look at BER performance figures at a *specified* E_b/N_o you get the same BER performance whether the data is framed or not. Adding framing to a Closed Network link would increase the bandwidth, decrease the Carrier/Noise, decrease the displayed E_b/N_o (as it does not compensate for framing) and therefore degrade the BER. However when brought back to the same E_b/N_o you do of course recover the same BER. Framing therefore does not degrade the BER for a stated E_b/N_o , but it does require more power (and bandwidth) to achieve the same E_b/N_o .

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Eb/No Explanatory Diagram



- 2 Calculate ratio of Carrier power Noise power



$$\left(\frac{C}{N}\right) \text{ dB} = 10 \log_{10} \left(10^{\left(\frac{C+N}{N}\right)} - 1 \right)$$

- 3 Determine $\frac{E_s}{N_o}$

$$\frac{E_s}{N_o} = \frac{\text{Energy per symbol}}{\text{Noise power density}} = \frac{C}{N}$$

Each symbol represents several transmitted bits depending on the modulation:

BPSK = Transmitted bit / symbol
 PSK / QPSK = 2 Transmitted bit / symbol
 8PSK = 3 Transmitted bit / symbol
 16QRM = 4 Transmitted bit / symbol

4

$$\frac{E_s}{N_o} - 10 \log (\# \text{Bits} / \text{Symbol}) \rightarrow \frac{E_t}{N_o}$$

BPSK $\rightarrow -0$ dB
 QPSK / OQPSK $\rightarrow -3$ dB
 8PSK $\rightarrow -4.77$ dB
 16QRM $\rightarrow -6$ dB

FEC decoder reduces data rate & corrects errors. Data rate reduced by FEC code rate:

1 / 2 Rate = 1 Decoded bit / 2 transmitted bits
 3 / 4 Rate = 3 Decoded bits / 4 transmitted bits
 7 / 8 Rate = 7 Decoded bits / 8 transmitted bits
 2 / 3 Rate = 2 Decoded bits / 3 transmitted bits

5

$$\frac{E_t}{N_o} - 10 \log (\text{FEC Code Rate}) \rightarrow \frac{E_{DEC}}{N_o}$$

1 / 2 Rate $\rightarrow +3$ dB
 3 / 4 Rate $\rightarrow +1.25$ dB
 7 / 8 Rate $\rightarrow +0.58$ dB
 2 / 3 Rate $\rightarrow +1.76$ dB

RS decoder reduces data rate & corrects errors. Data rate reduced by RS code rate:

Code rate $\frac{k}{n}$ expressed as (n,k,t)
 (126,112,7) = 112 Information bits / 126 Decoded
 (219,201,9) = 201 Information bits / 219 Decoded
 (225,205,10) = 205 Information bits / 225 Decoded

6

$$\frac{E_{DEC}}{N_o} - 10 \log \left(\frac{k}{n} \right) \rightarrow \frac{E_b}{N_o}$$

(126,112,7) $\rightarrow +0.51$ dB
 (219,201,9) $\rightarrow +0.37$ dB
 (225,205,10) $\rightarrow +0.40$ dB

Bandwidth change due to framing is ignored in INTEL SAT definition of E_b/N_o as E_b refers to the composite data rate.

Summary

1 Measure $(C+N)/N$ $\rightarrow 10 \log_{10} \left(10^{\left(\frac{C+N}{N}\right)} - 1 \right)$ $\rightarrow \left(\frac{C}{N} = \frac{E_s}{N_o} \right)$ $\rightarrow 10 \log (\# \text{Bits} / \text{Symbol}) \rightarrow \frac{E_t}{N_o}$ $\rightarrow 10 \log (\text{FEC Code Rate}) \rightarrow \frac{E_{DEC}}{N_o}$ $\rightarrow 10 \log \left(\frac{k}{n} \right) \rightarrow \frac{E_b}{N_o}$

Example 6.5dB $\rightarrow (5.40\text{dB} - 3\text{dB (QPSK)}) \rightarrow 2.40\text{dB}$ $\rightarrow 2.40\text{dB} + 1.25\text{dB (3/4 Rate)} \rightarrow 3.65\text{dB}$ $\rightarrow 3.65\text{dB} + 0.51\text{dB (126,112,7)} \rightarrow 4.16\text{dB}$

Tables to Convert (C+N)/N to Eb/No

$\frac{C+N}{N}_0$	$\frac{C}{N} = \frac{E_s}{N_0}_0$	$\frac{E_t}{N_0}_0$	$\frac{E_{Dec}}{N_0}_0$	$\frac{E_b}{N_0}_0$
4.6 4.8	2.75 3.05	Adjust for modulation: BPSK: -0dB QPSK: -3.0dB OQPSK: -3.0dB 8PSK: -4.77dB	Adjust for FEC Rate: 1/2 Rate: +3.0dB 3/4 Rate: +1.25dB 7/8 Rate: +0.58dB 2/3 Rate: +1.76dB	Adjust for RS Codec: (n,k,t)= (126,112,7): +0.51dB (219,201,9): +0.37dB (225,205,10): +0.40dB
5.0 5.2 5.4 5.6 5.8	3.35 3.64 3.92 4.20 4.47			
6.0 6.2 6.4 6.6 6.8	4.74 5.01 5.27 5.53 5.78			
7.0 7.2 7.4 7.6 7.8	6.03 6.28 6.53 6.77 7.01			
8.0 8.2 8.4 8.6 8.8	7.25 7.49 7.72 7.95 8.19			
9.0 9.2 9.4 9.6 9.8	8.42 8.64 8.87 9.10 9.32			
10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5	9.54 10.09 10.64 11.18 11.72 12.25 12.78 13.30 13.82 14.34			
15.0	14.86			

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$\frac{C+N}{N}_0$	$\frac{C}{N} = \frac{E_s}{N_o}_0$	$\frac{E_t}{N_o}_0$	$\frac{E_{Dec}}{N_o}_0$	$\frac{E_b}{N_o}_0$
15.5	15.38			
16.0	15.89			
16.5	16.40			
17.0	16.91			
17.5	17.42			
18.0	17.93			
18.5	18.44			
19.0	18.94			
19.5	19.45			
>20	=(C+N) / N (error <0 .04dB)	Example: 8SPK with 2/3 Rate TCM FEC, & RS=(219,201,9)		
(C+N)/N= 8.4dB	C/N= 7.72dB	8PSK so subtract 4.77dB	2/3 Rate FEC, so add 1.76dB	RS Code (219,201,9) so add 0.37dB
Measure	Look up	Calculate Eb/No = C/N - 2.64dB		

1.32 IP Functionality

1.32.1 Base Modem IP

As shown below, the base modem has one RJ45 auto-sensing 10/100Mbps Ethernet port for M&C and one for sending and receiving satellite IP traffic.



Base Modem Ethernet Ports

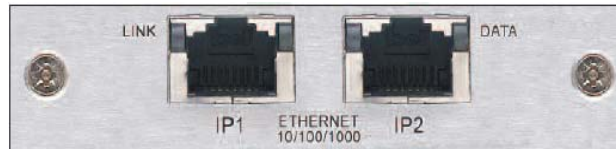
Both of the Ethernet connections by default form part of an Ethernet bridge and share an IP address. Essentially, the bridge makes the modem disappear from the network in relation to passing IP traffic over satellite. Consequently, for simple point-to-point communications, little or no user set up is required to pass IP traffic over satellite. If both Ethernet ports are configured to be part of the bridge (which is the default) 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 of 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 settings an IP address of 0.0.0.0 causes the modem to request an IP address from a DHCP (Dynamic Host Control Porotocol) server on the network. Typically an external router will be required to perform complex network IP routing functions (such as dynamic routing). 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. The use of a default gateway IP address is also supported. When specified (i.e. the value is not 0.0.0.0) then the gateway provides a next-hop IP address for all destinations that are not on the local subnet. Typically this is the address of a router that has been set up to forward packets to the correct network.

The bridge has to learn what devices are on which network segment in order to avoid creating bridging loops, where Ethernet frames circulate endlessly, using up valuable bandwidth. The bridge therefore maintains information on how to forward frames, based on replies that are received from each device.

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. If the modem has an IP traffic card fitted then

the IP traffic port of the base modem is replaced by the ports on the IP traffic card (see picture below).



IP Traffic Card Dual 10/100/1000 Base-T Ethernet Ports

1.32.2 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.

1.32.2.1 Gateways

The key to understanding the default gateways on the modems is being aware that there is one TCP/IP stack running on a processor on the base modem and, if fitted, one TCP/IP running on a processor on the IP Traffic card *and that there can only ever be one gateway associated with each TCP/IP stack in operation even although the modem menus support three gateways:*

- M&C gateway
- Traffic port gateway
- Satellite port gateway

The traffic port gateway is *never* used unless an IP traffic card is fitted. The satellite port gateway is *never* used unless routing mode is selected. You can *never* set both a traffic port gateway and a satellite port gateway at the same time because the software controlling the associated IP features is running on a single TCP/IP stack.

In routing mode you can set either the satellite gateway or the IP traffic gateway. It is undefined which will be used if you attempt to set both!

There are no hard and fast rules for setting gateways, but if there is a single router then:

- On the modem local to the router the IP traffic gateway will normally be used to point to the router;

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- The satellite gateway of the remote modem will normally point to the satellite IP address of the modem local to the router.

If there are two routers then:

- Either the modem IP traffic gateways could point to the local router and static routes point to the far modem, or alternatively,
- The satellite gateways could point to the other modem's satellite address and static routes could be used to forward to the local router (assuming dynamic routing is not being used).

The IP traffic address is used when the M&C port is out of the bridge. It is also used when an IP traffic card is fitted (to address the IP card), regardless of the M&C port settings. The IP traffic address is not particularly useful until TCP acceleration, header compression or routing is switched on, at which point (b)routing decisions are being made, which use the IP traffic address.

TCP acceleration requires a gateway to be set unless everything is on the same subnet. Note that *brouting* is a mode that uses both bridging and routing at the same time (UDP packets will be bridged and TCP packets will be routed, but will still have an Ethernet frame over satellite). Bridged packets always retain their Ethernet frame over satellite. Ethernet frames are only absent over satellite when routing mode is used.

The base modem will only ever use the M&C gateway.

If the M&C port is out of the bridge, with no IP traffic card fitted, then the M&C gateway is applied to the IP traffic port - if required, then an M&C gateway must be set up using a static route in this case.

1.32.3 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 base modem throughput is restricted to 10000 packets per 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 its packet processing limit.

The base modem packet processing limit equates to roughly 5Mbps of UDP (at the smallest Ethernet frame size of 64 bytes).

TCP acceleration works to 10Mbps on the base modem.

The IP Traffic card throughput is restricted to 50000 packets per second. This equates to roughly 25Mbps of UDP (at smallest Ethernet frame size of 64 bytes).

TCP acceleration works to the maximum data rate of the modem (currently 60Mbps on SCPC modems) using either the base modem IP or the IP Traffic card.

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

1.32.4 Jumbo Ethernet Frame Support

Leaving aside preamble, a standard Ethernet frame has 18 bytes of overhead and varies in size between 64 bytes and 1518 bytes. Some protocols extend the Ethernet frame e.g. VLAN and MPLS both add 4 bytes.

The base modem supports Ethernet frames up to 1536 bytes in length.

The IP Traffic card supports Ethernet frames up to 1600 bytes in length.

1.32.5 IP Over ESC

The Engineering Service Channel (ESC) is a low rate independent data channel from the main data channel that exists within some framed satellite services such as IBS and Closed Network plus ESC. It was originally intended for inter-earth station communications and is often used for M&C control of remote equipment.

The ESC is implemented as an internal serial interface run at baud rates up to a maximum of 115kbps. The '*ESC interface type*' needs to be set to '*IP*' to put the ESC into IP mode. Because the ESC is a serial interface, IP will not run directly on top of it – the modem encapsulates IP packets within PPP, much the same as a dial-up modem connecting to the internet. When used for IP, the ESC channel runs in bridge mode, with the M&C port being bridged to the ESC channel.

Since the ESC channel acts as a bridge, some bandwidth may be consumed by broadcast traffic finding its way onto it and it is best to minimize this if possible.

The modem allocates private IP addresses to the two ends of the ESC link – no user address set up is required.

The ESC channel in IP mode has some sophisticated M&C modes as described in the following list (in all cases, IP packets destined for the remote network continue to be bridged over the ESC):

- Paradise Universal Protocol (PUP) commands can be sent to the modem with an '*esc*' prefix to force them to be sent over the ESC to the far modem e.g. '*esc get RxRemoteEbNo*'.
- If you don't want packets to be indiscriminately forwarded over the ESC then you can take the M&C port out of the bridge, meaning that packets on the M&C port will not *normally* then go any further than the local modem. You can then force chosen packets to be forwarded over the ESC if you want. Forwarding is controlled by the '*Remote M&C interface*' setting. Setting this to '*IP – Forward to remote*' causes the modem to process TCP packets sent to ports 6703 and 6704 in a special way.
 - Packets sent to port 6703 are forwarded over the ESC to port 6703 on the remote modem. At the remote modem (with the remote M&C interface mode set to '*IP – Remote (Rem M&C)*'), the payloads of packets received

- over the ESC on port 6703 are forwarded out of the serial RS485 M&C interface (i.e. converted from IP to serial commands).
- Packets sent to port 6704 are forwarded over the ESC to port 6701 on the remote modem. At the remote modem, packets received over the ESC on port 6701 are treated as local M&C commands for the modem and go no further.
- You can send M&C packets to port 6701 on the local modem at any time when using the ESC channel in IP mode, without having to set the '*Remote M&C interface*'. If you just want to bridge IP packets then you can ignore the remote M&C interface setting.

To summarise the ESC bridging options:

- IP can be used over the ESC and the main data channel at the same time, whether using the base modem IP or the IP Traffic card.
- With the M&C port in the bridge and IP selected for both the ESC and main data channel, the M&C port is now bridged to the ESC channel *not the IP traffic port*. The IP traffic port is still bridged, but only to the satellite port (when the ESC is not being used, bridging the M&C port bridges it to the IP traffic port and the satellite port)

Note that the ESC channel is used to support the AUPC feature but this does not prevent it being used for other purposes at the same time (the AUPC messages are just multiplexed in with the other data).

1.32.6 IP Interoperability

Over satellite, the modem uses HDLC to encapsulate the Ethernet frames or IP packets (unless DVB-S2 is being used, in which case another form of encapsulation is used such as MPE or ULE). If Cisco HDLC is selected on the modem then the received IP stream can be forwarded out of a serial interface to a serial router that supports Cisco HDLC, which can convert it back to IP.

In general different modem manufacturer's IP, even when using HDLC, is not interoperable as there is no standard defined in this area. If instead DVB-S2 is used, then generally IP is interoperable between different manufacturer's modems, so long as incompatible IP features are not being used such as compression or acceleration.

1.32.7 IP Connectivity Modes

The modem software supports several types of Ethernet network topology.

Firstly, there is a point-to-point mode for when one modem is transmitting to and receiving from one other modem (i.e. there is a direct satellite return path).

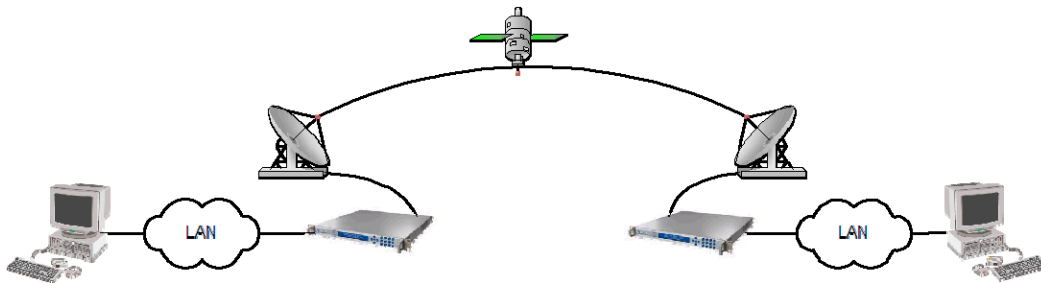
Secondly, there is a point-to-multipoint mode for when one hub modem is transmitting to several remote modems. The remote modems may be Rx only or may transmit back to Rx-only modems at the hub that are daisy-chained together to the hub Tx modem (to allow all of the hub modems to share the hub Tx carrier).

Thirdly, there is a mesh network mode where a number of remote sites each have one Tx carrier that is used to communicate with the other sites. Each site also has one Rx-modem for every site, to allow it to receive from each of the other sites. (Partial mesh networks are also supported where one or more of the sites communicate with only a subset of the other sites.)

These are described in the following sections.

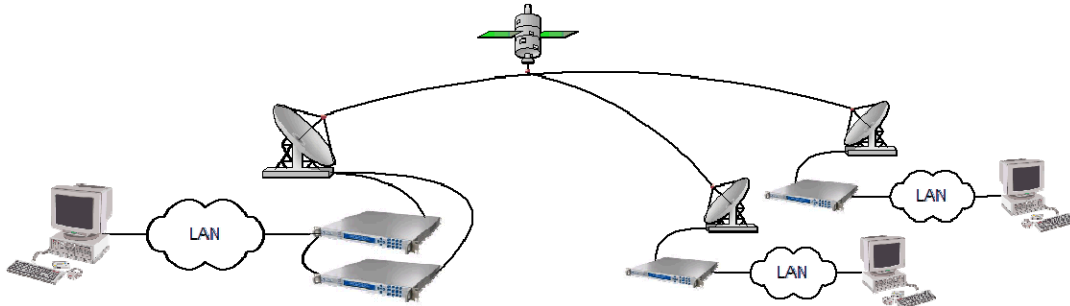
Note that for multicast, it does not matter whether you use point-to-point bridging or point-to-multipoint bridging or routing – in all cases the modem just passes the multicast traffic.

1.32.7.1 Ethernet Point-to-Point Bridging



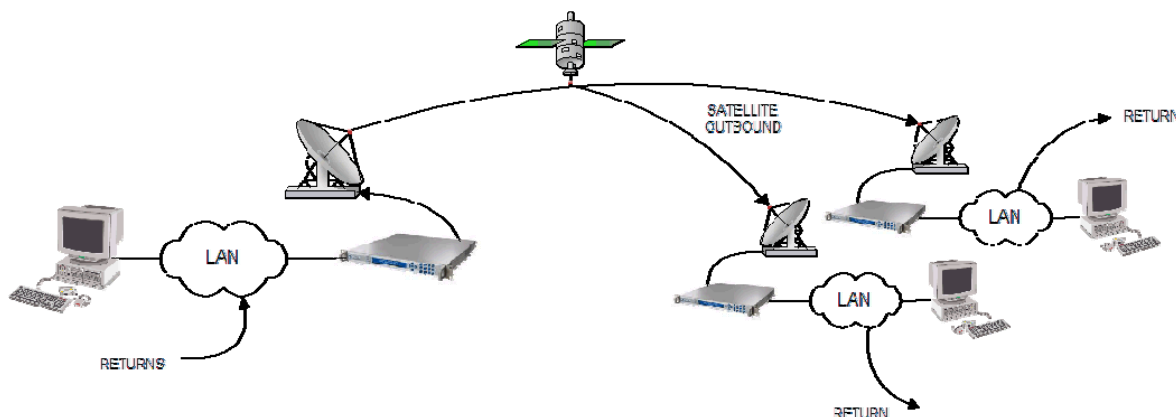
- An Ethernet bridge in the modem passes IP packets transparently, as if the modem is not actually there.
- The bridge learns which interface (terrestrial or satellite) devices are attached to and consequently only forwards packets over satellite when required.
- IP packet contents are unchanged going over the bridge (the source Ethernet MAC address will be changed to the modem's MAC address, which is normal).
- Because the modem does not change the contents, any protocol that can be used over Ethernet can be used (VPN, MPLS, VLAN, HTTP, SMTP, etc.).
- Point-to-point bidirectional bridged links over satellite work in exactly the same way as a terrestrial bridge.
- A protocol called Spanning Tree is used to ensure that network loops do not occur and that a single path is used between any two points.
- If you do not need to access the modem for M&C purposes then it is not actually necessary to set any IP address to use bridge mode – the modem will pass traffic out of the box.

1.32.7.2 Ethernet Point-to-Multipoint Bridging



- Uses a shared outbound carrier to multiple remote modems, with either direct returns over satellite (to multiple Rx modems at the hub), indirect terrestrial returns or no return.
- If no return channel exists then you can only ever send multicast traffic (since there is no reply to any ARP requests so no other traffic will ever be sent to the modem from the PC).
- The hub Tx modem does not expect to receive replies to ARP requests (since replies will be by a different path i.e. via hub Rx modems).
- However, the ARP replies sent to the Rx-only hub modems still get back to the originating devices, so these still continue to send data to the modem, which passes it indiscriminately over satellite except for data destined for devices it recognises as being on the local terrestrial side of the network,
- It does not matter what subnetting is used at the remotes – the devices can be on one or many subnets unless...
 - TCP acceleration or header compression is also being used, in which case all the modems need to be on a single subnet.
 - When routing is used, all the modems need to be on a single satellite subnet but you can use different subnets on the terrestrial side.
- Double hop is supported, where a remote can communicate with another remote via the hub. Double hop is not wasteful of bandwidth because the hub Tx modem only retransmits data over satellite if it cannot find the destination device on the local terrestrial network.
- Each remote sees the data intended for the other remotes and these unwanted packets must either be filtered out by enabling VLAN tagging or be filtered by a router. A similar problem exists in routing mode, in which case 'black hole' gateways can be specified at the remotes to forward unwanted packets to a non-existent address, causing them to be dropped by the remote modem.

1.32.7.3 Ethernet Point-to-Multipoint Bridging



- This is used where there is a shared outbound carrier from the hub to remotes, and the return path is *not* over satellite (i.e. there is an indirect terrestrial return).
- It relies on the presence of another route for IP traffic to pass from remotes back to the hub.
- It is typically used as an overlay IP delivery system to boost bandwidth out from the hub to remote subnets.
- In this specific mode, a '*Bridge filtering*' option is available at the remotes to discard all data not destined for the subnet that the remote modem is on (this is not required if VLAN tagging or router filtering is being used).

1.32.8 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.

1.32.9 Traffic Shaping

Traffic shaping provides greater 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.

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/Unit/Advanced/QoS*.

1.32.9.1 Guaranteed Bandwidth

The allocation of bandwidth to a classified data stream can be controlled via the *Edit/Unit/Advanced/QoS* tab of the web user interface.

The **Committed Information Rate (CIR)** is the guaranteed bandwidth, in bits per second (bps) 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 the transmission data rate of the modem.

1.32.9.2 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 is not wasted and it can be allocated in a controlled manner between potentially competing streams.

This setting is called the **Burst Information Rate (BIR)** specified in bits per second (bps). It defines the maximum amount of bandwidth, beyond the guaranteed bandwidth, that a stream should be allocated, should spare bandwidth become available. Each BIR should not be greater than the transmission data rate of the modem.

1.32.9.3 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 its input buffer waiting for transmission over satellite, then the packets will be sent based on their priority, with the highest priority being sent first. Packets are buffered up to a limit, after which packets may be dropped.

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).

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.

1.32.9.4 Stream Classification

How does the modem know which packets belong to which streams? Streams can be classified using one of the four methods described in the following sections. These can be selected using the *Quality of service scheme* dropdown control on the web user interface. 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 0. The default data stream gets a BIR value of the maximum transmit data rate of the modem.

1.32.9.4.1 IP Address

It is possible to classify a data stream based on either the source and/or the destination address in the IP packet as well as the port number of the TCP or UDP header in the packet.

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Each address has an associated subnet mask that delimits the particular host subnet from the overall network. For example, if an address is 10.3.0.0 and the mask is 255.255.0.0 then any packet containing the subnet 10.3 will be matched. To match on the whole of an address the mask must be set to 255.255.255.255.

If matching on a port is also selected then the packet will only be classified as part of the data stream if both the address and the port number match.

A maximum of 16 data streams are supported, each of which has its own CIR, BIR and priority level settings.

The following example shows a traffic shaping scheme based on matching on source address and source port number. Note the *Enable shaping* checkbox, which controls whether traffic shaping is enabled or not.

The screenshot displays the 'Cliff's Shaping Test Modem 1 - 10.1.70.1' web interface in a Windows Internet Explorer browser. The interface features a navigation bar with tabs for STATUS, EDIT, VIEW, TEST, HELP, and LOGOUT. Below this, there are tabs for Alarms, Special modes, Operation, SAF, and QoS. The QoS tab is active, showing a 'Quality of service scheme' configuration page. The 'IP Address' dropdown is selected, and the 'Enable shaping' checkbox is checked. The 'QoS IP address class' is set to 'Source address + port'. A table lists 16 QoS classes (0-15) with columns for CIR (bps), BIR (bps), Priority, Source Address, Source Mask, and Source Port. Class 0 is highlighted with a CIR of 500,000 and a BIR of 900,000. The 'Total' row shows a CIR of 1,000,000 and a BIR of 1,000,000. The 'Tx data rate' is also set to 1,000,000. A sidebar on the left contains a 'SUMMARY' section with status indicators for UNIT STATUS, RX TRAFFIC, TX TRAFFIC, TEST MODE, and TX CARRIER, along with a 'HELP' section.

QoS Class	CIR (bps)	BIR (bps)	Priority	Source Address	Source Mask	Source Port
0	500000	900000	0	10.1.70.5	255.255.255.255	21
1	400000	800000	1	10.1.70.2	255.255.255.255	22
2	50000	1000000	2	10.3.80.0	255.255.192.0	23
3	50000	1000000	3	10.3.0.0	255.255.0.0	24
4	0	0	0	0.0.0.0	255.255.255.255	0
5	0	0	0	0.0.0.0	255.255.255.255	0
6	0	0	0	0.0.0.0	255.255.255.255	0
7	0	0	0	0.0.0.0	255.255.255.255	0
8	0	0	0	0.0.0.0	255.255.255.255	0
9	0	0	0	0.0.0.0	255.255.255.255	0
10	0	0	0	0.0.0.0	255.255.255.255	0
11	0	0	0	0.0.0.0	255.255.255.255	0
12	0	0	0	0.0.0.0	255.255.255.255	0
13	0	0	0	0.0.0.0	255.255.255.255	0
14	0	0	0	0.0.0.0	255.255.255.255	0
15	0	0	0	0.0.0.0	255.255.255.255	0
Total	1000000					
Tx data rate	1000000					

As can be seen, QoS Class 0 is guaranteed a bandwidth of 500 000bps. It may be allocated up to 900 000bps, depending on what is allocated to other QoS classes. If no other data is being received then Class 0 will be allocated up to 900 000bps, if needed.

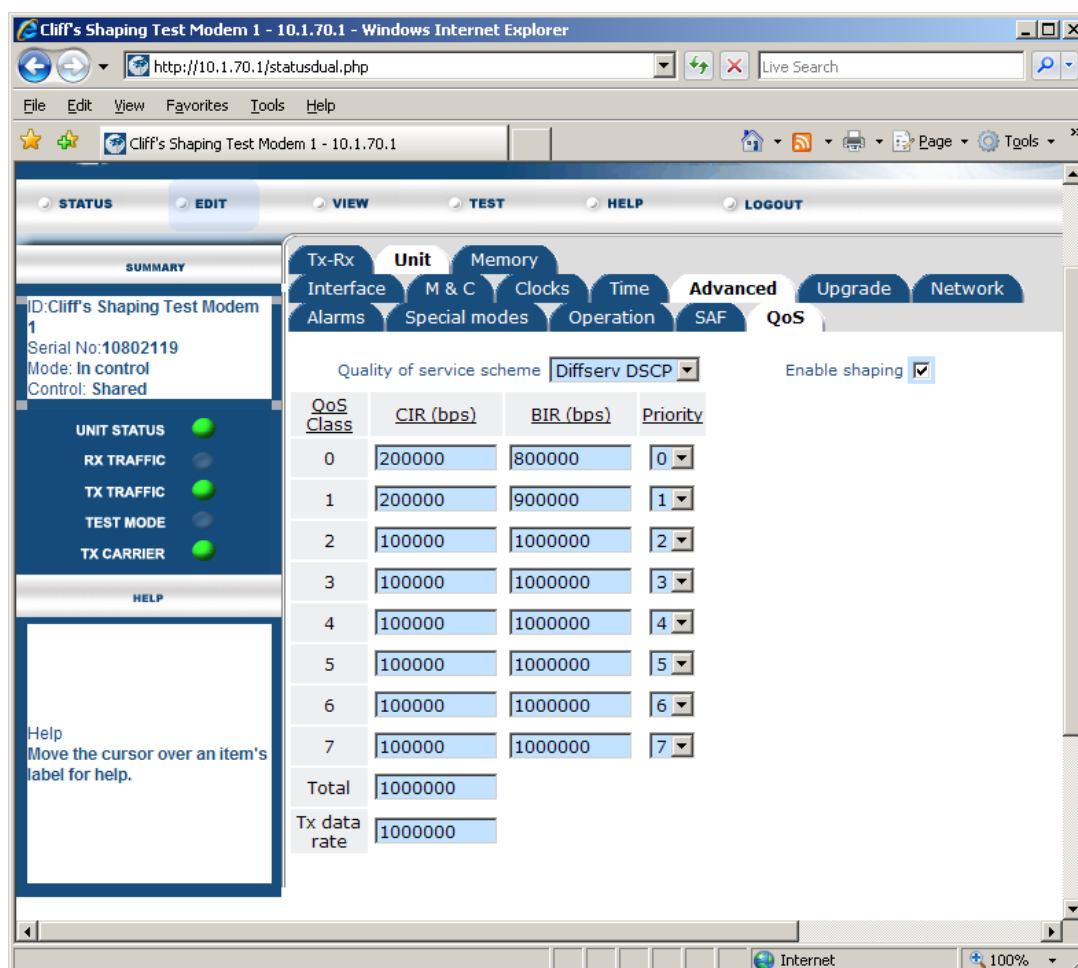
Assume at this point (when Class 0 ideally wants 900 000bps) that the Class 1 data stream is flowing at 350 000bps. Since 350 000bps is less than the CIR of Class 1 then it will get all the bandwidth it needs. Class 0 will get its guaranteed 500 000 bps, but will be allocated only an additional 150 000bps (bringing its total to 650 000bps) because this is all of the spare bandwidth, and is less than the Class 0 BIR value.

In another example, assume Class 2 is being received at 400 000bps and Class 1 at 950 000bps. In this situation the Class 1 data stream will be allocated 800 000bps, its maximum, while Class 2 will be allocated only 200 000bps. The spare bandwidth is allocated to Class 1 first because it has a higher priority. When the BIR of Class 1 is reached, the remaining spare bandwidth will be allocated to Class 2.

1.32.9.4.2 Diffserv DSCP Class

It is possible to classify data streams based on the Differentiated Services Code Point (DSCP) value in the IP packet header. The DSCP class bits are the top three bits of the DS field in an IP header (the other three bits of the field indicate drop precedence, which can be mimicked using the Priority setting for the stream in the modem). 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 modem maps the eight possible DSCP classes directly to eight equivalent internal modem classes (each of which can be allocated its own CIR, BIR, etc.). DSCP Class 0 maps to internal modem QoS Class 0, etc., down to DSCP Class 7 which maps to QoS Class 7. Class 7 has the highest priority.

An example traffic shaping scheme based on DSCP classification is shown below.



1.32.9.4.3 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.

[Note that the modem includes support for IEEE 802.1p (priority tagging) as an alternative QoS scheme to traffic shaping in its own right. In this case the packets must already be tagged at the point of entry to the modem. It is a layer 2 feature that uses 8 classes of data (3-bit field) to prioritise packets. The modem uses the tags to decide which packet to transmit over satellite first when it has more than one packet to send.]

Two modes are supported, namely Strict Priority Queuing and Fair Weighting Queuing:

- *Strict priority queuing: packets are queued for transmission based solely on their priority – highest will always be sent first.*

- *Fair-weighting queuing: higher priority transmitted first but lower priority packets are given a percentage of the bandwidth to stop total starvation.*

The 8 QoS priority levels are mapped to three TCP/IP queues. Packets with highest QoS priority (level 7) are sent to high priority TCP/IP queue. Delay-sensitive packets (QoS levels 6 and 5) are sent to the medium priority queue. The remainder (QoS levels 4 to 0) are sent to the low priority TCP/IP queue. For Strict priority queuing, all packets in high priority queue are processed before any in medium priority queue which in turn are processed before any in the low priority queue. For Fair-weighting queuing, for every 4 packets sent from high priority queue, 2 are sent from medium queue and 1 from low priority queue.]

The following example shows a traffic shaping scheme based on priority tagging.

The screenshot displays the 'Cliff's Shaping Test Modem 1' web interface. The main configuration area is titled 'Quality of service scheme' and shows a table for QoS classes. The 'Enable shaping' checkbox is checked. The table lists 8 classes with their respective CIR (bps), BIR (bps), and Priority values.

QoS Class	CIR (bps)	BIR (bps)	Priority
0	100000	800000	7
1	100000	900000	6
2	100000	1000000	5
3	100000	1000000	4
4	100000	1000000	3
5	100000	1000000	2
6	200000	900000	1
7	200000	800000	0
Total	1000000		
Tx data rate	1000000		

1.32.9.4.4 MPLS EXP

Stream classification may be based on MPLS QoS, specifically the 3-bit EXP field in the MPLS header. This is often used to support Diffserv in MPLS networks. The MPLS EXP field has eight possible values, mapping directly to equivalent internal modem classes (0 to 7) each of which can be shaped using its own CIR, BIR, etc.

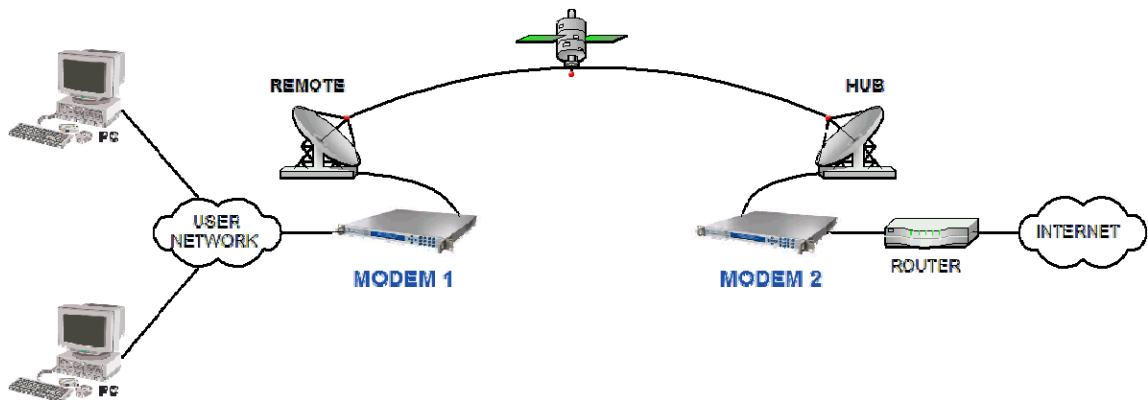
Each packet passed to the modem must have this field set to the appropriate value in order for the modem to recognize the different data streams.

1.32.9.5 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.

1.32.10 HTTP Web Acceleration



HTTP web acceleration speeds up the display of web pages.

Web pages are made up of multiple objects. Each in-line image is a separate object and web browsers typically fetch each in-line object sequentially, one at a time, once the skeleton web page has been received. Some browsers will start a second TCP connection so two objects can be fetched in parallel. A typical web page with several images can take multiple times the satellite delay before it is fully displayed.

By prefetching all in-line objects in advance (in Modem 1 in the picture above), on average there is a 30% reduction in the time taken to display a web page. Note that the modem does not have enough memory to cache web pages – the benefit is due to prefetching only.

The modem requires the IP address of a Domain Name Server (DNS) in order to convert domain name requests into actual IP addresses.

HTTP web acceleration is provided as a free feature with TCP acceleration on the IP Traffic card (it does not run on the base modem due to memory constraints).

1.32.11 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. It can 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.

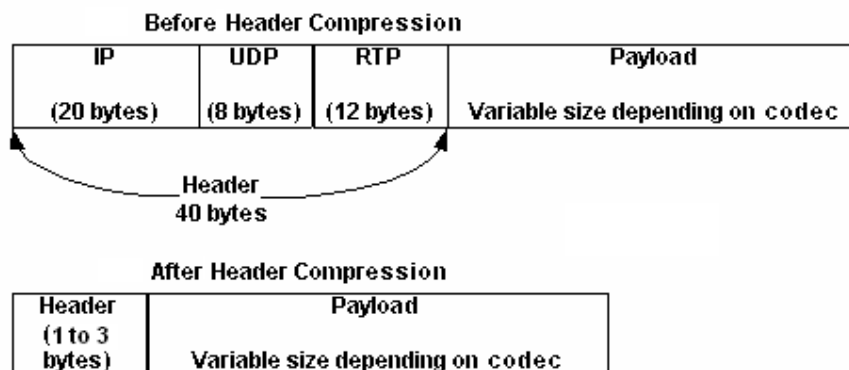
1.32.12 Header Compression

The modem supports RObust Header Compression (ROHC) of:

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

The 40 bytes of IP, UDP and RTP headers are typically compressed to between 1 to 3 bytes. Currently the headers of TCP packets will *not* be compressed.

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 1 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.

1.32.13 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.

Three VLAN modes are supported:

- Transparent VLAN operation in bridging mode

The modem supports IEEE 802.1q VLAN tags. If data is received with these tags then the data, complete with tags, is transported transparently over satellite.

- In point-to-multipoint operation, the modem adds VLAN tags intelligently at the Hub and then filters specific streams at each Remote based on those tags, discarding the VLAN tags prior to outputting the packets.

The VLAN tags are used over just the satellite portion of the link **where there is a return path and VLAN tags are not already present in the data coming into the modems.**

In this mode, each remote modem is assigned a unique VLAN tag by the user (4094 tags are available). The Hub Tx modem automatically learns which tags are being used by each remote. It also learns which devices are connected to each remote. It then adds a VLAN tag to each incoming packet, labelling it with the correct VLAN id for the particular remote it is destined for.

At each remote, all packets are inspected and rejected unless they contain the relevant VLAN tag for that particular remote, thus filtering out unwanted data. The remotes remove the VLAN tags for onward transmission of packets onto the local network at the remote. VLAN tagging by the modem is supported only in point-to-multipoint mode (selected by setting the Ethernet traffic mode to Hub or Remote as appropriate).

- The modem can apply TCP acceleration to a specific VLAN stream.

Select TCP acceleration as normal at the hub and remote modems. Set a VLAN id at the remote modem that represents the data stream to be pulled off. At the hub, set the VLAN id of the VLAN that you want to accelerate (note this is the full 16-bit VLAN field value from the IEEE 802.1q header, not just the 12-bit VLAN id portion). The IP traffic addresses of the modems must be on the same subnet as the selected VLAN. Only packets coming in that have a matching 16-bit VLAN field will be accelerated.

1.32.14 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.

ACM can be used in both directions at the same time, maximising throughput for outbound and return. Deployed links have reported throughput gains of up to 100%.

ACM works in conjunction with DVB-S2 (although the return channel does not have to be DVB-S2 unless ACM operation is required for both outbound and inbound carriers).

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.

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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 1/4 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-

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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.)

Note that ACM works to the full symbol rate of the modem.

ACM menu on/off options are accessible once DVB-S2 is selected as the Tx or Rx service (see the *Edit-Tx-Service* and the *Edit-Rx-Service* screens). ACM status can be viewed by selecting the *Down* arrow when the *Status-Traffic* screen is displayed (see the *Status-Traffic* screen for more details).

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.

1.33 DVB-S2 and SmartLink

The Quantum modem supports SCPC, DVB-S2 and combined SCPC/DVB-S2 operation.

The DVB-S2 standard was approved by ETSI (European Telecommunications Standards Institute) in November of 2006. The new standard incorporates the latest technology in order to provide greater spectral efficiency and improved stability, using high-order modulation schemes and more powerful FEC coding.

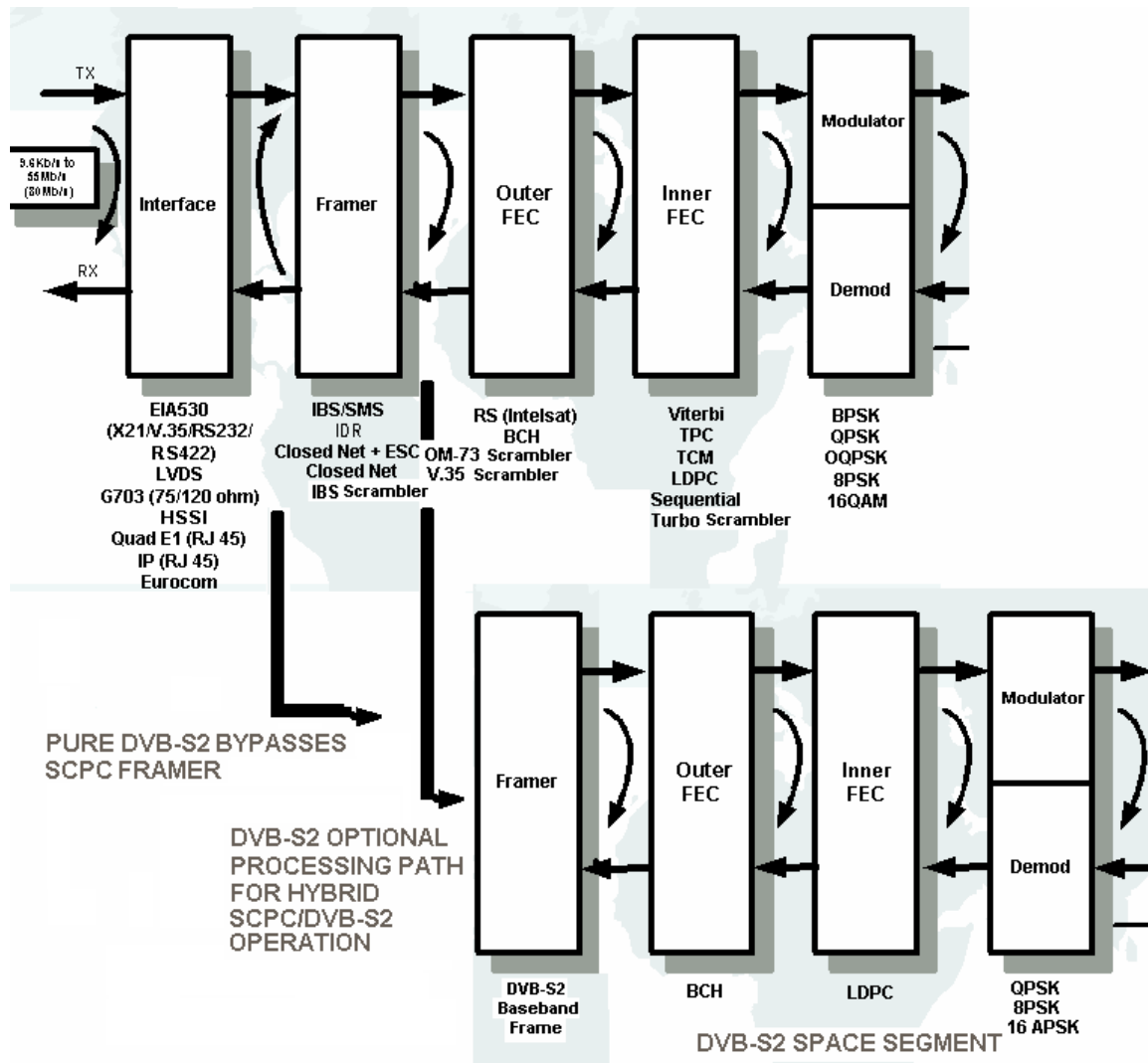
It is a common misconception that DVB-S2 is a standard for the broadcast of video but this is incorrect as the standard is essentially data agnostic. DVB-S2 allows for *both* continuous data streams (such as those provided by G.703, HSSI and EIA530 interfaces) and packetised data (such as IP and MPEG video). The space segment savings of DVB-S2 can therefore be obtained equally on a wide range of satellite links ranging from traditional low-rate SCPC links to high rate broadcast video and IP. Initial DVB-S2 satellite modem products in the industry reflected the high pioneering costs of the technology and were aimed at high-end broadcast video and IP markets. Paradise Datacom is proud to bring this technology to a much wider market in the form of the cost-competitive Quantum modem, which provides backwards compatibility for legacy SCPC links and a painless migration path to newer bandwidth-saving technology.

The Quantum allows:

- DVB-S2 outbound with an SCPC return or an SCPC outbound with a DVB-S2 return.
- DVB-S2 outbound and return.
- SCPC outbound and return.
- *SmartLink* mode where SCPC features are combined with DVB-S2 space segment savings. All traditional SCPC features such as IBS, IDR, Drop and Insert, ESC, AUPC, etc. are supported.

DVB-S2 does not directly support any of these SCPC features and therefore *SmartLink* was developed to allow existing SCPC services to benefit immediately by switching to the newer highly-efficient DVB-S2 technology without compromising the services being provided.

SCPC, DVB-S2 and *SmartLink* processing paths through the modem are shown in the diagram overleaf. The top path (Interface-Framer-Outer FEC-Inner FEC-Modulator/Demodulator) shows the path used in SCPC processing and the functionality that is associated with each of these blocks. The lower path (Interface-SCPC Framer-DVB-S2 Framer-Outer FEC-Inner FEC-Modulator/Demodulator) shows the path used in DVB-S2 and *SmartLink* processing. Note that 'pure' DVB-S2 bypasses the SCPC framer and uses the DVB-S2 framer only. *SmartLink* takes the output of the SCPC framer (which includes the output from Drop and Insert, the ESC channel, etc.) and overlays this with DVB-S2 framing. Even although this can involve two lots of framing (depending on whether SCPC Closed Network mode is selected) the increased overhead is more than offset by the savings of switching to DVB-S2 space segment. The diagram shows which features can be mixed in *SmartLink* mode and which cannot – for example, 16QAM appears on the SCPC processing path only and is therefore not available when *SmartLink* is operational.



Processing Paths through Modem (Top Path is SCPC; Lower Path is DVB-S2/SmartLink)

If DVB-S2 is required but no SCPC features are required then as well as selecting *SmartLink*, the Tx or Rx service should be set to *Closed network* as this does not add any extra framing to that provided by DVB-S2.

DVB-S2 is provided as a Tx/Rx service option whereas *SmartLink* is provided as an SCPC FEC option once an SCPC service has been selected. Currently the only terrestrial interface that is interoperable with other vendors' equipment when running a pure DVB-S2 service is the IP interface. IP is supported on the base modem when in SCPC and *SmartLink* modes but requires the P3714 IP Traffic card option when using a DVB-S2 service.

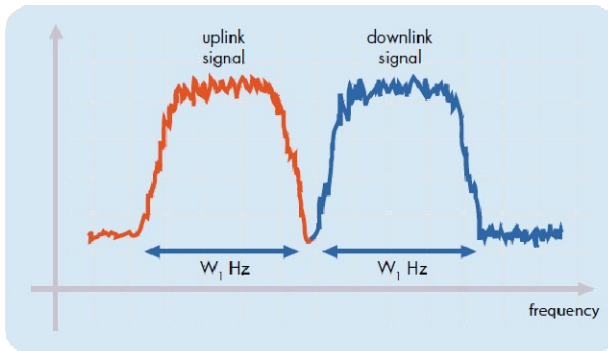


If a DVB-S2-only service is required for an interface other than IP then the Closed Network service should be selected, along with the SmartLink FEC option. This will provide a DVB-S2 service with no additional SCPC framing overhead. DVB-S2 with IP is supported directly from the Tx and Rx service menu options.

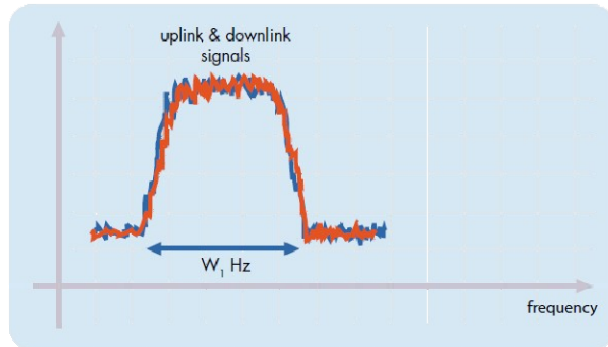
Once DVB-S2 or *SmartLink* has been enabled, various other configuration menu options become available, including choice of modulation and FEC rate, as well as DVB-S2 FEC frame size choice and DVB-S2 pilots. DVB-S2 pilots introduce a regular burst of unmodulated carrier that helps the demodulator lock onto the signal in poor signal-to-noise conditions at a cost of increased overheads of around 2.4%.

1.34 Paired Carrier

Paired Carrier can be used to reduce satellite bandwidth requirements by up to 50% by overlapping transmit and receive carriers in the same space segment. It uses ViaSat's patented PCMA technology. Adaptive self-interference cancellation is used to subtract the unit's transmitted signal from the composite received signal, leaving just the desired signal. This is depicted in the diagrams below.



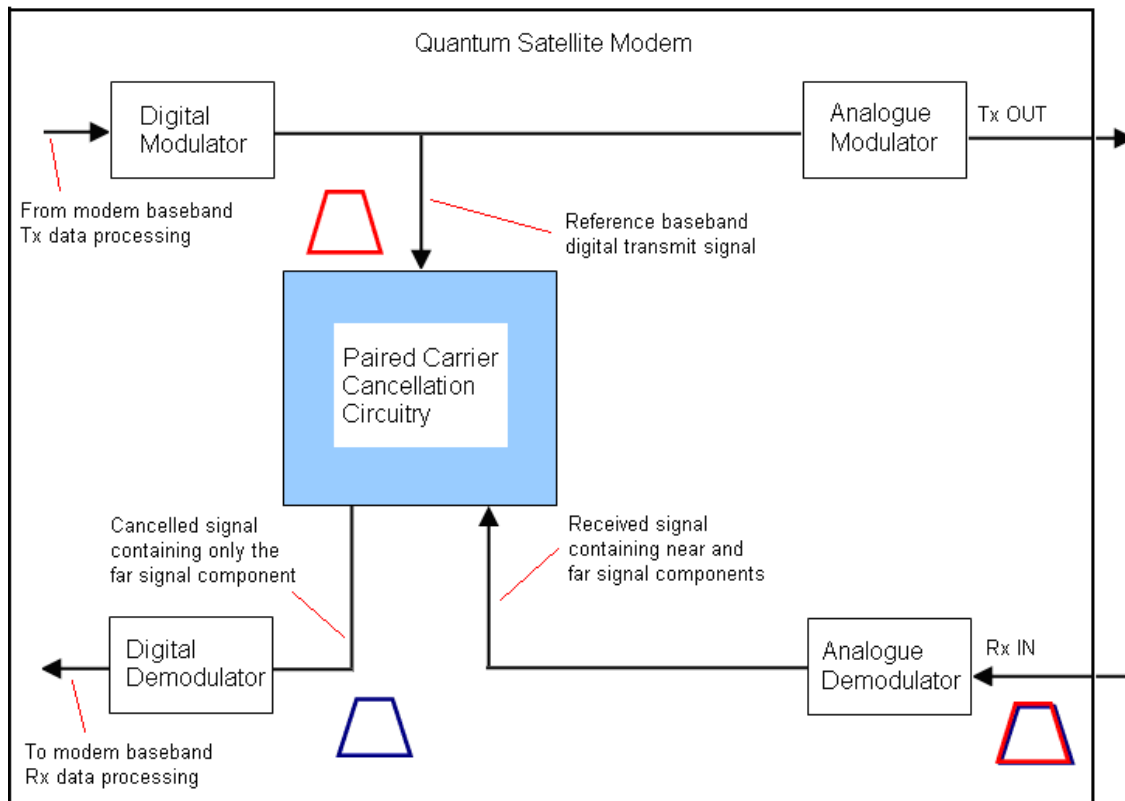
Typical satellite transmission with separate frequency slots for uplink and downlink.



Using *Paired Carrier*, uplink and downlink carriers overlaid, can save 50% on space segment.

Frequency Re-use by Overlaying Carriers

The *Paired Carrier* processing in the modem to cancel the unwanted signal in the composite received signal to be left with only the desired signal is shown in the diagram overleaf. The signal cancellation algorithm estimates and compensates for gain, frequency, phase and delay in matching the unwanted component of the composite Rx signal with a delay buffered version of its own transmission.



Quantum Modem Paired Carrier Processing

Paired Carrier can be added to existing systems as well as being incorporated into the design of new systems. The signal cancellation techniques used guarantees at least 25dB (typically 30dB) cancellation of the unwanted signal meaning that the uplink and downlink signals can share the same space segment. By doubling satellite throughput in terms of spectral efficiency (bits/s/Hz) *Paired Carrier* can be used to cut operational expenses and/or free up satellite bandwidth for new applications and services. The savings can be used to reduce bandwidth or increase throughput or convert to a higher coding gain to decrease power.

Both symmetric and asymmetric point-to-point links are supported. Symmetric links typically have similar antenna sizes and use similar power levels at each end of the link whereas asymmetric links will typically use a larger antenna at one end of the link and a smaller antenna at the other end, with dissimilar power levels. In the asymmetric case, the system can be designed to require signal cancellation at only one end of the link, with the unwanted signal at the other end being reduced to a level comparable with system noise.

Paired Carrier is designed for use in point-to-point links. For point-to-multipoint operation, the Paradise PCMA-70 Satellite Bandwidth Extender can be used to overlay several smaller carriers on top of a larger carrier. It then cancels the larger unwanted carrier before feeding the output to the individual demodulators responsible for processing each of the smaller carriers. The PCMA-70 works with any network topology and any type of modem technology (so long as the outbound is an SCPC carrier) including star topology (hub/spoke, one-to-many), FDMA mesh (single satellite hop, many-to-many), hybrid star

mesh, Single Channel Per Carrier (SCPC) and Demand Assigned Multiple Access (DAMA) voice and data networks.

Paired Carrier helps in the case of bandwidth-limited links. However, if a link is instead power limited then its design can be changed to turn it into a bandwidth-limited link and then *Paired Carrier* can be used to improve the bandwidth utilisation.

It should be noted that *Paired Carrier* operation is waveform agnostic and will work with *all* modulation and FEC schemes. It is used in addition to, not instead of, other bandwidth saving techniques. *Paired Carrier* and DVB-S2 represent the two most bandwidth-efficient technologies available today and can uniquely be used together in the Quantum modem.

Some frequently asked questions about *Paired Carrier* operation along with answers are provided below.

Q. Does *Paired Carrier* require a particular modulation or FEC configuration?

A. No, *Paired Carrier* imposes no special parameter limitations on the carriers involved. However, sometimes it is advantageous to use the bandwidth savings to switch to a more robust modulation and coding scheme - but this is application dependent.

Q. Can *Paired Carrier* handle multiple transmit and receive carriers?

A. No, the separate Paradise PCMA-70 Satellite Bandwidth Extender should be used if you require to cancel multiple carriers appearing within the cancellation bandwidth.

Q. Can *Paired Carrier* handle asymmetric carriers, that is, carriers with different data rates and/or different symbol rates on transmit and receive?

A. Yes, the *Paired Carrier* can handle asymmetric carriers. The transmit and receive parameters are totally independent.

Q. My transmit and receive carrier levels off satellite are different, can I still use the *Paired Carrier* satellite signal canceller?

A. Yes, the wanted and unwanted signals off satellite can be of different levels, however, the wanted and unwanted signal levels (power spectral density) should normally be within 10dB of each other. Symbol rate asymmetry of up to 12:1 is supported. It is sometimes possible to relax these conditions subject to the constraints of an overall detailed link budget analysis. Power asymmetry must be kept between +10 to -10dB using the equation

$$\text{Power ratio (dB)} = \text{Near PSD} - \text{Far PSD} + 10\log(\text{Near symbol rate}/\text{Far symbol rate})$$

Q. Does the modem redundancy configuration affect *Paired Carrier* operation?

A. No, *Paired Carrier* works equally as well in 1:1 and 1:n modem redundancy systems. The standby modem will have to go through the normal acquisition process when it comes on traffic. While it is in standby, it is not possible for the demodulator to lock (it cannot cancel the unwanted carrier since in principle it can only cancel its own transmission). Paradise has therefore muted various spurious alarms that would otherwise be reported for the standby modem in this situation.

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Q. Can I remotely control the *Paired Carrier* function?

A. Yes, *Paired Carrier* can be controlled remotely in the same way as any other modem function via RS232, RS485, web browser or SNMP.

Q. Can I add *Paired Carrier* into an existing network?

A. Yes, bandwidth savings can be made with existing networks, but a link budget analysis must be made to assess the suitability and benefits.

Q. Surely there is some disadvantage in using *Paired Carrier*?

A. *Paired Carrier* has a minimal impact on Eb/No for a desired BER but typically between 0.15dB and 0.5dB extra carrier power is required to be transmitted on satellite to overcome the imperfections in the signal cancellation process. Also, of course, power is needed for the second carrier.

Q. What prerequisites exist for using *Paired Carrier*?

A. It requires a full-duplex link where you must be able to receive your own uplink signal off satellite. It works only with 'bent-pipe' transponders where there is no demodulation/remodulation or cross-strapping between transponders. The transponder must do no more than filter, frequency convert and amplify the signal.

Q. Is it difficult and time consuming to install and set up *Paired Carrier*?

A. No. The operator sets the satellite delay or alternatively the modem and satellite positions to allow the satellite signal to be acquired. A few other parameters specific to *Paired Carrier* need to be set up. Set up takes less than 5 minutes in total.

Q. Is *Paired Carrier* available as a field upgrade?

A. Yes. All Quantum modems can be field upgraded to support *Paired Carrier* operation to the desired cancellation bandwidth.

1.35 Sat-ABIS

Sat-ABIS is an embedded optimiser in the modem for GSM Abis traffic.

It is used in symmetric point-to-point links for cellular backhaul, saving up to 50% bandwidth. It combines and optimises Abis traffic on four T1/E1 interfaces (using either CRC4, FAS, ESF or D4 framing) into a single carrier and supports up to 256 Abis voice channels.

Compressed data is converted to HDLC-framed packets for transmission over satellite. Sat-ABIS interoperates with GSM equipment from major manufacturers including Alcatel, Nokia, Ericsson, Siemens and Motorola. The modems with Sat-ABIS sit between the BTS and BSC.

Sat-ABIS supports 1:1 redundancy with no external hardware. Four Ethernet ports for future growth.

In relation to compression, Sat-ABIS:

- Removes silence (idle speech) frames.
- Removes idle data frames (channels not assigned to calls).
- Performs (LAPD) signalling optimization, including compression of repetitive data patterns such as idle flags between HDLC control messages on signal channels.

'Drop and Insert' of timeslots is provided, thereby supporting fractional T1/E1 links.

Abis implementations vary with manufacturer and therefore the modem allows each timeslot (and 16kbps portions of timeslots) – see picture overleaf - to be allocated to either voice or signalling, thereby allowing the correct compression techniques to be applied to each portion of the data.

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Paradise Evolution modem1 ...

http://10.0.200.103/statusdual.php?TB=1

Free Hotmail Suggested Sites Web Slice Gallery Telegraph.co.uk: new... Modem configurator door entry The Independent Other bookmarks

PARADISE DATACOM
EVOLUTION SERIES

STATUS EDIT VIEW TEST HELP LOGOUT Local

SUMMARY

ID: Paradise Evolution modem
Serial No: 10601267
Mode: In control
Control: Shared

UNIT STATUS
RX TRAFFIC
TX TRAFFIC
TEST MODE
TX CARRIER

HELP
Move the cursor over an item's label for help.

Sat Abis

ABIS link mode: Uplink Dropped TRAU alarm threshold: 9999

Port 1

Port 1 voice mode: Channel Port 1 voice slots: 1-4
Port 1 signal mode: Slot Port 1 signal slots: 1-5

Port 2

Port 2 voice mode: Off Port 2 Voice slots: 1-4
Port 2 signal mode: Off Port 2 signal slots: 1-5

Port 3

Port 3 voice mode: Off Port 3 voice slots:
Port 3 signal mode: Off Port 3 signal slots:

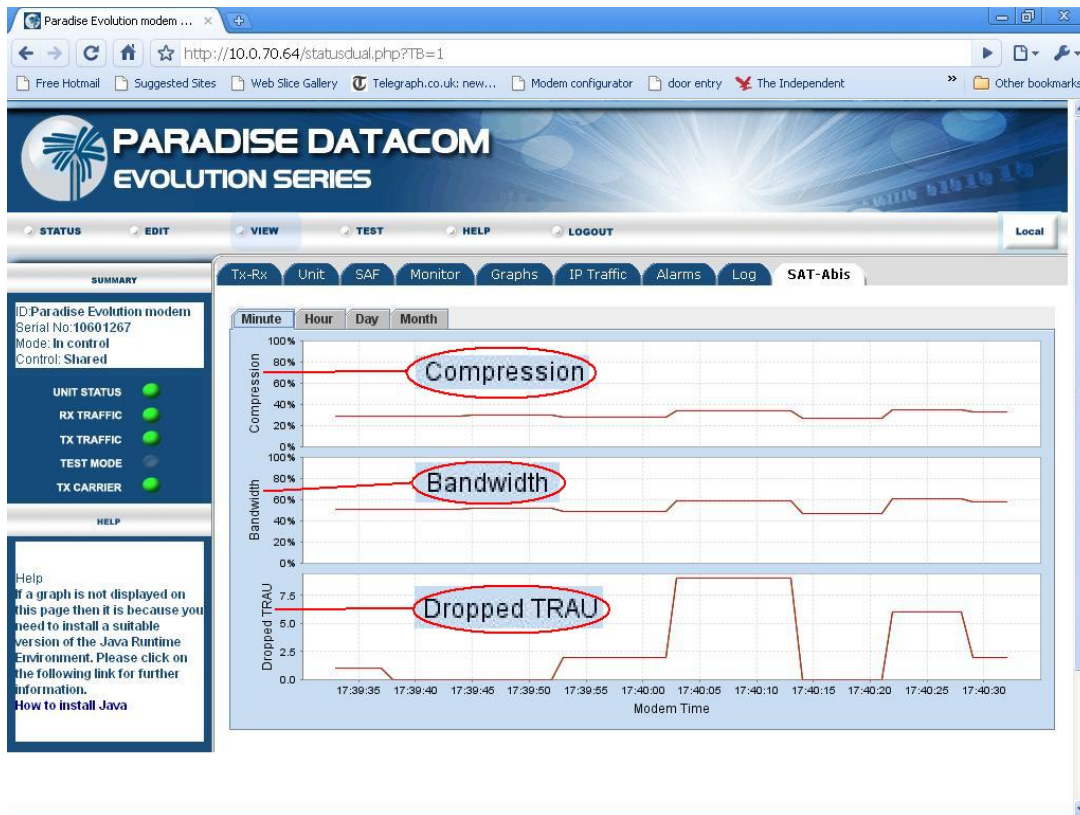
Port 4

Port 4 voice mode: Off Port 4 voice slots:
Port 4 signal mode: Off Port 4 signal slots:

Sat-ABIS Web Configuration Screen

Diagnostics in the form of the achieved compression ratio, percentage of the available satellite bandwidth being used and the dropped TRAU count are available for Sat-ABIS as shown overleaf.

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Sat-ABIS Web Diagnostics

The compressed data is passed over satellite formatted as HDLC packets that run asynchronously to the T1/E1 interfaces. However, the hub clock input to Sat-ABIS is extended over satellite and used to synchronise the remote to the hub. The hub clock is used as a clock generator for HDLC-framed data and the remote modem derives its clock from the satellite signal and generates a 2.048 MHz bearer to the BTS. The bearer is looped by the BTS back into the remote for synchronised communications back to the hub.

As well as saving up to 50% bandwidth, Sat-ABIS as an embedded solution reduces box count.

Sat-ABIS is compatible with FastLink low-latency LDPC to minimise delay and it is also compatible with *Paired Carrier* for even greater bandwidth savings.

1.36 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 $\frac{3}{4}$ 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 $\frac{3}{4}$ 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 $\frac{1}{2}$ 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.

If one FEC is to be used in place of all others then Paradise believes you should choose one with flexible configuration as opposed to a fixed set of modulation and code rates that are inevitably a compromise.

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

FastLink performance (a full set of BER graphs and latencies) is defined in a separate datasheet available from the Paradise Datacom web site at <http://www.paradisedata.com>.

FastLink performance is summarized in the table shown over the page.

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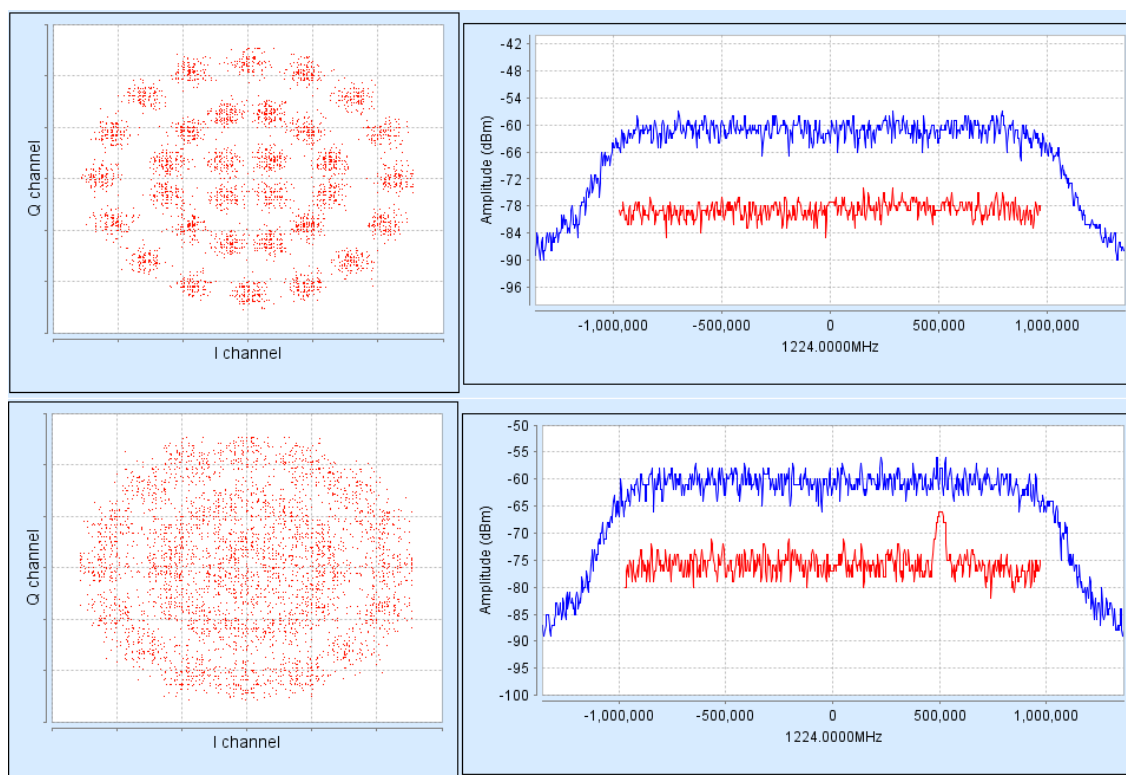
FastLink	Code Rate	Eb/No for 5e-8 (Guaranteed)			Latency (ms) at 64kbps		
Modulation		Low BER	Balanced	Low Latency	Low BER	Balanced	Low Latency
BPSK	0.499	2.1	2.9	3.4	514	34	18
(O)QPSK	0.532	2.2	2.6	2.9	516	67	35
(O)QPSK	0.639	2.4	2.8	3.2	516	67	35
(O)QPSK	0.710	2.7	3.3	3.7	516	67	35
(O)QPSK	0.798	3.3	3.9	4.4	516	67	35
8PSK	0.639	See Note 1			517	133	69
8PSK	0.710	Note 2	5.5	5.9	517	133	69
8PSK	0.778	5.7	6.1	6.6	517	133	69
8QAM	0.639	4.5	4.8	5.1	517	133	70
8QAM	0.710	5	5.4	5.7	517	133	70
8QAM	0.778	5.6	5.9	6.3	517	133	70
16APSK	0.726	See Note 3			520	134	73
16APSK	0.778	See Note 3			520	134	73
16APSK	0.828	7.7	8.2	8.5	520	134	73
16APSK	0.851	8	8.5	8.9	520	134	73
16QAM	0.726	Note 4	7.5	7.7	519	136	70
16QAM	0.778	7	7.6	7.9	519	136	70
16QAM	0.828	7.5	8.0	8.2	519	137	71
16QAM	0.851	7.8	8.2	8.6	519	137	72
32APSK	0.778	9.4	9.9	10.3	520	137	71
32APSK	0.828	10.1	10.7	11.2	520	137	71
32APSK	0.886	11.1	11.6	12.2	520	137	72
32APSK	0.938	12.9	13.5	14.3	520	137	72

FastLink Low-latency LDPC Performance Summary

1.37 LinkGuard™ Interference Detection

LinkGuard™ is a Paradise patent-pending 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.

The example screenshots below 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.



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

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interfering carriers. If there is more than one source of interference then it will detect and display all of them.

If Paradise's Paired Carrier is being used (where two carriers are deliberately superimposed on top of each other) then LinkGuard™ is capable of detecting and displaying any interference under both of the carriers.

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 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 (other than DVB-S2, which will be supported in the future) and is available as standard in all new Paradise Quantum and Evolution modems.

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 Quantum and Evolution Series Satellite Modems*') 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 Quantum and Evolution Series Satellite Modems*'. 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 Quantum and Evolution Series Satellite Modems*'.

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
```


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- 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 LVDS, EIA530 (RS422, V.35, and RS232), IDR, HSSI, G.703 (balanced and unbalanced), Quad E1, IP traffic and Eurocom D1 interfaces. The three data interface positions on the modem are designated Position 1 (upper) and Position 2 (lower) and Position 3. Position 1 can accommodate an EIA 530 panel or the IDR card. Position 2 can accommodate any of the interface cards other than IDR or G.703 (unbalanced). Position 3 accommodates balanced G.703 only.

The P3702 G703 option card supports E1/T1/E2/T2/E3/T3 data rates. The card is fitted directly on to the main board. The balanced G.703 interface is available on the EIA530 connector, if fitted. The unbalanced interface uses co-axial cables to the dedicated G703 BNC connectors in interface Position 3.

The P3701 IDR option is fitted directly to the main PCB, but the connector occupies the upper interface position (1).

It is possible to fit alternative interfaces from the Paradise P37xx range in the modem. A P3051 Link PCB may be required to connect to other interface cards.

1:1 Operation

The standard modem interfaces do not require hardware changes for 1:1 redundancy operation.

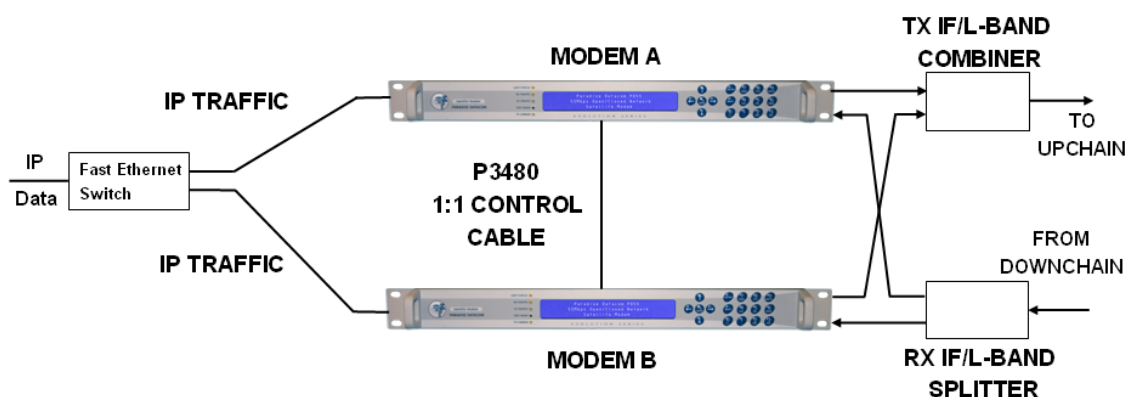
However, the G.703 option interface needs to be configured by the front panel for 1:1 mode (Normal or 1:1). The 1:1 G.703 mode control selects what happens when power is removed. If the power is lost in *Normal* mode the G.703 input and output are joined so that if in Drop/Insert operation the G.703 signal is looped through multiple equipments, the other traffic is not affected by a break in the G.703 line. If the power is lost in *1:1* mode the G.703 output goes high impedance if power is lost, allowing its 1:1 partner to carry the traffic.

'Y' cables are normally used with the terrestrial interfaces. The IP interface requires separate but parallel connections to the network, using cross-over IP cables. If using an IP traffic interface card then either cable type will suffice as the card is autosensing

If the Modems M&C ports are removed from the Ethernet Bridge then connect the IP data cables to the IP traffic port. If using an IP traffic interface card connect the IP cables to either port on the interface card. Please note: The 1:1 controller cable must be of type P3480

Please see the diagram over the page.

IP 1:1 Modem Redundancy Connection Schematic



Handshake Lines

Many interfaces provide optional control lines (such as RTS/CTS etc). It is generally better to implement these between equipments if possible.

Q3001 in LVDS Mode

If the LVDS interface is fitted and is selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

Min Req	Signal Description	LVDS Name	Circuit Number	25 pin		Electrical Levels
				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)						
✓	Clock In	TT	113	24	11	LVDS
✓	Data In	SD	103	2	14	LVDS
	Sig ' Valid In	RS	105	4	19	LVDS
	Sig Acpt ' d Out	CS	106	5	13	LVDS
	Int ' Tx Clock Out	ST	114	15	12	LVDS
DATA CIRCUIT FROM MODEM (RX)						
✓	Clock Out	RT	115	17	9	LVDS
✓	Data Out	RD	104	3	16	LVDS
	Sig ' Valid Out	RR	109	8	10	LVDS
COMMON LINES						
✓	Signal Ground	SG	102	7		Ground
✓	Shield/Protective ground	PG	101	1		Screen

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Min Req	Signal Description	LVDS Name	Circuit Number	25 pin		Electrical Levels
	Device (DTE) Ready In	TR	108	20	23	LVDS
	Device (DCE) Ready Out	DM	107	6	22	LVDS
	Local Loop In	LL	141	18		LVDS
	Remote Loop In	RL	140	21		LVDS

The modem can operate at high data rates using the LVDS interface, but the maximum useable data rate is limited by connecting cable length. The maximum data rate is 10Mbps over a 10m cable (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (.e. 5Mbps to 20m, 2.5Mbps to 40m etc). Similarly, the maximum data rate increases as the connecting cable length is reduced (i.e. 20Mbps to 5m, 40Mbps to 2.5m).

The input clock/data phase is selected automatically, reporting a 'Data Marginal' warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the 'Data In' signal is checked against the 'Clock In' signal. With the Tx Clocking Set to *Internal* or *Rx* the 'Data In' signal is checked against the 'Int' Tx Clk Out' signal.

By selecting *Advanced* it is possible to configure the modem to raise an alarm if either the 'Sig' Valid In' line (RS) or 'Device (DTE) Ready In' line (TR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the 'Sig' Valid In' line (RS) by selecting *Edit, Tx, Carrier, RTS enabled*.

Q3705 in HSSI Mode

If the HSSI interface is fitted and is selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

Min Req	Signal Description	HSSI Name	50 pin		Electrical Levels
			+	-	
DATA CIRCUIT TOWARDS MODEM (TX)					
✓	Clock In	TT	9	34	ECL
✓	Data In	SD	11	36	ECL
✓	Signal Ground	SG	7	32	Ground
✓	DTE Available	TA	8	33	ECL
	Int' Tx Clock Out	ST	6	31	ECL
DATA CIRCUIT FROM MODEM (RX)					

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Min Req	Signal Description	HSSI Name	50 pin		Electrical Levels
✓	Clock Out	RT	2	27	ECL
✓	Data Out	RD	4	29	ECL
✓	Signal Ground	SG	1	26	Ground
✓	DCE Available	CA	3	28	ECL
COMMON LINES					
✓	Signal Ground	SG	13	38	Ground
✓	Signal Ground	SG	19	44	Ground
	Loopback Circuit A	LA	10	35	ECL
	Loopback Circuit B	LB	12	37	ECL
	Loopback Circuit C	LC	5	30	ECL

The modem can operate at high data rates using the HSSI interface, but the maximum useable data rate is limited by the connecting cable length. The maximum data rate is 10Mbps over a 10m cable (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (e.g. 5Mbps to 20m, 2.5Mbps to 40m, etc). Similarly, the maximum data rate increases as the connecting cable length is reduced (i.e. 20Mbps to 5m, 40Mbps to 2.5m).

The input clock/data phase is selected automatically, reporting a *Data Marginal* warning whenever it has to switch phase. If the modem reports *Data Marginal* frequently then this is not a modem fault but an indication that there is a clocking problem external to the modem (i.e. changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the *Data In* signal is checked against the *Clock In* signal. With the Tx Clocking Set to *Internal* or *Rx* the *Data In* signal is checked against the *Int` Tx Clk Out* signal.

All signals are balanced, differentially driven and received at standard ECL levels. The loopbacks LA and LB provided are direct supersets of the EIA signals LL (Local Loopback) and RL (Remote Loopback) Loopback LC is an optional request signal from DCE to DTE, to request that the DTE provides a loopback path to the DCE.

By selecting *Advanced* it is possible to configure the modem to raise an alarm if either the *Sig` Valid In* line (RS) or *Device (DTE) Ready In* line (TR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the *Sig= Valid In* line (RS) by selecting *Edit, Tx, Carrier, RTS enabled*.

Please note: Although the HSSI cable uses the same connector as the SCSI-2 specification, the cable impedances of HSSI and SCSI-2 cables are different. SCSI-2 cables can be as low as 70 Ohms, whereas HSSI cables are specified at 110 Ohms. As a result, cables made to SCSI-2 specifications may not work correctly with HSSI. Incompatibilities will be more apparent with longer cable lengths.

EIA530 in RS422 Mode

If the EIA 530 interface is fitted and RS422 signals are selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

Min Req	Signal Description	RS422 Name	Circuit Number	25 pin		Electrical Levels
				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)						
✓	Clock In	TT	113	24	11	RS422
✓	Data In	SD	103	2	14	RS422
	Sig ' Valid In	RS	105	4	19	RS422
	Sig Acpt ' d Out	CS	106	5	13	RS422
	Int ' Tx Clock Out	ST	114	15	12	RS422
DATA CIRCUIT FROM MODEM (RX)						
✓	Clock Out	RT	115	17	9	RS422
✓	Data Out	RD	104	3	16	RS422
	Sig ' Valid Out	RR	109	8	10	RS422
COMMON LINES						
✓	Signal Ground	SG	102	7		Ground
✓	Shield/Protective ground	PG	101	1		Screen
	Device (DTE) Ready In	TR	108	20	23	RS422
	Device (DCE) Ready Out	DM	107	6	22	RS422
	Local Loop In	LL	141	18		RS232
	Remote Loop In	RL	140	21		RS232

The maximum data rate is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The input clock/data phase is selected automatically, reporting a `Data Marginal` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (i.e. changing clock/data phase, a problem which would otherwise cause untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the `Data In` signal is checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `Int= Tx Clk Out` signal.

By selecting *Advanced* it is possible to configure the modem to raise an alarm if either the `Sig= Valid In` line (RS) or `Device (DTE) Ready In` line (TR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig= Valid In` line (RS) by selecting *Change, Tx, Modulator, Carrier, RTS-Controlled*.

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EIA530 in V.35 Mode

If the EIA 530 connector is fitted and V.35 signals are selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

Min Req	Signal Description	V.35 Name	Circuit Number	25 pin		Electrical Levels	Old Style Winchester
				A	B		
DATA CIRCUIT TOWARDS MODEM (TX)							
✓	Clock In	SCTE	113	24	11	V.35	U & W
✓	Data In	SD	103	2	14	V.35	P & S
	Sig ' Valid In	RTS	105	4		RS232	C
	Sig Acpt'd Out	CTS	106	5		RS232	D
	Int' Tx Clock Out	SCT	114	15	12	V.35	Y & aa
DATA CIRCUIT FROM MODEM (RX)							
✓	Clock Out	SCR	115	17	9	V.35	V & X
✓	Data Out	RD	104	3	16	V.35	R & T
	Sig ' Valid Out	RLSD	109	8		RS232	F
COMMON LINES							
✓	Signal Ground	SG	102	7		Ground	B
✓	Shield/Protective ground	FG	101	1		Screen	A
	Device (DTE) Ready In	DTR	108	20		RS232	H
	Device (DCE) Ready Out	DSR	107	6		RS232	E
	Local Loop In	LL	141	18		RS232	-
	Remote Loop In	RL	140	21		RS232	-

The maximum data rate is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc.).

The input clock/data phase is selected automatically, reporting a 'Data Marginal' warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the 'Data In' signal is

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checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `Int= Tx Clk Out` signal.

If you require the older 34-pin `Winchester` connector then an adaptor lead is required - please contact the factory for details.

By selecting *Advanced* it is possible to configure the modem to raise an alarm if either the `Sig= Valid In` line (RTS) or `Device (DTE) Ready In` line (DTR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig= Valid In` line (RTS) by selecting *Edit, Tx, Carrier, RTS enabled*. **EIA530 in RS232 Mode**

If the EIA 530 connector is fitted and RS232 signals are selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies. The interface type can be selected as *Synchronous* or *Asynchronous*.

Min Req	Signal Description	RS232 Name	Circuit Number	25 pin		Electrical Levels
				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)						
✓	Clock In	DA	113	24	RS232	
✓	Data In	BA	103	2	RS232	
	Sig ' Valid In	CA	105	4	RS232	
	Sig Acpt' d Out	CB	106	5	RS232	
	Int' Tx Clock Out	DB	114	15	RS232	
DATA CIRCUIT FROM MODEM (RX)						
✓	Clock Out	DD	115	17	RS232	
✓	Data Out	BB	104	3	RS232	
	Sig ' Valid Out	CF	109	8	RS232	
COMMON LINES						
✓	Signal Ground	AB	102	7	Ground	
✓	Shield/Protective ground	SHIELD	101	1	Screen	
	Device (DTE) Ready In	CD	108	20	RS232	
	Device (DCE) Ready Out	CC	107	6	RS232	
	Local Loop In	LL	141	18	RS232	
	Remote Loop In	RL	140	21	RS232	

The maximum synchronous data rate is 100kbps (over good quality screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 50kbps to 20m, 25kbps to 40m etc). Note that this is a synchronous RS232 interface - if you need an asynchronous interface then please contact the factory.

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For the Synchronous RS232 interface the input clock/data phase is selected automatically, reporting a `Data Marginal` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the `Data In` signal is checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `Int= Tx Clk Out` signal. By selecting *Advanced* it is possible to configure the modem to raise an alarm if either the `Sig= Valid In` line (CA) or `Device (DTE) Ready In` line (CD) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig= Valid In` line (CA) by selecting *Change, Tx, Modulator, Carrier, RTS-Controlled*.

For Asynchronous RS232 interface the Tx / Rx AIS detectors and the data marginal detectors are automatically disabled to prevent any unwanted alarms. The internal Tx clock output is also automatically used to provide a reference clock to the incoming Async data. For best operation, Paradise recommends using the Async RS232 interface at least 10 times oversampled. For example, an Async baud rate of 56.7kbaud requires a Modem bit rate of 512kbit.

P3702 in G.703 Mode

If the G.703 option is fitted to the modem, together with either the EIA 530 connector or BNC connector panel, then G.703 becomes a front panel / software selectable interface. If G.703 is selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

When G703 interface is selected, the *Advanced* menu allows the mode to be selected.

The G703 interface panel supports E1, T1, E2, T2, E3 and T3 data rates at the following line coding, impedance, traffic bit rates and physical interfaces.

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Rate	Bit rate	Line code	Impedance	Interface
T1	1544kbps	AMI	100 ohm	EIA530
T1	1544kbps	B8ZS	100 ohm	EIA530
E1	2048kbps	HDB3	120 ohm	EIA530
E1	2048kbps	HDB3	75 ohm	BNC
T2	6312kbps	B6ZS	110 ohm	EIA530
T2	6312kbps	B8ZS	75 ohm	BNC
E2	8448kbps	HDB3	75 ohm	BNC
E3	34.368Mbps	HDB3	75 ohm	BNC
T3	44.736Mbps	B3ZS	75 ohm	BNC

You can select either balanced 75Ω G.703 (on the BNC connectors) or unbalanced 100/110/120Ω G.703 (on the EIA 530 connector) depending upon interface connectors available. If the impedance is set for 100/110/120Ω, then the following pinout applies.

Min Req	Signal Description	25 pin		Electrical Levels
		A	B	
DATA CIRCUIT TOWARDS MODEM (TX)				
✓	Data In	2	14	G.703
DATA CIRCUIT FROM MODEM (RX)				
✓	Data Out	3	16	G.703
COMMON LINES				
	Signal Ground	7		Ground
✓	Shield/Protective ground	1		Screen

Line Code / Line Length

For both T1 and E1 G.703 cards the line code is set from the front panel after the electrical interface is selected. For T1 either AMI or B8ZS is available, for E1 cards AMI or HDB3. In coded (ie non AMI modes) the modem will display a 'Data Marginal' warning whenever a line code violation is detected. For T1 cards a choice of line lengths is also given to allow the card to pre-compensate the T1 signal for line losses. If you are in doubt, select the <133 feet option (no pre-compensation).

Interface Settings

When the 75 Ω BNC interface is selected, the screen of the output connector is always connected to ground. The screen of the input connector may be selected as follows:

- *Input screen grounded* (recommended)
- *Input screen floating*

The action to be taken if the power is removed can be specified as:

- *Normal* - the G.703 input is looped to the output by a relay if power is removed. This is so any other traffic on the G.703 PCM bearer is not lost by a break in the bearer.
- *1:1 Operation* - the G.703 output goes high impedance if power is removed allowing the units 1:1 partner to carry the traffic. The normal input impedance switches to whichever one is on-line (with the standby input at high impedance)

If installing the G.703 card, the BNC labelled 'IN' connects to J3 on the card and the BNC labelled 'OUT' to J2 on the card.

IP Mode

The IP is a standard interface supplied with the modem. If *IP* is selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies.

The modem supports two RJ45 Ethernet ports for IP and remote control ports.

The Ethernet automatically supports 10/100 data rates and uses CAT 5 Ethernet cable, either straight or crossover, depending upon whether the modem is connected directly to a host or hub/switch.

The *Edit/Unit/M&C* menu allows modem IP configuration.

The P3714 IP Traffic card provides 2 RJ45 10/100/1000 BaseT Ethernet ports. The IP Traffic port on the base modem is redundant when the IP Traffic card is fitted and should not be used. The IP Traffic card does not replace the base modem M&C Ethernet interface, which should continue to be used for remotely configuring the modem over Ethernet.

EIA530 in X.21 Mode

The EIA530 interface can provide both X.21 DCE and X.21 DTE operation. For X.21 operation the interface must be set to RS422 mode, and the Tx & Rx Clocking modes must be set correctly. With the use of the appropriate adaptor lead (to convert to the X.21 standard 15 pin D connector), a full X.21 DCE or DTE interface is available.

X.21 DCE Operation

This has only a clock *from* the modem to the terrestrial equipment. Configure a cable with a 15 pin 'D' female at one end (X.21 DCE) and a 25 pin 'D' male at the other end as follows:

Min Req	X.21 DCE (15 pin D female)			Signal Description	RS422 Name	Circuit Number	25 pin		Electrical Levels
	Name	A	B				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)									
✓	T	2	9	Data In	SD	103	2	14	RS422
	C	3	10	Sig ' Valid In	RS	105	4	19	RS422
DATA CIRCUIT FROM MODEM (RX)									
✓	S	6	13	Clock Out	RT	115	17	9	RS422
✓	R	4	11	Data Out	RD	104	3	16	RS422
	I	5	12	Sig ' Valid Out	RR	109	8	10	RS422
COMMON LINES									
✓	Sig gnd	8	Signal Ground	SG	102	7	Ground		
✓	Prot gnd	1	Shield/ Prot ' ground	PG	101	1	Screen		

Clocking

For the interface to function as X.21, the clocking must be set as follows. The *Rx Clock Menu* is used to set the source of the single clock from the modem as *Satellite*, *Internal*, or *Station Clock*. *Tx Clk In* does not exist in X.21 and cannot be used. The Tx clock should be set to *Rx* as the Tx data is clocked by the same clock as the Rx data.

The maximum data rate is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The input clock/data phase is selected automatically, reporting a 'Data Marginal' warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). Check the phase of the *Data In* with respect to the *Clock Out* line.

It is possible to configure the Tx carrier to be switched on and off by the 'Sig= Valid In' line by selecting *Edit/Tx/Carrier/RTS enabled*.

X.21 DTE Operation

This has only a clock to the modem from the terrestrial equipment. Configure a cable with a 15 pin 'D' male at one end (X.21 DTE) and a 25 pin 'D' male at the other end as follows:

Min Req	X.21 DTE (15 pin D male)			Signal Description	RS422 Name	Circuit Number	25 pin		Electrical Levels
	Name	A	B				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)									
Y	S	6	13	Clock In	TT	113	24	11	RS422
Y	R	4	11	Data In	SD	103	2	14	RS422
	I	5	12	Sig ' Valid In	RS	105	4	19	RS422
DATA CIRCUIT FROM MODEM (RX)									
Y	T	2	9	Data Out	RD	104	3	16	RS422
	C	3	10	Sig ' Valid Out	RR	109	8	10	RS422
COMMON LINES									
Y	Sig gnd	8	Signal Ground	SG	102	7	Ground		
Y	Prot gnd	1	Shield / Prot ' ground	PG	101	1	Screen		

Clocking

For the interface to function as X.21, the clocking must be set as follows. The *Tx Clocks* menu should be used to take the single clock from the terrestrial by selecting *Tx Clock In*. The *Rx Clocks* menu should also be set to return Rx data in time with the single Tx Clock by also selecting *Tx Clock In*. No other combinations will work.

The maximum data rate is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The input clock/data phase is selected automatically, reporting a 'Data Marginal' warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). Check the phase of the *Data In* with respect to the Clock In line.

It is possible to configure the Tx carrier to be switched on and off by the 'Sig= Valid In' line by selecting *Edit, Tx, Carrier, RTS enabled*.

MIL-STD-188-114A Interface

The modem terrestrial interface is compliant with the interfaces defined in MIL-STD-188-114A when set in EIA530 RS422 mode.

This MIL-STD document specifies three types of `balanced generators`:

- Type 1 Low offset voltage, for <100kbps. Defined in the 1985 document for compatibility with older equipment.
- Type 2:3V offset maximum, for 100kbps to 10Mbps. MIL-STD-188-114A specifies this corresponds to the EIA RS-422A balanced generators.
- Type 3:New terminated voltage generator for >10Mbps.

Strictly the modem is compliant with the Type 2 interface, defined for use from 100kbps to 10Mbps. However this interface will also operate down to 4800bps. The low offset voltage Type 1 generator is not supported, but as specified for use with older equipment in 1985, should not be an issue today.

The Type 3 is for data rates above 10Mbit/s – this physical interface is not currently supported.

Connectors, pin assignments and communication protocols are not standardised in this MIL-STD document: FED-STD-1030A may be considered equivalent to EIA RS423A and CCITT V.10 while FED-STD-1020A may be considered equivalent to EIA RS422A and CCITT V.11.

P3709/P3713 Eurocom D1 Interface

Two versions of Eurocom D1 card are offered.

P3709 is fully pin-for-pin compatible with Eurocom 25 way D-type plug on the P1451 card for P300.

P3713 provides combined Eurocom D1, EIA530 and G703 balanced interfaces on the standard EIA530 25 way D-type socket.

Although P3709 hardware supports the interface mode select pins, both cards are configurable from the front panel or web interfaces.

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P3709 D-type connector (plug)

Pin	Eurocom D1	Pin	Eurocom D1
1	Screen	14	D I/F (high rate) enable
2	Ground	15	Ground
3	D I/F Rx Data B output	16	D I/F Rx Data A output
4	D I/F Rx Clock A output	17	D I/F Rx Clock B output
5	D I/F Tx Data B input	18	D I/F Tx Data A input
6	D I/F Tx Clock B input	19	D I/F Tx Clock A input
7	Ground	20	G I/F (low rate) enable
8	D I/F Tx Clock B output (modem)	21	D I/F Tx Clock A output (modem)
9	Ground	22	Ground
10	G I/F Rx Data B output	23	G I/F Rx Data A output
11	G I/F Tx Data B input	24	G I/F Tx Data A input
12	Test Mode, must be open circuit	25	Ground
13	Ground		

P3713 D-type connector (socket)

Pin	Eurocom D1	Pin	Eurocom D1
1	Ground	14	
2		15	C / G I/F Tx Data A input
3	C / G I/F Tx Data B input	16	C / G I/F Rx Data A output
4	C / G I/F Rx Data B output	17	
5		18	D I/F Tx Clock A output (modem)
6	D I/F Tx Clock B output (modem)	19	
7	Ground	20	D I/F Tx Clock A input
8	D I/F Tx Clock B input	21	D I/F Tx Data A input
9	D I/F Tx Data B input	22	D I/F Rx Clock B output
10	D I/F Rx Clock A output	23	D I/F Rx Data A output
11	D I/F Rx Data B output	24	
12		25	
13			

Where: C indicates Eurocom type C interface
 D indicates Eurocom type D interface
 G indicates Eurocom type G interface

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P3713 D-type connector (socket)

Pin	EIA530	Pin	EIA530
1	Screen	14	Tx Data B
2	Tx Data A	15	ETC A
3	Rx Data A	16	Rx Data B
4	RTS A	17	Rx clock A
5	CTS A	18	Local Loopback
6	DSR A	19	RTS B
7	Ground	20	DTR B
8	Rx Ready A	21	Remote loopback
9	Rx Clock B	22	DSR B
10	Rx Ready B	23	DTR B
11	Tx Clock B	24	Tx Clock
12	ETC B	25	Not used
13	CTS B		

P3713 D-type connector (socket)

This supports the P3702 G.703 card.

Pin	G703 Balanced	Pin	G703 Balanced
1	Screen	14	Tx Data B
2	Tx Data A	15	
3	Rx Data A	16	Rx Data B
4		17	
5		18	
6		19	
7	Ground	20	
8		21	
9		22	
10		23	
11		24	
12		25	
13			

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Comparison of P3709 and P3713 Interface connections

The D-type can be a socket (Combined Eurocom/EIA530) or plug (P300 compatible Eurocom).

P3713	P3709	Eurocom D/1	EIA530	G703
SCKT	PLUG	P3709/P3714	P3713	P3713
1	13	Ground	Screen	
2	12	<i>Test Mode, must be open circuit</i>	Tx Data A	Tx Data A
3	11	G I/F Tx Data B input	Rx Data A	Rx Data A
4	10	G I/F Rx Data B output	RTS A	
5	9	Ground	CTS A	
6	8	D I/F Tx Clock B output (modem)	DSR A	
7	7	Ground	Ground	
8	6	D I/F Tx Clock B input	Rx Ready A	
9	5	D I/F Tx Data B input	Rx Clock B	
10	4	D I/F Rx Clock A output	Rx Ready B	
11	3	D I/F Rx Data B output	Tx Clock B	
12	2	Ground	ETC B	
13	1	<i>Screen</i>	CTS B	
14	25	<i>Ground</i>	Tx Data B	Tx Data B
15	24	G I/F Tx Data A input	ETC A	
16	23	G I/F Rx Data A output	Rx Data B	Rx Data B
17	22	Ground	Rx clock A	
18	21	D I/F Tx Clock A output (modem)	Local Loopback	
19	20	G I/F (low rate) enable	RTS B	
20	19	D I/F Tx Clock A input	DTR B	
21	18	D I/F Tx Data A input	Remote loopback	
22	17	D I/F Rx Clock B output	DSR B	
23	16	D I/F Rx Data A output	DTR B	
24	15	Ground	Tx Clock	
25	14	<i>D I/F (high rate) enable</i>	Not used	

The Eurocom signals marked in *italics* are not supported on the P3713 combined EIA530/Eurocom D/1 connector.

Relays switch between EIA530 and Eurocom D1 or G703 signals. Undefined pins in Eurocom D1 and G703 modes remain connected to the EIA530 interface.

P3713 Adapter Cable

Where compatibility with existing P300 wiring is required an adapter cable can be supplied.

1. Simple IDC D-type plug to plug with connector reversed (pin 1 to 13)
2. Custom cable with additional ground pins at Eurocom side with select pins not connected.

Quad E1 Interface

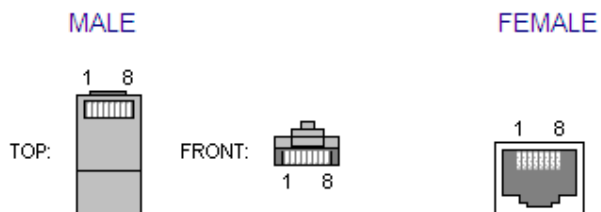
The P3706 Quad E1 interface card provides 4 RJ45 connectors supporting balanced E1 G.703. The Quad E1 interface panel supports four full E1s, four partial E1s or a mix of both. Unbalanced G.703 can be provided by an external adaptor. If the Quad E1 interface is selected under *Edit/Unit/Interface/Terrestrial* then the following interface description applies. Please note this is per port.

Min Req	Signal Description	RJ45		Electrical Levels
		A	B	
DATA CIRCUIT TOWARDS MODEM (TX)				
✓	Data In	1	2	G.703
DATA CIRCUIT FROM MODEM (RX)				
✓	Data Out	4	5	G.703

Line code is fixed as HDB3 for all ports. The master clock source, for all ports is the lowest active port number that is configured and connected. For example, if port one is being used then this provides the clock source for all other ports. Therefore, as far as the clock configuration is concerned, all other ports are described as slaves. The slaved ports require a bearer to be generated from the modem. Alternatively, timing may be distributed to the terrestrial equipment/modem from a single master clock source. If clocking topology is not considered prior to implementing a Quad E1 system then clocking problems may result.

Note: Quad E1 requires an IB/SMS service to be selected and if multiple E1s are to be used then additional SAF codes may have to be purchased. (2E1, 3E1 and 4E1)

Example RJ45 connectors are shown in the following figure:



Multi-Mux Interface

The P3706 Quad E1 interface card supports a MUX SAF feature, which when enabled via the *Edit/Unit/Interface/Terrestrial* menu allows the following combinations of terrestrial multiplexed data to be aggregated onto a single satellite carrier.

Port 1	Port 2	Port 3	Port 4
E1	E1	E1	IP data
E1	E1	E1	EIA530 data
E1	E1	EIA530 data	IP data

Line code is fixed as HDB3 for all E1 ports. Other electrical interface rates need to be a multiple of 64kbps and master timing is derived from the lowest active port number that is configured and connected.

Note that Quad E1 ports 3 and 4 do not need to be SAF enabled in order to use the MUX feature, as long as the MUX SAF itself is present.

Chapter 11 Connector Pinouts

Remote M&C (RS485/RS232) Connector

The selection of RS232 or RS485 must be made via the front panel. The communications protocol is defined in the document '*Remote M&C Specification for Quantum and Evolution Series Satellite Modems*'.

Connector type: 9-pin 'D' female.

Pin	Signal name	Direction	Name-RS485		Name-RS232
				Paradise	
1	Shield/Gnd *			Shield/Gnd	Shield/Gnd
2				-	-
3	Master-B	+ to modem		RX-B	-
4	Slave-B	+ from modem		TX-B	-
5	Shield/Gnd *			Shield/Gnd	Shield/Gnd
6	Slave-A	- from modem		TX-A	Tx. data
7				-	-
8				-	-
9	Master-A	- to modem		RX-A	Rx. data

* Pins 1 and 5 are both grounded on the modem (ie Shield and Ground are interchangeable).

1-for-n (also used for 1-for-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

A suitable four way lead (4 + Screen) 1:1 redundancy lead is as follows:

<u>Unit 1</u>	<u>Unit 2</u>	
Pin 1 ...Screen...	Pin 1	(circuit ground)
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)

Keep this lead as short as practical, and ensure it is screened to prevent spurious changeovers by noise induced in these high impedance signal leads.

Refer to the earlier section on 1 FOR 1 switching for details of 1 FOR 1 operation.

A standard 1-for-1 lead (part number P1391) is available from 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 rated 30V DC 2A, or 125VAC 0.4A. The functions are as defined in Section 6.5.

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.

Async ESC Connector

This connector comprises:

- An RS232/RS422/RS485 async port for use on either the ESC or Aux channels.
- An RS232 serial port (currently unused).
- An RS422 Station Clock input.

ASYNC ESC CONNECTOR		
RS232	RS422/ RS485	Async port for ESC or Aux channel
2	2 (a)	Async ESC/Aux Input (to satellite)
-	9 (b)	Async ESC/Aux Input (to satellite)
3	3 (a)	Async ESC/Aux Output (from satellite)
-	10 (b)	Async ESC/Aux Output (from satellite)
1	1	Ground
RS232		Serial port (currently unused)
12		Serial Input (RS232 port)
5		Serial Output (RS232 port)
13		Ground
RS422		Differential Station Clock Input
4		Station Clock (a)
11		Station Clock (b)
13		Ground

Differential Station Clock

This provides a RS422 compatible station clock in addition to the unbalanced 75Ω station clock BNC connector.

Async Port for ESC or Aux Channels

The modem has two fully independent data channels that may be carried over the satellite within any overhead that is added. These are referred to as the ESC and Aux channels. The shared interface on this connector allows the use of only one of these channels at a time, and then only in an Async mode (there is no clock signal on this port). If both ESC and Aux channels are to be used together or either channel used in a synchronous mode, then the IDR option must be fitted which provides separate ESC & Aux ports both with clock, data, and octet lines. When the IDR option is fitted the shared ESC/Aux port on the Async ESC connector is DISABLED.

When configured for different services the ESC and Aux channels provide as follows:

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- In **Closed Net Plus ESC** mode the ESC channel provides the variable rate async ESC facility, the Aux channel is not used.
- In **IBS/SMS** modes the ESC channel provides the High Rate Async ESC facility (2400 Baud at 64kbps) and the Aux channel either the Intelsat low rate ESC facility (50 Baud at 64kbps) or a variable rate synchronous Aux circuit. However to use the Aux channel in a synchronous mode the IDR option must be fitted. Without the IDR option that has separate ports for ESC & Aux channels, both ESC and Aux channels (ie high rate async ESC & Intelsat low rate ESC) cannot be used simultaneously.
- In **IDR** Mode this port is not used, as when the IDR option is fitted separate ESC and Aux ports on the IDR card replace this shared ESC/Aux port. Refer to the definitions of the ESC & Aux ports on the 50 way IDR ESC/Aux/Backward Alarm connector on the following few pages.

Standard Lead

A constellation monitor/serial lead (part number M1479) is available from Paradise Datacom. This lead provides the required connections to a 25 pin D type for a PC connection (note that this is currently unused by the modem) and three BNCs for connecting to an oscilloscope for the constellation monitor.

ESC/Aux and Backward Alarms Connector

This connector is fitted as part of the IDR option. Note that when this option is fitted, the ESC and Aux ports on this connector replace the shared ESC/Aux port on the Async ESC connector.

Connector type: 50-pin 'D' female

ESC Port

Pin Number	Sync	Async	RS485/RS422 Usage	RS232 Usage
30	U		Tx ESC Clock out A	Tx ESC Clock out
31	U		Tx ESC Clock out B	n/c
13	U	U	Tx ESC Data in A	Tx ESC Data in
14	U	U	Tx ESC Data in B	n/c
32	U		Rx ESC Clock out A	Rx ESC Clock out
33	U		Rx ESC Clock out B	n/c
15	U	U	Rx ESC Data out A	Rx ESC Data out
16	U	U	Rx ESC Data out B	n/c
46	(U)		Tx ESC Octet out A	Tx ESC Octet out
47	(U)		Tx ESC Octet out B	n/c
48	(U)		Rx ESC Octet out A	Rx ESC Octet out
49	(U)		Rx ESC Octet out B	n/c
17	U	U	Ground	Ground

(U) indicates lines are optional.

In Closed Net Plus ESC mode the variable rate *async* ESC is available on this port.

In IBS modes high rate *async* ESC is available on this port.

In IDR modes this port provides access to the 8kbps IDR ESC channel. This can either be by *synchronous* at 8kbps or (if the Async ESC feature is available) *asynchronous* at up to 4800 or 9600 Baud.

Aux Port

Pin Number	Sync	Async	RS422 Usage	RS232 Usage
26	U		Tx Aux Clock out A	Tx Aux Clock out
27	U		Tx Aux Clock out B	n/c
9	U	U	Tx Aux Data in A	Tx Aux Data in
10	U	U	Tx Aux Data in B	n/c
28	U		Rx Aux Clock out A	Rx Aux Clock out
29	U		Rx Aux Clock out B	n/c
11	U	U	Rx Aux Data out A	Rx Aux Data out
12	U	U	Rx Aux Data out B	n/c
42	(U)		Tx Aux Octet out A	Tx Aux Octet out
43	(U)		Tx Aux Octet out B	n/c
44	(U)		Rx Aux Octet out A	Rx Aux Octet out
45	(U)		Rx Aux Octet out B	n/c
50	U	U	Ground	Ground

(U) indicates lines are optional.

In Closed Net plus ESC mode the aux port is not used.

In IBS modes the Aux port can be set to both `Intelsat` (using TS32 bit 1) and `Sync` modes (selectable to use any of TS16, TS32 bits 1& 5-8, & TS48). In both modes a clock is provided and the port can be used synchronously (with the clock), or asynchronously (allowing the async data to be oversampled by the higher rate clock). In this oversampled mode (as specified by Intelsat), the Baud rate is limited to approximately 25-33% of the synchronous clock rate.

In IDR modes the Aux port provides either 32 or 64kbps data access in place of either one or both of the 32kbps ADPCM audio channels. Typically this would be used synchronously, but if required it could be used asynchronously & oversampled giving maximum baud rates of approx 9600 Baud (in place of one audio channel) or 19200 Baud (in place of both Audio channels).

Audio Ports

Pin Number	Description
38	Tx Audio Channel 1 in A
39	Tx Audio Channel 1 in B
40	Tx Audio Channel 2 in A
41	Tx Audio Channel 2 in B
34	Rx Audio Channel 1 out A
35	Rx Audio Channel 1 out B
36	Rx Audio Channel 2 out A
37	Rx Audio Channel 2 out B
50	Ground

All ports are 600Ω, with levels +7dBm to -16dBm set independently from the front panel. Audio is encoded as 32kbps ADPCM (or 16kbps ADPCM in some custom modes)

The Audio ports may be used in two applications:

In IBS modes, if set to *emulate* a P1348/P1448 Audio/Data mux card, the ESC ports provide the equivalent of the two audio ports on the P1348/P1448 (ie can transmit 64kbps=2 audio channels, or 128kbps=2 audio channels plus 64 kbps data from main data port).

In IDR modes these are used to access the IDR Audio ESC channels. One or both Audio ESC's may be dropped in favour of 32 or 64kbps access to the channel by the Aux port.

Backward Alarms

Pin Number	Description
1	BA 1-4 Common
2	BA1 N/O
18	BA1 N/C
3	BA2 N/O
19	BA2 N/C
4	BA3 N/O
20	BA3 N/C
5	BA4 N/O
21	BA4 N/C
22	BA1 Input
23	BA2 Input
24	BA3 Input
25	BA4 Input
7	Rx Summary fault output (link to BA in)
6	Ground

N/O indicates normal open in the normal, non-alarm state & N/C normally closed in the non-alarm state. Unlike the modem fault relays, the backward alarms are not normally energised, and fall back to the 'Normal' state when modem power is removed. The modem deferred alarm acts as a summary backward alarm and activates when any backward alarm is received (this does fall back to the 'Fail' state when power is removed).

Backward alarm inputs float to the 'Good' state (high =+5V) and indicate 'Fail' when connected to 0V. The Rx summary fault is an open collector output, 0V = Fail, open collector=OK. From the front panel the backward alarm inputs (BA x) can be set as follows (E=Ext, A=Auto-Rx fail, O=OK):

	Menu Opt	BA 1	BA 2	BA 3	BA 4
Mode 1	EEEE	Ext patch	Ext patch	Ext patch	Ext patch
Mode 2	AEEE	Rx Fail	Ext patch	Ext patch	Ext patch
Mode 3	AOOO	Rx Fail	Good	Good	Good
Mode 4	AAAA	Rx Fail	Rx Fail	Rx Fail	Rx Fail

If external patching is required, connect the Rx summary fault to the required BA input and any other modem fail outputs to the appropriate other BA inputs. Leave unused inputs floating.

In IDR modes these are used for the 4 standard IDR backward alarms.

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In IBS modes BA 1 indicates the normal single IBS backward alarm status (mirrored by the unit deferred alarm). For multidestinational *IBS* carriers it is possible to operate the modem in IBS mode, but use 4 separate backward alarms as per IDR. From the front panel select Service as `Other`, based on `IBS`, and follow the screen prompts.

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.

1.38 Transmit Faults

Fault Text	Notes	Relays	To Ter	To Sat	Other
Tx fault: External Tx clock selected, but no clock from interface.	The modem is set to use an external clock but no clock is being provided. The clock generation will use the internal clock as a backup to maintain the carrier and signal integrity. Check the data connector is attached and check for activity on the clock input lines.	T	TB	SA,SC	
Tx fault: Data Ready Input active.	The DRI line has been de-asserted by the data source feeding the modem, indicating a unit fault with data source.	T			
Tx fault: Signal Valid Input active.	The SVI line has been de-asserted by the data source feeding the modem, indicating it wished to disable transmission. If the carrier is set to RTS Enabled the carrier will be muted.	T			
Tx fault: Data input is all ones (AIS), indicating upstream equipment fault.	The data supplied to the modem is all ones (AIS). This is normally used to indicate an upstream equipment fault. It is not a modem fault. This alarm can be switched off if required using the <i>Edit-Unit-Advanced-Alarms-Actions</i> menu.	T	TB	SA,SC,	
Tx fault: Frame sync lost on Tx input. Check bearer type and AIS.	The modem detects frame synchronisation when the Drop MUX is active (or 2048k IBS G.732 mode is enabled). Check the bearer type is specified correctly. This fault normally occurs only when there are significant errors on the terrestrial link or when the signal is supplied with AIS and the modem is set to ignore AIS. Check that the AIS detector is not disabled. There is an option to make the modem re-seek frame synchronisation when CRC synchronisation is lost - check the modem is not set to expect a CRC and is forcing frame re-acquisition when CRC is lost but there is no CRC on the PCM signal.	T	TB	SA,SC	
Tx fault: Dropped data is all ones (AIS), indicating upstream equipment fault.	The specific timeslots dropped by the Drop MUX contain all ones (AIS). This is different to the 'Tx Fault: Data input is all ones (AIS)' message described above which refers to the whole PCM bearer being AIS. In this case, it is only the specific dropped timeslots that contain AIS. This is normally used to indicate an upstream equipment fault - it is not a modem fault.	T	TB	SA	
Tx fault: CRC sync loss on Tx input.	The modem only seeks Cyclic Redundancy Code (CRC) sync when the Tx baseband is set to use the Drop mux in G.732 mode (or 2048k IBS G.732 0% overhead mode) and when set by the user to process CRC's. If CRC sync is permanently lost, check if a CRC is present on the PCM signal.	T			
Tx fault: Input BER > 1E-3.	The Bit Error Rate at the Tx input (measured on the PCM Frame Alignment Words) is worse than 1×10^{-3} . This can only be due to a very poor error rate on the PCM input signal.	T	TB	SA	
Tx fault: TS16 MF sync lost on Tx input	The modem only seeks TS16 Multiframe sync when the Tx baseband is set to use the Drop mux in a G.732 mode and CAS signalling has been selected (or 2048k IBS G.732 0% overhead mode with CAS is enabled). Check that a CAS multiframe is present on the PCM signal applied to the modem	T	TB/TE	SC	
Tx fault: Frame sync lost on Tx input. Check bearer type and AIS.	Frame sync has been lost on the terrestrial input. Only displayed when using the drop mux. Check the bearer type has been correctly configured. If the AIS detectors are disabled check equipment generating bearer is not generating AIS.	T			
Tx fault: Frame sync lost on ports (1 to 4).	Frame sync has been lost on one or more of the Quad E1 card terrestrial inputs.	T			

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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.				CM
Tx fault: Data input all ones on ports (1 to 4).	Quad E1 fault indicating AIS (all 1s, i.e no data) is being received on the specified Quad E1 card terrestrial ports.				
Tx fault: Drop mux fault on ports (1 to 4).	Quad E1 card data input fault when trying to drop specified timeslots from specified E1 ports onto transmitted carrier.				
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.				

1.39 Transmit Warnings

Fault Text	Notes	Relays	To Ter	To Sat	Other
Tx warning: Maximum multiframe period too small.	Framer failed to find a frame length to support TS ID maintenance. Try reducing ESC baud rate or increasing maximum multiframe period.				
Tx warning: Frame backward alarm detected at Tx input, indicating Rx output or downstream Rx equipment fault.	A frame backward alarm has been detected at the Tx 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 status and that the Rx data output from the modem is connected to the downstream equipment.	D		SB	
Tx warning: TS16 MF backward alarm detected at Tx input, indicating equipment downstream of Rx has failed to find MF sync.	A multiframe backward alarm has been detected at the Tx input indicating that equipment downstream of the receive path has failed to find multiframe sync and is returning an alarm. On the Rx path, if the Insert Mux bearer is set to Originate, then check the Rx path is also using CAS, otherwise it will generate a bearer without a TS16 Multiframe.	D		SB/SD	
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: Tx exceeds 4.5Mbps limit in TPC 5/16.	Configuration error, data rate for FEC scheme exceeded.				
Tx warning: Tx exceeds 6.5Mbps limit in TPC 21/44 or 2/3.	Configuration error, data rate for FEC scheme exceeded.				
Tx warning: Tx exceeds 7.7Mbps limit in TPC 1/2.	Configuration error, data rate for FEC scheme exceeded.				
Tx warning: Tx exceeds 12Mbps limit in TPC 7/8.	Configuration error, data rate for FEC scheme exceeded.				
Tx warning: Tx exceeds 33Mbps limit in TCM 2/3.	Configuration error, data rate for FEC scheme exceeded.				
Tx warning: Tx data rate outside interface range.	Configuration error, data rate for terrestrial interface exceeded.				
Tx warning: G703 carrier lost.	Modem is set to use the G703 terrestrial interface but no G703 signal has been detected, check configuration of G703 interface.				CM
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: Line Code Violation detected.	Line code violations have been detected on the G703 interface, check configuration of G703 interface.	D			
Tx warning: Tx symbol rate outside range.	The modems current configuration exceeds the permissible symbol rate, check the configuration.				CM
Tx warning: Data clock inverted, data changing state on wrong edge.	The phase of the input clock and data is checked to ensure the data is stable when it is actually latched into the modem. This message means that the data is changing at this critical time, and it will cause data errors. Check the A & B clock lines are not reversed.	D			
Tx warning: Dropped TRAU above threshold.	When Sat-ABIS card is being used this indicates that the number of TRAU frames being dropped is above the set threshold. This indicates that the assumed ABIS compression ratio is not being achieved and consequently some ABIS traffic is being dropped due to insufficient satellite bandwidth being available.				

1.40 Receive Faults

Fault Text	Notes	Relays	To Ter	To Sat	Other
Rx fault: RS de-interleaver unable to sync to decoded data. Check RS settings.	The demodulator can lock to the carrier and the inner FEC decoder to the demodulated data. However, the Reed-Solomon de-interleaver cannot synchronise with the decoded data. Check the RS de-interleaving depth and the values of 'n' and 'k'.	R	TA,TC	SB	RF
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: Cannot find frame sync on Rx data - check Rx Service settings.	The modem cannot find the IBS or IDR frame sync on the receive data. Check the Rx Service settings.	R	TA,TC	SB	RF
Rx fault: Cannot find IBS TS32 multiframe sync on Rx data.	The modem cannot find the IBS TS32 multiframe sync on the receive data although it has found frame sync.	R	TA,TC	SB	RF
Rx fault: No insert bearer, generating.	Modem is set to loop bearer but no bearer was detected at Tx input. The bearer is currently being generated by the insert mux.	R			
Rx fault: CAS multiframe sync lost.	The modem cannot find the IBS CAS multiframe sync on the receive data although it has found frame sync and TS32 multiframe sync. CAS Multiframe sync is used to convey either 1) Channel Associated Signalling (CAS) in G.732 Drop/Insert modes using CAS; 2) To maintain the identity of a group of timeslots in some cases; 3) To maintain Robbed Bit Signalling (RBS) in T1-D4 or T1-ESC Drop/Insert modes. Check as follows for each use: 1) The Tx modem is set to operate in CAS mode if CAS signalling is to be conveyed within the IBS/SMS overhead; 2) If the Tx modem cannot use a CAS Multiframe to maintain the TS identity for the 'Odd values of N' then to prevent this modem seeking a CAS multiframe for one of these values, set timeslot identity to 'Do not maintain'; 3) If the Tx modem cannot use a CAS Multiframe to maintain RBS over satellite, switch RBS off.	R	TA,TC	SB	RF
Rx fault: Final BER > 1E-3.	Final BER has exceed 1x10-3	R	TA,TC	SB	
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: Insert data is all ones (AIS), indicating upstream equipment fault.	The final customer data after demodulation, error correction, deframing and descrambling is all ones. This is normally used to indicate an upstream equipment fault (such as a lack of input clock at the Tx end), it is not a modem fault.	R	TA	SB	
Rx fault: Data input is all ones (AIS), indicating upstream equipment fault.	The modem is set to loop bearer, but that bearer is indicating AIS.	R			
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: Insert mux fault on ports (1 to 4).	Quad E1 card fault.				
Rx fault: Rx SM sync loss.	Quad E1 sync loss fault.				
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.				

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Fault Text	Notes	Relays	To Ter	To Sat	Other
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 is unmuted 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 ABIS traffic.	No valid ABIS data has been detected.				
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 valid baseband frame, indicating the data has become corrupted (poor signal, interference, etc).				
Rx fault: RS de-interleaver unable to sync to decoded data. Check RS settings.					

1.41 Receive Warnings

Fault Text	Notes	Relays	To Ter	To Sat	Other
Rx warning: Doppler buffer max limited Rx data rate above 42Mbps.	Buffer size should not exceed 80ms when data rate exceeds 42Mbps				
Rx warning: The minimum period between buffer slips is less than the user threshold set for the deferred alarm.	Buffer slips are occurring too frequently, this could indicate that the clock accuracy is less than expected.	D			
Rx warning: Rx exceeds 4.5Mbps limit in TPC 5/16.	Configuration error, data rate for FEC scheme exceeded.				
Rx warning: Rx exceeds 6.5Mbps limit in TPC 21/44 or 2/3.	Configuration error, data rate for FEC scheme exceeded.				
Rx warning: Rx exceeds 7.7Mbps limit in TPC 1/2.	Configuration error, data rate for FEC scheme exceeded.				
Rx warning: Rx exceeds 12Mbps limit in TPC 7/8.	Configuration error, data rate for FEC scheme exceeded.				
Rx warning: Rx exceeds 33Mbps limit in TCM 2/3.	Configuration error, data rate for FEC scheme exceeded.				
Rx warning: Rx data rate outside interface range.	Configuration error, data rate for terrestrial interface exceeded.				
Rx warning: The distant 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: Maximum multiframe period too small.	Deframer failed to find a frame length to support TS ID maintenance. Try reducing ESC baud rate or increasing maximum multiframe period.				

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Fault Text	Notes	Relays	To Ter	To Sat	Other
Rx warning: Backward alarm from satellite detected at Rx input, indicating Tx or downstream of Tx equipment fault.	A backward alarm has been detected at the Rx input. This indicates that equipment downstream of the transmit path (i.e. from the modem Tx output) has failed and is returning an alarm. This may be due to a downstream receive path equipment failure, the modem Tx failing or a satellite failure. Check the modem Tx path status. Check the Tx IF output from the modem is connected to the upconverter equipment and onwards. Monitor the Tx carrier (or distant Rx if possible) with a spectrum analyser.	D	TB		
Rx warning: CAS multiframe backward alarm from satellite, indicating equipment downstream of Tx has failed to find CAS MF sync.	A multiframe backward alarm has been detected at the Rx input indicating that equipment downstream of the transmit path has failed to synchronise to the CAS multiframe and is returning an alarm. This could be caused by any equipment from the Tx modulator onwards but is unlikely to be other than the Tx mod, the Rx demod, or further down the Rx path.	D	TE		
Rx warning: Backward alarm 1 (or 2 or 3 or 4) from satellite, indicating equipment downstream of Tx has failed.	This indicates which of the four backward alarms are active at the Rx input. This indicates that equipment downstream of the transmit path (ie the distant end Rx path or further downstream) has failed and is returning an alarm. In Multidestination circuits this may not correspond to the Tx path of this modem. The fault may be due to any receive downstream equipment, but could be due to the relevant modem Tx output failing. Check the relevant modem Tx path indicates OK. Check the Tx IF output from the modem is connected to the upconverter equipment and onwards and monitor the Tx carrier (or distant Rx if possible) with a spectrum analyser.	D			
Rx warning: Backward alarm at Insert MUX, indicating equipment downstream of Rx has failed.	This will only be displayed if the modem is 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: The final BER is worse than the user threshold set for the deferred alarm.	This indicates that the received signal has degraded resulting in a potentially unacceptable number of errors.	D			
Rx warning: Rx FIFO underflow on ports (1 to 4).	Quad E1 card Rx problem.				
Rx warning: Rx FIFO overflow on ports (1 to 4).	Quad E1 card Rx problem.				
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 interference 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.				

1.42 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

1.43 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: Quad E1 ports have active alarms (1 to 4).	Indicates that the Quad E1 card ports have unspecified alarms. Consult factory.				
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.				

1.44 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

1.45 Common Main Specifications

Parameter	Modem
Modulation Scheme	BPSK, QPSK, OQPSK, 8PSK (Option), 8QAM (Option), 16APSK (Option), 16QAM (Option), 32APSK (Option), 64QAM (Option)
IF Frequency Range	50-90MHz and 100-180MHz
L-band Frequency Range	950 – 2050 MHz
Frequency Resolution	100Hz
Traffic Interface - Electrical	(Built-in) Ethernet (10/100 BaseT) IP Traffic on RJ45 with link and traffic indicators. Electronically Selectable with other interfaces fitted
Traffic Interface - Options	RS422 including X.21 DCE and DTE emulation, V.35 and RS232 on EIA530 connector 25 pin female D-type (Option) – EIA530 maximum 10Mbps, RS232 max 100kbps LVDS 25 pin female D-type (Option) HSSI 50 pin SCSI-2 type connector G.703 balanced on EIA530 G.703 unbalanced on BNC female 75Ω Ethernet (10/100/1000 BaseT) IP Traffic card with dual RJ45 (more capable than standard base modem IP)
User Traffic Data Rate	<i>Note: all data rates are modem specific – see datasheets for specific modem data rates.</i> 4.8kbps – 2Mbps Extends base operation to 5Mbps Extends 5Mbps to 10Mbps Extends 10Mbps to 20 or 25Mbps Extends 25Mbps to 55Mbps (PD55) Extends 25Mbps to 60Mbps (PD60) Extends 60Mbps to 100Mbps (PD60) Extensions are cumulative
User Traffic Data Rate Resolution	1bps
Note The combination of FEC Rate, Modulation scheme and Satellite Overhead limits the Traffic Data Rate Range in all modes.	
User Data Rate Range – Closed Network	4.8kbps to 10Mbps (PD10), 20Mbps (PD20), 25Mbps (PD25), 55Mbps (PD55), 100Mbps (PD60) no satellite overhead (with high data rate options)
User Data Rate Range – Minimum Overhead (Closed Network Plus ESC)	As Closed Network above except limits inclusive of overhead of approximately 1.4 times the ESC baud rate. Resolution of 1bps. Supports ESC rate from 110 baud to >38.4kbaud.
User Data Rate Range – IBS/SMS Option	4.8kbps to 10 Mbps (6.7% satellite overhead added). Resolution of 1bps.
User Data Rate Range – IDR Option	4.8kbps to 10 Mbps (96k overhead added) Resolution of 8k (limitation of frame structure)

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Audio Channels Option	Used with IBS/SMS satellite framing and IDR Options to provide 2 x 32kbps audio ADPCM coded channels within a 64kbps IBS carrier and 2 x 32kbps audio ADPCM coded channels plus 64kbps data within a 128kbps IBS carrier
Inner Forward Error Correction	<p>DVB-S2 (LDPC/BCH) option: as per EN 302 307 - QPSK, 8PSK, 16APSK; rates 1/4 to 9/10</p> <p>SCPC: Note BPSK and (O)QPSK provided as standard; other modulations are options</p> <p>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</p> <p>TPC option: BPSK 5/16, 21/44, 0.493 (Paradise), 2/3, 3/4, 0.789 (Paradise), 7/8 (Paradise), Rate 7/8 de facto (O)QPSK: 5/16, 21/44, 0.493 (Paradise), 2/3, 3/4, 0.789 (Paradise), 7/8 (Paradise), 7/8 de facto, 0.93 (Paradise) 8PSK: 3/4 de facto, 7/8 de facto, 0.93 (Paradise) 16QAM: 3/4 de facto, 7/8 de facto, 0.93 (Paradise) Viterbi: BPSK/(O)QPSK 1/2, 3/4, 7/8 TCM option: 8PSK 2/3 Sequential option: BPSK/(O)QPSK 1/2, 3/4, 7/8</p>
Outer Forward Error Correction	Concatenated Intelsat Reed-Solomon Outer Codec to IESS308/310 with Custom Option offering variable code rate up to 10 Mbps.
Scrambling – IBS/SMS Option	Synchronised to framing per IESS-309 up to 10 Mbps
Scrambling – IDR Option and Closed Network	<p>With RS Coding: synchronised to RS overhead. Without RS Coding and Non-TPC FEC: V.35 self-synchronising No RS Coding with TPC FEC: $2^{12}-1$ up to 10 Mbps</p>
Scrambling – Closed Network Plus ESC	<p>32kbps or above: synchronised to ESC overhead. Less than 32kbps: as per closed network. V.35 Scrambler has CCITT, Intelsat, Fairchild and Linkabit modes up to 55Mbps (with high Data Rate options)</p>
Scrambling OM-73 Option	Up to 55Mbps (PD55 only)
IF Connector Type	BNC female
L-band connector Type	N Type female

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IF Impedance	50Ω & 75Ω, electronically selectable
L-band Impedance	50Ω
IF Return Loss	18dB typical
L-band Return Loss	14dB Minimum
Internal Frequency Reference - Ageing	<1ppm/yr
External Reference	Clocking Only: 1-10MHz in 1kHz steps. Clocking and RF Frequency: 10MHz, 0dBm±1dB

1.46 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 –30dBm continuously variable in 0.1dB steps
Output Level Stability	±0.5dB, 0°C to 50°C
Transmit Filtering	Intelsat IESS compliant. $\alpha = 0.35$; $\alpha = 0.25$; $\alpha = 0.20$
Occupied Bandwidth	1.2 times Symbol Rate
Recommended Channel Spacing	1.4 times Symbol Rate
Phase Accuracy	±2° maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As IESS-308, nominally 3dB better.
IF Output Frequency Stability	<1ppm/yr
L-band Output Frequency Stability	7.5E-8/yr with high stability reference option
IF Harmonics	Better than –55dBc/ 4kHz in band
L-band Harmonics	Better than –55dBc/ 4kHz in band, no worse than –45dBc out of band to 5GHz
IF Spurious	Better than –55dBc/ 4kHz in band
L-band Spurious	Better than –55dBc/ 4kHz in band, no worse than –40dBc out of band 10MHz to 5GHz
Transmit On/Off Ratio	55dB minimum
External Transmit Inhibit	By external contact closure or by TTL signal applied to rear panel Alarms & AGC connector

1.47 Rx Demodulator Specifications

Parameter	Modem
IF Input Range	-30 to -60dBm wanted signal
L-band Input Range	Minimum: -130+10 log symbol rate Maximum: -80+10 log(symbol rate) (i.e. -90dBm to -10dBm)
IF Maximum Composite Signal	30dB above level of desired input up to a maximum of 0dBm
L-band Maximum Composite signal	35db above level of desired input up to a maximum of +10dBm
Frequency Acquisition Range	Selectable from $\pm 1\text{kHz}$ to $\pm 32\text{kHz}$ up to 10 Mbps (1kHz steps) $\pm 10\text{kHz}$ to $\pm 250\text{kHz}$ from 10 to 52 Mbps (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	$\pm 100\text{ppm}$ minimum
Receive Filtering	Intelsat IESS compliant. $\alpha = 0.35$; $\alpha = 0.25$; $\alpha = 0.20$
Performance Monitoring	Measured Eb/No (range 0-15dB, $\pm 0.2\text{dB}$). Measured Frequency Offset (100Hz resolution). Wanted signal level strength indicator centred on the middle of the Rx. Input range.
AGC Output	Buffered direct AGC output for antenna tracking etc.

1.48 Clocking and Buffering Specifications

Parameter	Modem	
Clock Integrity	Frequency Locked Loops give phase-locked immune operation even with poor clock sources such as routers etc.	
Tx Clocking	Internal	Standard, options accuracy depends on reference fitted ($\pm 1\text{ppm}$ to $\pm 1\text{ppb}$)
	External	Tracking range $\pm 100\text{ppm}/\text{min}$
	Rx Clock	Slaves Tx timing from Rx clock. (Includes full asymmetric operation)
Rx Clocking	Buffer Disable	Clock from Satellite
	Tx Input clock	Plesiochronous. (Includes full asymmetric operation)
	Internal	Accuracy depends on reference fitted ($\pm 1\text{ppm}$ standard, options to $\pm 1\text{ppb}$)
	External timing clock (DTE interface only)	
	Station Reference (see below)	
Station Reference Inputs	75 Ω BNC female Station Clock Connector, transformer isolated. 1MHz to 10MHz in 1kHz steps (accepts sinusoidal >0dBm or square-wave e.g., G.703 para 10)	

	120Ω RS422 compatible input, 1MHz to 10MHz in 1kHz steps via Async ESC connector
	NB: When set to 10MHZ, the station reference may replace internal reference to all internal circuitry and reference outputs on the IF ports. The unit automatically switches back to internal reference if the station reference fails.
Buffer Size	Selectable in 1ms increments from 0ms to 99ms at data rates up to 42Mbps and from 0ms to 80ms at data rates from 42Mbps up to 55Mbps. Automatically adjusted to slip an integer number of terrestrial multi-frame lengths for framed rates Buffer storage: Maximum buffer size – 256kbytes

1.49 Framing and Deframing Specifications

Parameter	Modem
Closed Network Format	Unframed, no overhead.
IBS/SMS Option Format	Intelsat IBS to IESS-309 and IESS-310 up to 10 Mbps, and Eutelsat SMS to EESS501.
IDR Option Format	Intelsat IDR to IESS-308 and IESS-310 up to 10 Mbps.
Closed Network plus ESC Format	Provides variable rate asynchronous ESC, optional synchronous scrambler above 32kbps to replace error multiplying V.35 scrambler, optional backward alarm facility and optional timeslot ID maintenance when used with Drop/Insert, all in minimum possible overhead down to <0.5%
Poor BER Performance	Deframer includes extended threshold operation that improves performance when used with Reed-Solomon in very poor BER conditions (where a single uncorrectable RS codeword can contain enough corrupt frame alignment words to knock an Intelsat specified deframer out of frame sync). Up to 10 Mbps

1.50 Intelsat Reed-Solomon Codec and Custom Option Specifications

Parameter	Modem
Format	Concatenated Reed-Solomon outer codec to IESS-308/310
Code Rate	Default n, k, t = (126, 112, 7) depth 4. Automatically switches to: (225, 205, 10) depth 4 for 1544kbps IDR mode or (219, 201, 9) depth 4 for 2048kbps IDR mode and TCM ≤ 1544kbps or (219, 201, 9) depth 8 for TCM > 1544kbps.
Processing Delay	Combined encoder and decoder: $8 \times (2n - k + 60)$ Combined Interleaver/De-Interleaver: $8 \times n \times \text{Depth}$ (Calculate delay time using data rate including RS overhead).
Custom Option	When fitted allows arbitrary selection of n and k to provide fully variable code rate. $60 \leq n \leq 255$ $(n - 20) \leq k \leq (n - 2)$ in steps of 2. Interleaving depth of 4 or 8. The custom option allows use of shorter code words to reduce interleaver/de-interleaver delay on low data rate circuits. Up to 10Mbps.

1.51 Drop and Insert Option Specifications

Parameter	Modem
Bearer Types	T1-D4, T1-ESF and E1-G.732
Timeslot Selection	Independent selection of arbitrary timeslots for both drop and insert.
Bearer Generation	The terrestrial bearer may be looped through the Drop Mux then Insert Mux, or terminated after the Drop Mux and a new blank bearer generated by the insert Mux. The bearer generated within the Insert Mux provides full multiframe and CRC support and may be generated from the Tx clock, station reference, satellite clock or Internal reference.
Bearer Backup	In the event that the Insert Mux bearer clock is lost, or AIS is supplied, then the Insert Mux will switch temporarily to bearer generation mode in order to preserve the receive traffic. The backup bearer may be generated from the station reference, satellite clock or internal reference.
Terrestrial CRC	Fully supported, with front panel display of terrestrial error rate based on CRC (T1-ESF and G.732) or Frame Alignment Word errors (all bearer types).

Timeslot ID Maintenance	The IBS/SMS or Closed Net Plus ESC overhead maintains the identity of individual Drop/Insert timeslots for N=1,2,3,4,5,6,8,10,12,15,16,20,24 and 30. (See extended option below).
-------------------------	--

1.52 Extended Drop and Insert Option Specifications

Parameter	Modem
Timeslot Re-Ordering	Selected timeslots may be independently re-ordered on both Tx and Rx paths.
Multi-Destinational Working	All or only a subset of the received data may be inserted into the terrestrial bearer on the receive path for multi-Destinational working.
Timeslot ID Maintenance	The IBS/SMS or Closed Net Plus ESC is extended to maintain the identity of individual timeslots for <i>all</i> values of N from 1 to 31.
Signalling	Both Channel Associated Signalling (CAS) and Robbed Bit Signalling (RBS) are fully supported. For G.732 Drop/Insert, CAS signalling is extracted from terrestrial TS16 and carried over the satellite in IBS/SMS TS16 and TS48 before re-inserting into the distant terrestrial TS16. For RBS, the IBS or Closed Net Plus ESC overheads maintain the identity of the in-band signalling and it is re-inserted into the terrestrial multi-frame in the correct positions to maintain the RBS.

Note that when the Extended Drop and Insert option is used with a Quad E1 option card then only the Timeslot ID Maintenance feature is available.

1.53 Advanced ESC and Advanced Aux Option Specifications

Parameter	Modem	
ESC/Aux Port	A single port provides the interface for optional high rate async ESC (IBS/SMS option or Closed Net Plus ESC) or the Intelsat low rate async IBS ESC channel.	
Electrical Interface	RS232, RS422 or RS485 external interfaces or internal link to remote M&C port (software selected). Other devices externally wired in parallel with M&C port can also be accessed remotely.	
Async ESC Option	Closed Net Plus ESC	Overhead scales to provide any user specified async ESC baud rate whatever the satellite data rate. ESC limit is approximately 70% of main channel rate, overhead varies from <0.5% to >70%.
	IBS option	High rate async data using from 1/32 nd to 22/32 nd of the IBS overhead, providing async baud rates from 0.2% to 5.1% of the terrestrial rate (e.g., up to >2400 baud at 64kbps). Includes modes compatible with the P300 and P400 Series, P230 & P1300/P1361 (using 20/32 nd of the overhead).
IBS Aux Data Channel	With IBS option and Advanced Aux option: Intelsat low rate async ESC definition carried in bit 1 of TS32 providing a synchronous channel at 1/480 th of the data rate, allowing up to one quarter of this rate for over-sampled async data. Compliant with Intelsat IESS-403 low rate ESC definition.	

1.54 IDR Option Specifications

Parameter	Modem
IDR ESC Audio	Two 32kbps ADPCM channels
Interface	4-wire 600Ω, +7dBm to -16dBm (programmable in 0.1dB steps).
Backward Alarms	Outputs: Four "form c" relays. Inputs: Four protected inputs, short to 0V to send alarm with matching summary Rx fail output. Alarm inputs software configurable for: a) All external patch, b) 1=Rx fail and 2-4=external patch, c) 1=Rx fail and 2-4=OK, d) 1-4=Rx fail
ESC/Aux Ports	When the IDR option is fitted, independent ESC & Aux ports on the IDR option replace the single shared ESC/Aux port on the base unit.

ESC Port	RS232, RS422 or RS485 external interfaces or internal link to remote M&C port (software selected). No external cabling required between the ESC and M&C ports for M&C via ESC channel within overhead. Other devices externally wired in parallel with M&C port can also be accessed remotely. Provides clock, data and sync (octet timing) lines.	
	IDR	Synchronous access to 8kbps IDR ESC. With the Async ESC option, async ESC access to the 8kbps IDR ESC is provided giving up to a 9600 baud async channel
	Others	IBS and Closed Net Plus ESC facilities as before installation of IDR option, but now on ESC port on IDR card not shared ESC/Aux port of base unit.
Aux Port	RS232 or RS422 (user selectable). Provides clock and data lines	
	IDR	Provides 32 or 64kbps access in place of one or both audio ESC channels.
	IBS	Intelsat low rate ESC mode as previously but now via Aux port on IDR card not shared ESC/Aux port of base unit. IDR option also adds sync IBS mode, configurable to use between 1/32 nd and 21/32 nd of the IBS overhead providing a full sync Aux port at between 0.2% and 4.3% of the main data rate. Aux port provides satellite timing information for P1500 slave Frequency Standard when not configured for Aux data access.

1.55 BERT Option Specifications

Parameter	Modem
BER Channel	The BERT may operate through main traffic, ESC data or Aux data channels. Use of ESC & Aux data channels allows continuous real traffic BER performance monitoring while the modem carries traffic.
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 average BER and other parameters at regular intervals.

1.56 AUPC Specifications

Parameter	Modem
Modes of Operation	Monitor of distant Eb/No and BER only, full distant Eb/No maintenance. Unidirectional or Bi-directional operation.
Communication Link	Utilises asynchronous ESC channel on IBS/SMS, IDR and Closed Network plus ESC carriers (ESC from 300 baud, i.e., overheads down to less than 1%).
User Parameters	Target Eb/No, positive power offset, negative power offset.

1.57 Data Rate Specifications

Maximum symbol rates are as follows:

PD10 IF: 5 Msps
 PD10 L-band: 5 Msps
 PD20 IF: 10 Msps
 PD20 L-band: 10 Msps
 PD25 IF: 12.5Msps
 PD25 L-band: 12.5Msps
 PD55 IF: 40Msps
 PD55 L-band: 40Msps
 PD60 IF: 40Msps (37.5Msps for DVB-S2)
 PD60 L-band: 40Msps (37.5Msps for DVB-S2)

Maximum bit rates are shown over the page for PD55 IF and L-band modems.

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Modulation/FEC	FEC Rate de facto	Min Data Rate kbps	Max Data Rate Mbps
BPSK VIT / SEQ	1/2	4.8	15 / 2
BPSK VIT / SEQ	3/4	7.2	22.5 / 2
BPSK VIT / SEQ	7/8	8.4	26.2 / 2
BPSK VIT RS	1/2	4.3	13.33
BPSK VIT RS	3/4	6.4	20
BPSK VIT RS	7/8	7.5	23.33
O/QPSK VIT / SEQ	1/2	9.6	30 / 2
O/QPSK VIT / SEQ	3/4	14.4	45 / 2
O/QPSK VIT / SEQ	7/8	16.8	52.5 / 2
O/QPSK VIT RS	1/2	8.6	26.67
O/QPSK VIT RS	3/4	12.8	40
O/QPSK VIT RS	7/8	15	46.67
O/QPSK TPC	1/2	9.6	29.56
O/QPSK TPC	3/4	14.4	45
O/QPSK TPC	7/8	16.8	52.5
O/QPSK TPC	0.93	17.9	52.74
8PSK TCM	2/3	19.2	60
8PSK TCM RS	2/3	17.7	55.07
8PSK TPC	3/4	21.6	60
8PSK TPC	7/8	25.2	60
8PSK TPC	0.93	26.8	60
16QAM TPC	3/4	28.8	60
16QAM TPC	7/8	33.6	60
16QAM TPC	0.93	35.8	60
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	90
DVB-S2 8PSK	9/10	268	90
DVB-S2 16APSK	2/3	263.8	90
DVB-S2 16APSK	3/4	296.7	90
DVB-S2 16APSK	4/5	316.6	90
DVB-S2 16APSK	5/6	330.1	90
DVB-S2 16APSK	8/9	352.4	90
DVB-S2 16APSK	9/10	356.8	90
FASTLINK LOW-LATENCY LDPC: SEE SEPARATE DATASHEET			
NOTE: Maximum data rate for TPC is 60Mbps, for DVB-S2 is 90Mbps and for FastLink is 100Mbps			

1.58 Traffic Log Specifications

Parameter	Modem
Capacity	Over 6000 entries
Entry Format	Fault message with time and date stamp. Separate entry when fault clears/changes.

1.59 Common Specifications

Parameter	Modem
Loop-backs	Interface Loop (Local and Remote) Framer Loop (Local) RS Loop (Local) FEC Loop (Local) Deframer/Framer Loop (Remote) Internal IF loopback (local, automatically matching Rx IF frequency to Tx)
Test Modes	Transmit CW (Pure Carrier) Transmit Alternate 1-0 Pattern Wideband spectrum analyzer display
Alarm Relays	4 Independent Change-Over Contacts: Unit Fault, Rx Traffic Fault Tx Traffic Fault, Deferred Alarm (backward alarm, BER or Eb/No below user set threshold)
Embedded Software	Revised embedded software may be downloaded into FLASH memory via Ethernet port with modem remaining in equipment rack.
Configuration Memories	20 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	For multi-drop applications, RS485 interface. For direct to PC applications, RS232 interface (front panel selectable). M&C port may be directly internally linked to ESC port for "over-the-satellite" M&C without cabling. Ethernet (10/100 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	0-10V analogue output (Signal level, Eb/No, or Rx offset frequency) on Alarms & AGC connector

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Mechanical	1U chassis – 410mm deep, excluding front panel handles and rear panel connectors and fans.
Weight	3.5 Kg
Power Supply	100-240VAC, -10%, +6%, 1A at 100V, 0.4A at 240V, 47-63Hz. Fused IEC connector (live and neutral fused). 48 Volts DC option
Safety	EN60950-1
EMC	EN55022 Class B (Emissions) EN55082 Part 1 (Immunity)
Environmental	Operating Temperature Range 0-50°C
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

1.60 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

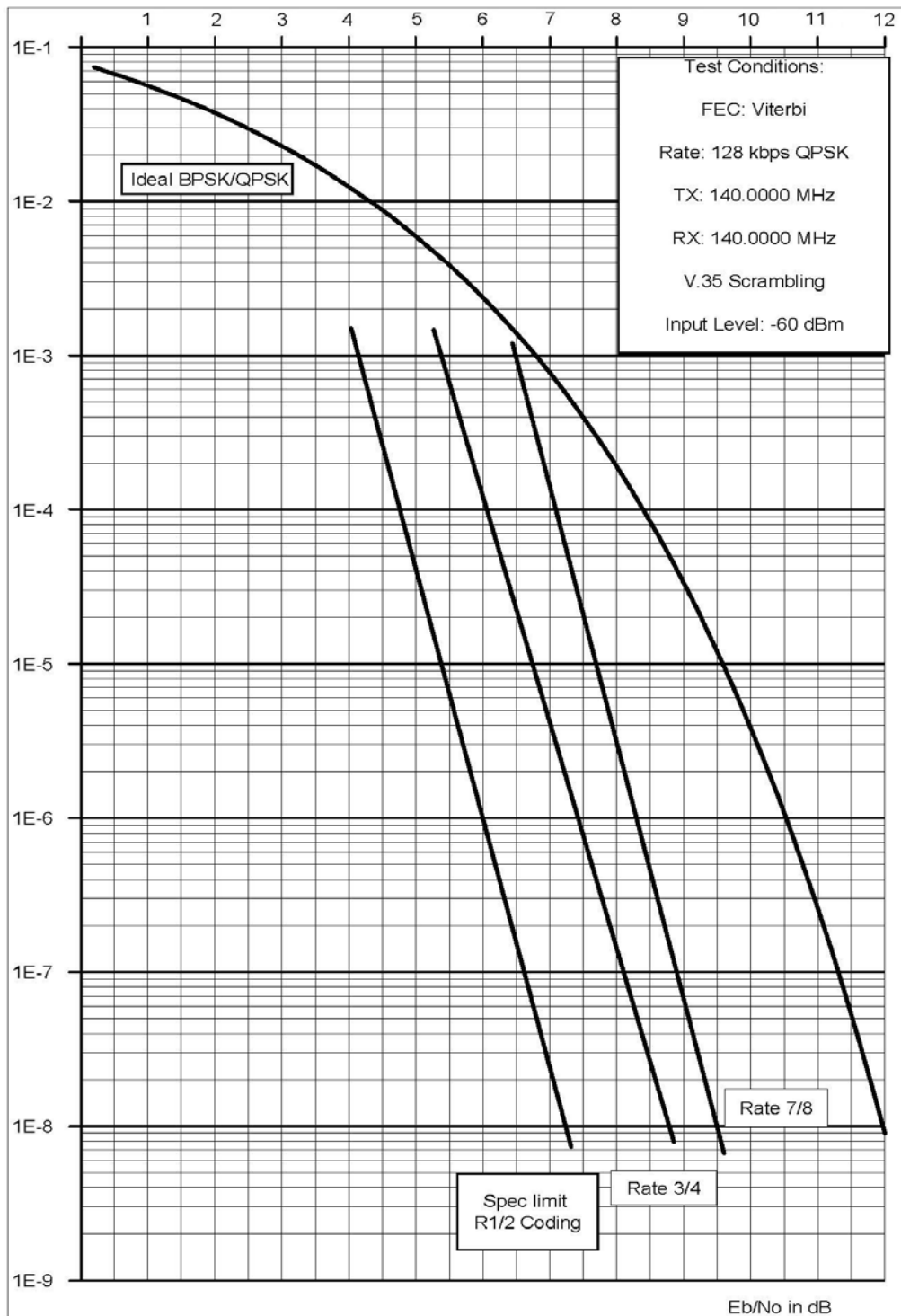
1.61 BUC / LNB facilities

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	+15/24V 0.5A DC to LNB via Rx IFL (standard)
FSK Control Option	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	Requires the High Stability 7.5×10^{-8} /yr Reference Oscillator Option. 10MHz may be provided via the Tx IFL to the BUC and via the Rx IFL to the LNB

1.62 Performance Graphs

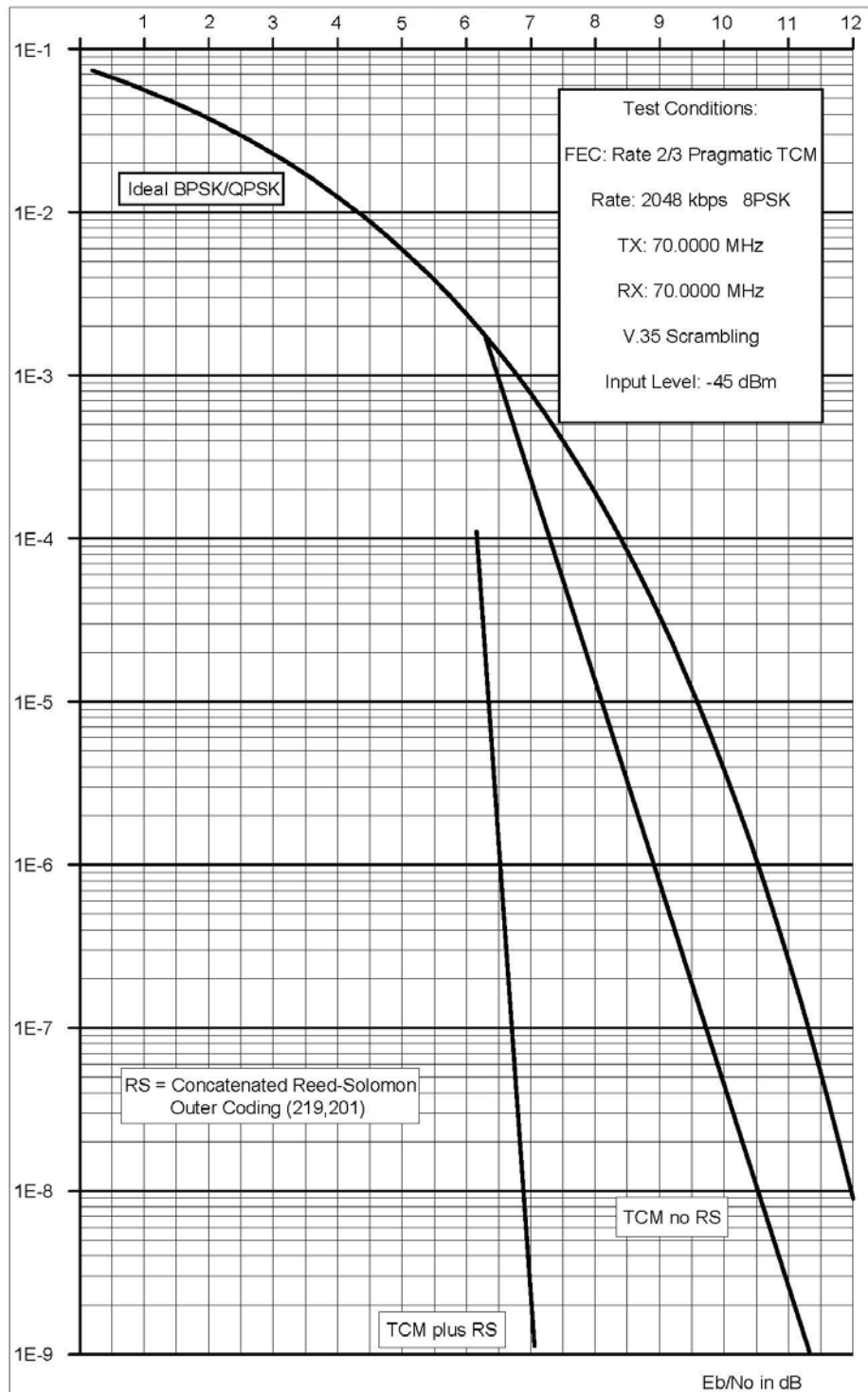
For FastLink low-latency LDPC BER curves, please see separate datasheet on the Paradise Datacom web site at <http://www.paradisedata.com>.

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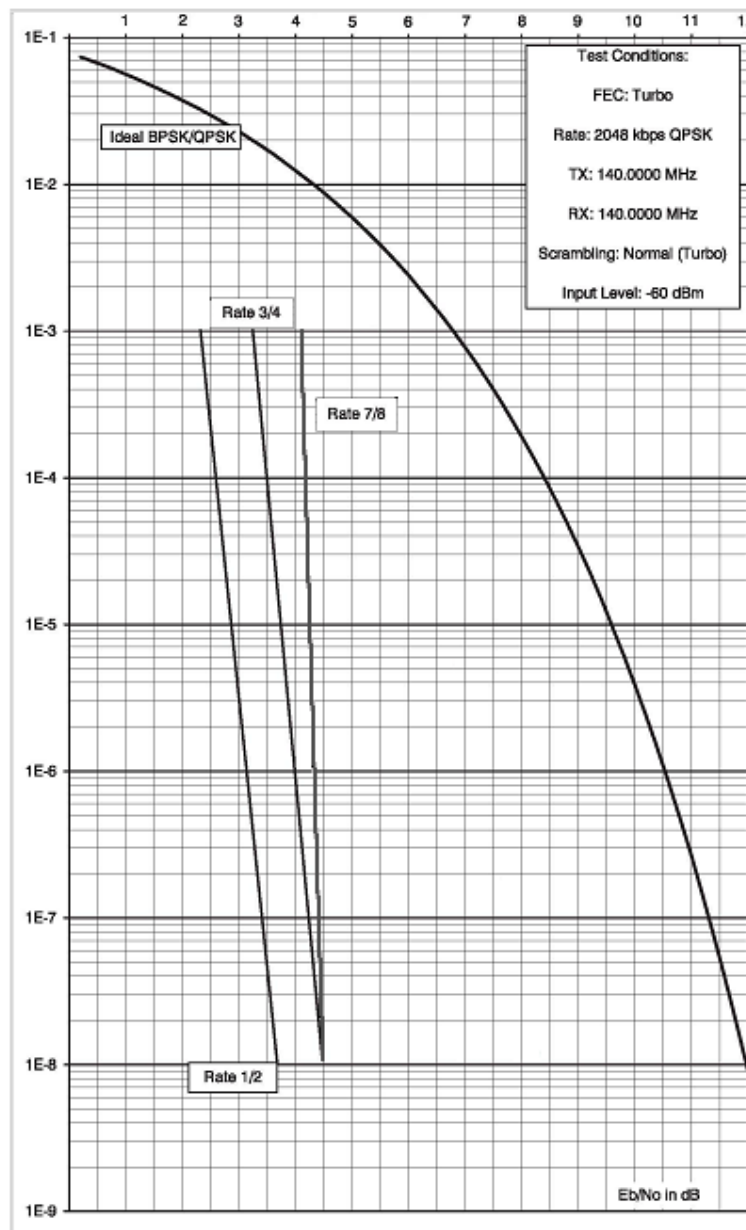


Modem, Error Probability versus E_b/N_0 – Viterbi Decoding

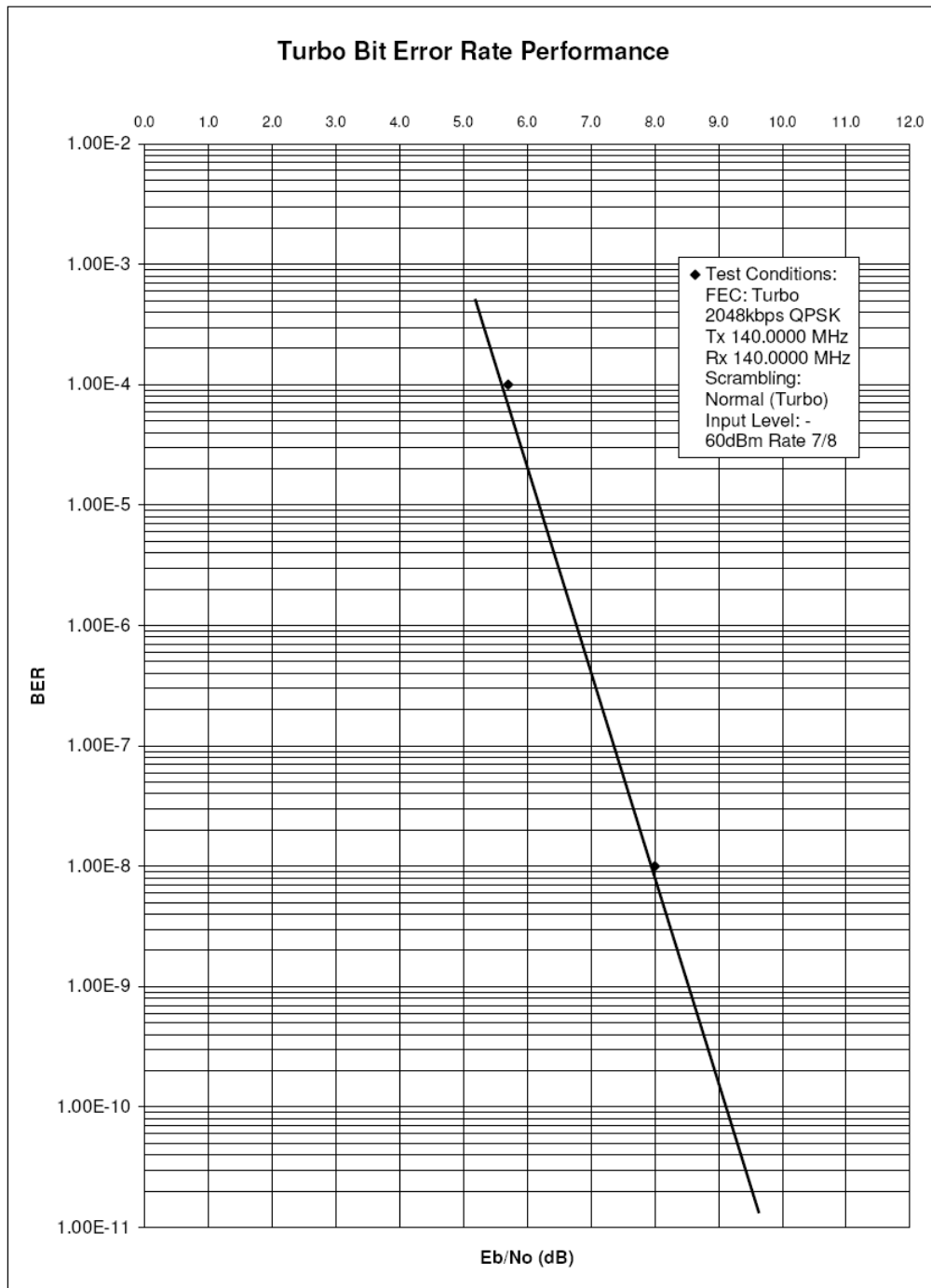
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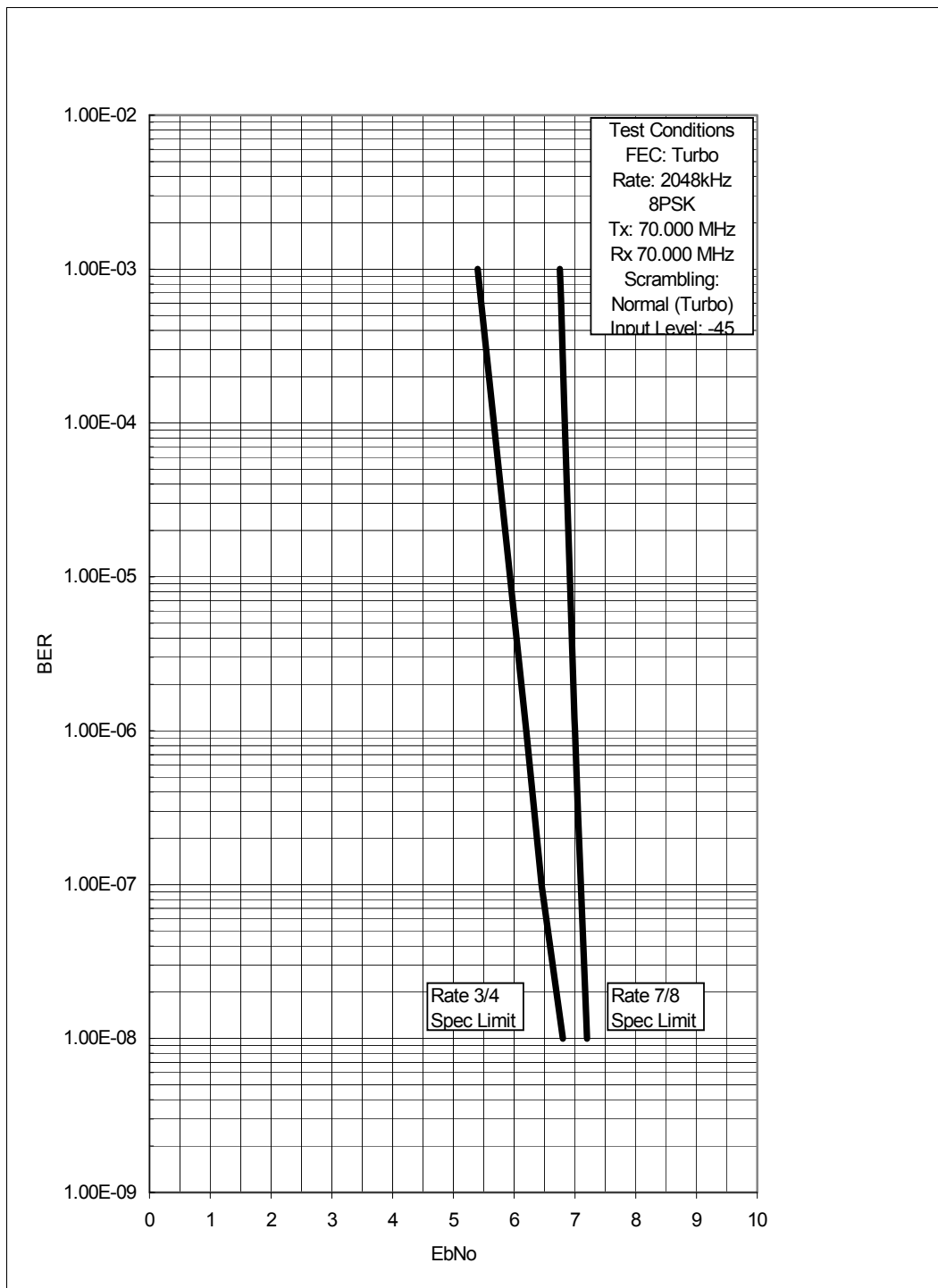
Modem, Error Probability versus Eb/No – 8PSK/TCM with/without Reed-Solomon



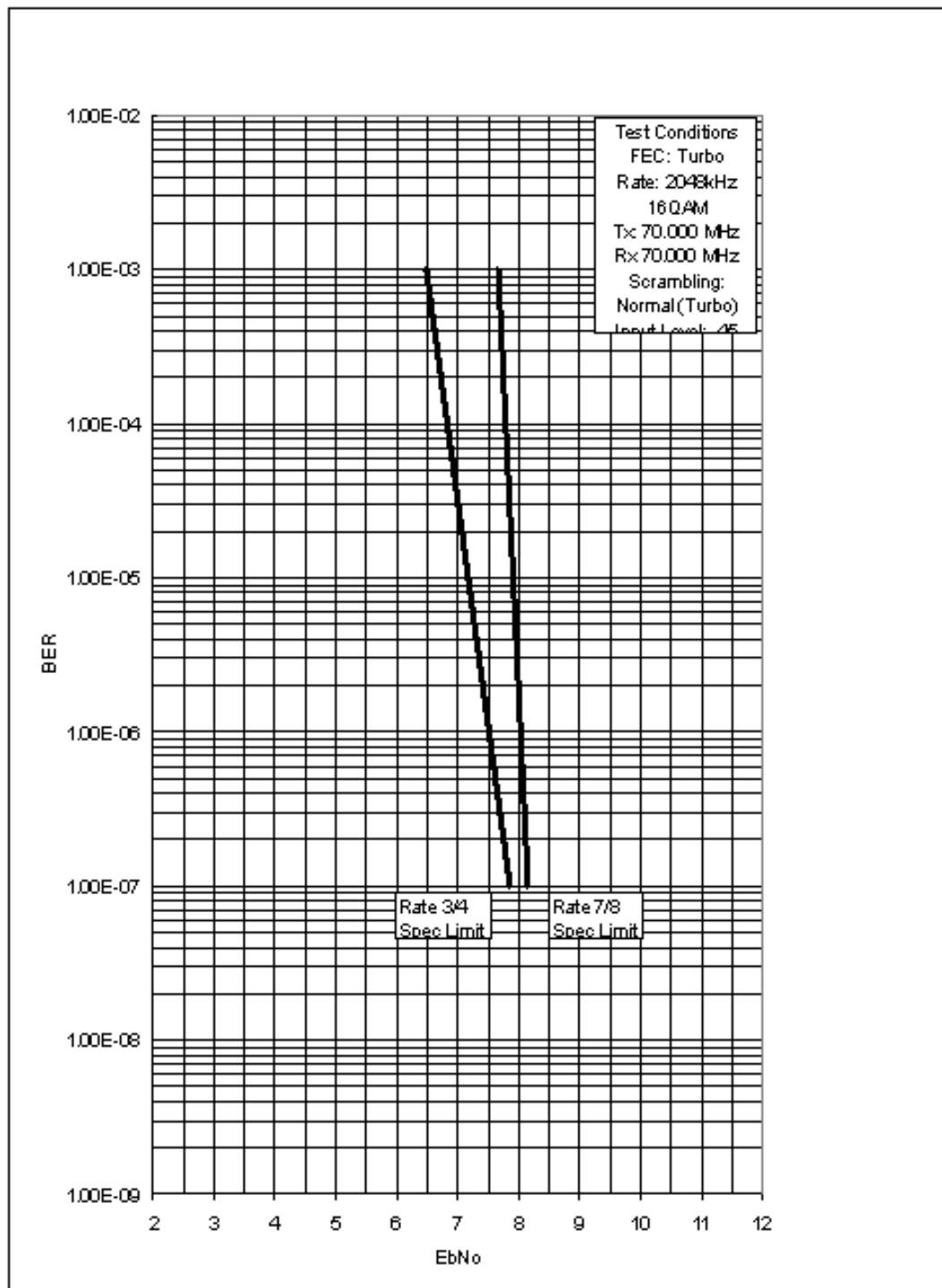
Modem, Error Probability versus E_b/N_0 – 2nd Generation Turbo Codec
(Note: rate 7/8 is de facto)



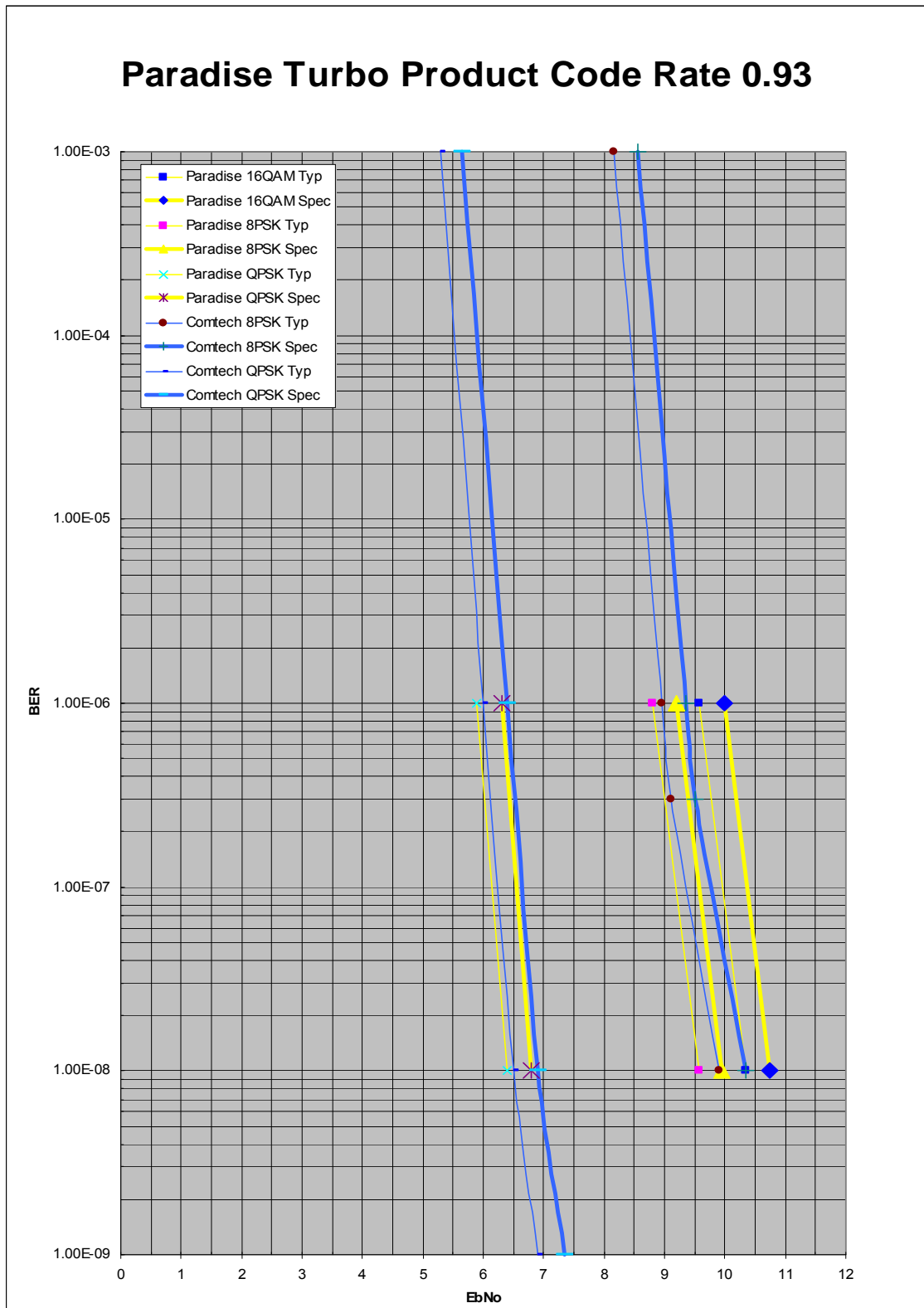
Modem, Error Probability versus E_b/N_0 for low-latency Paradise TPC rate 7/8



Modem, Error Probability versus E_b/N_0 8PSK Turbo



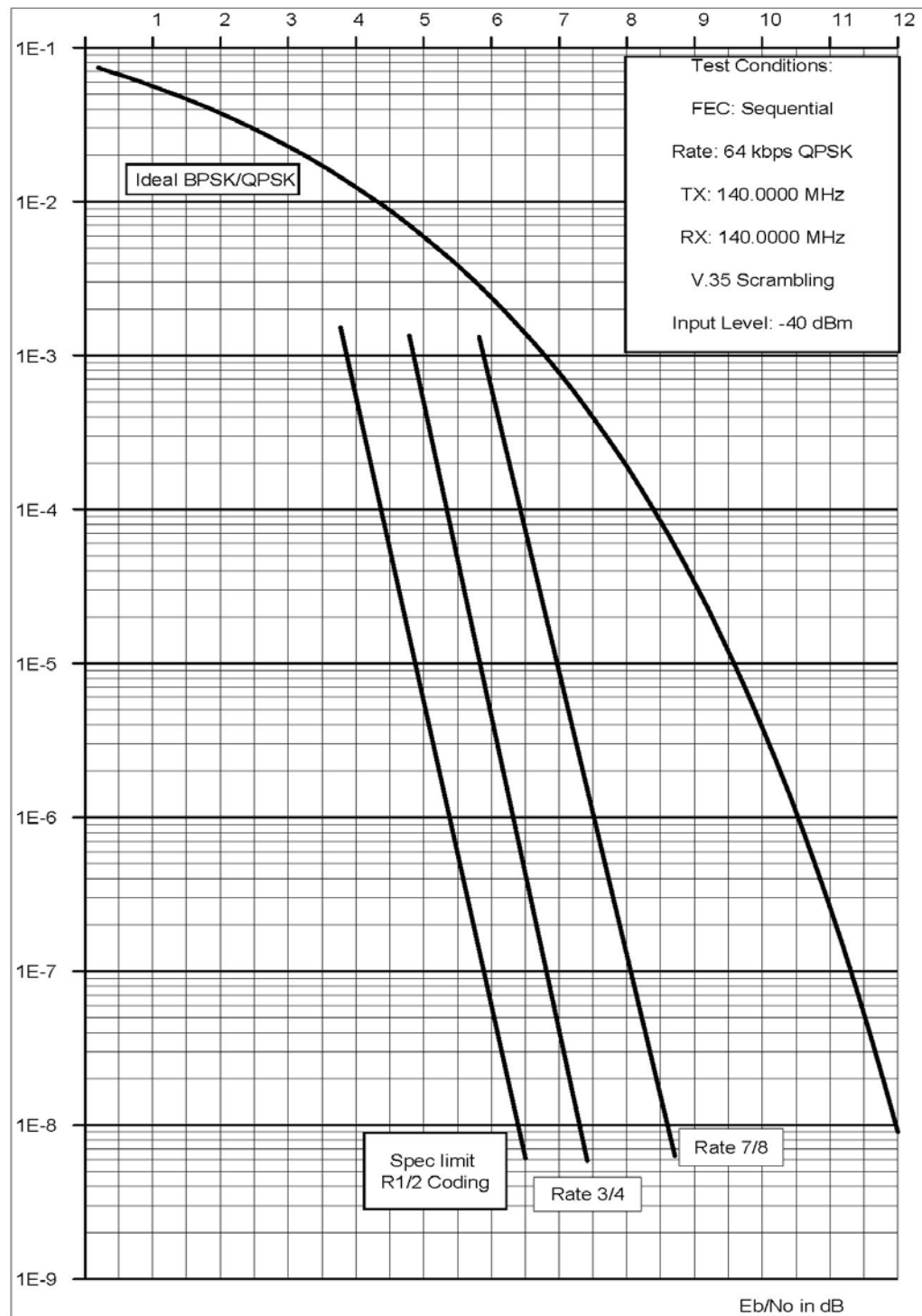
Modem Error Probability versus E_b/N_o 16QAM Turbo



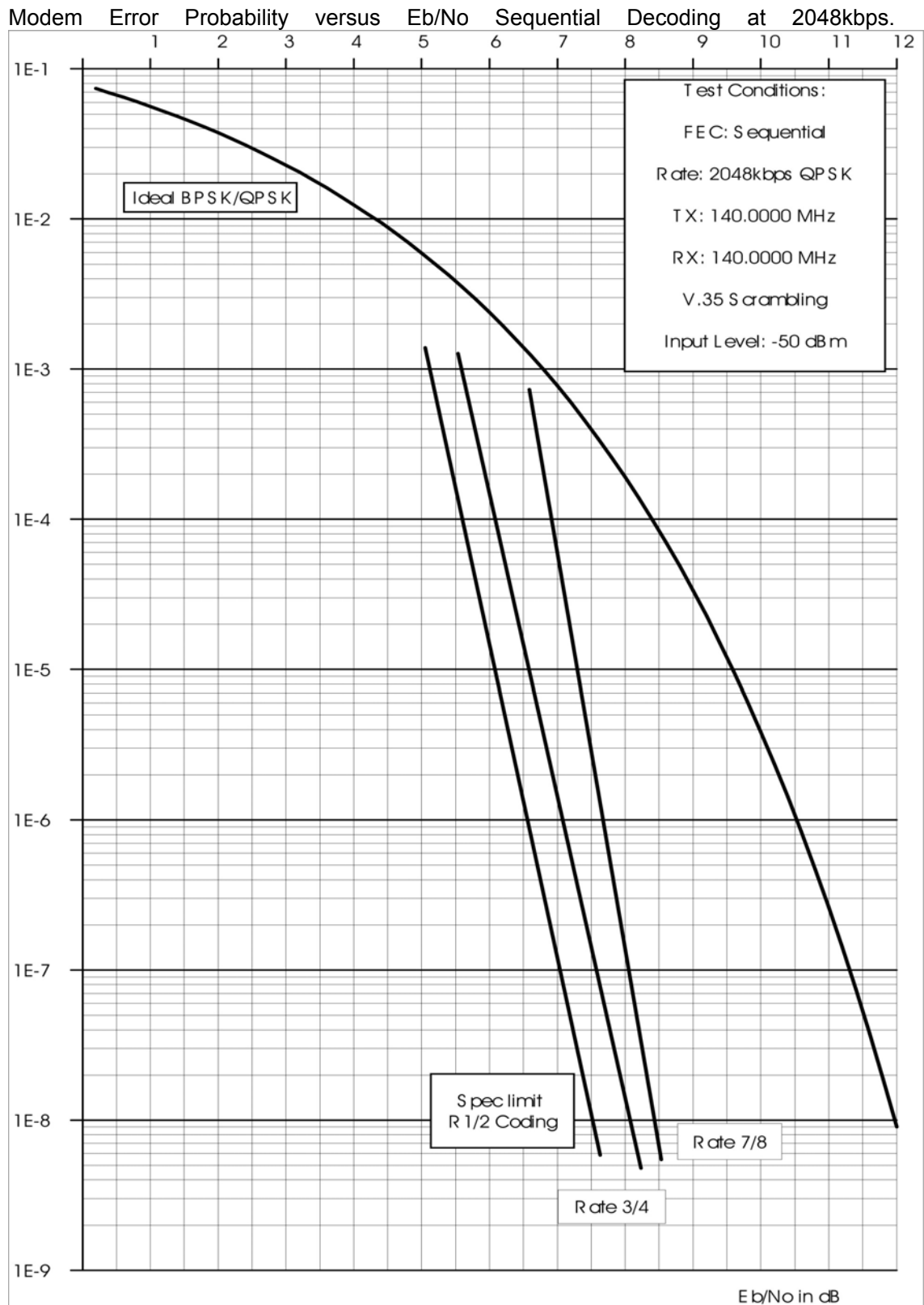
Modem Error Probability versus Eb/No Turbo Rate 0.93 (versus Comtech Turbo Rate 0.95)

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Modem Error Probability versus Eb/No - Sequential Decoding at 64kbps



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Chapter 14 Advanced Framing

This chapter describes the advanced SCPC framing options available on the modem local user interface menus. The modem web user interface supports equivalent menu options.

Edit-Tx-Baseband-Advanced Menu

Advanced:	1:Framing
	2:Timeslots
	3:Overhead

When the user level is set to *Advanced* (see the *Edit-Unit-Advanced-User Level* screen), this menu allows configuration of framing, timeslots and overhead.

Edit-Tx-Baseband-Advanced-Framing Menu

1:2048k mode	2:CAS	3:TS order
4:Drop mode	5:G732 sig	6:T1 sig
7:CRC		

This menu contains the following options:

- *2048k mode*. This option is used to indicate whether a continuous 2048kbps traffic stream is formatted as G.732 or not.
- *CAS*. This option specifies whether Channel Associated Signalling (CAS) information is present in Timeslot 16.
- *TS order*. This controls whether timeslot reordering is allowed.
- *Drop mode*. This specifies the framing format for Drop MUX operation.
- *G732 sig*. This option controls whether CAS information is processed and routed through the satellite.
- *T1 sig*. This specifies whether Robbed Bit Signalling (RBS) information is present in the traffic source.
- *CRC*. This is used to specify whether the terrestrial G.732 frame contains a checksum that should be checked for errors.

Edit-Tx-Baseband-Advanced-Framing-2048k Mode Screen

2048k data format: [Unformatted]
1:Unformatted
2:G.732

Options:

Unformatted

G.732

Factory default: *Unformatted*

Description: IBS: G.732 is Intelsat N=30/1920kbps (Sat=2048k) mode, Unformatted is N=32 (Sat=2184k) mode; IDR and Closed Network + ESC: G.732 aligns satellite frame with terrestrial for distant-end partial insert, Unformatted uses an arbitrary point for frame insertion.

Edit-Tx-Baseband-Advanced-Framing-CAS Screen

G.732 CAS signalling: [No CAS]
1:CAS
2:No CAS

Options:

CAS

When CAS is selected, the CAS will be conveyed from end-to-end of the link using the IBS overhead.

No CAS

This indicates that a terrestrial CAS multiframe and 'abcd' signalling nibbles for each timeslot are not present. Consequently, Timeslot 16 may be dropped/inserted in a similar manner to other timeslots.

Factory default:

No CAS

Description: For G.732 bearer operation, specifies whether Channel Associated Signalling information is present in Timeslot 16.

Edit-Tx-Baseband-Advanced-Framing-TS Order Screen

Remap timeslot order: [Do not map]
1:Do not map
2:Map

Options:

Do not map

Do not allow timeslots to be reordered.

Map

Allow timeslots to be reordered.

Factory default: *Do not map*

Description: Controls whether timeslots can be reordered within the G.732 frame prior to transmission. In some applications, this feature can remove the need for separate Digital Access Cross Connect (DACCs) equipment that is used to re-arrange timeslots.

Edit-Tx-Baseband-Advanced-Framing-Drop Mode Screen

Drop bearer format: [G.732]
1:G.732 2:T1-D4
3:T1-ESF

Options:

G.732

T1-D4

T1-ESF

Factory default: *G.732*

Description: Bearer type selection for Drop MUX operation.

Edit-Tx-Baseband-Advanced-Framing-CAS in TS16 Screen

Process CAS in TS16: [No CAS]
1:No CAS
2:CAS

Options:

No CAS

CAS

Factory default: *No CAS*

Description: Controls whether CAS information is processed and routed through the satellite.

Edit-Tx-Baseband-Advanced-Framing-T1 RBS Screen

T1 signal contains RBS: [No RBS]
1:No RBS
2:RBS

Options:

No RBS

Robbed bit signalling is not in operation or can be ignored.

RBS

Robbed bit signalling is in use, with the least significant bit of each timeslot being used for signalling in frames 6 and 12 (D4) or 6, 12, 18 and 24 (ESF) of the terrestrial multiframe.

Factory default:

No RBS

Description: Specifies whether Robbed Bit Signalling information is present in the traffic source. When selected, drop/insert data is placed into the bearer by the insert MUX in the same frames from which it came. It is still possible to drop from and insert into different timeslots, however, the data frames containing RBS are placed in the same relative positions within the terrestrial multiframe by the Insert MUX in order to preserve RBS.

Edit-Tx-Baseband-Advanced-Framing-CRC Screen

Process bearer CRC: [Ignore CRC] New: Ignore CRC
--

Options:

Ignore CRC

Specifies that the terrestrial G.732 frame does not contain a checksum or it should be ignored.

Check CRC

Specifies that the terrestrial G.732 frame does contain a checksum that should be checked for errors. If enough errors accumulate then a Tx Drop MUX BER alarm will be raised (*'Input BER > 1E-3'*).

Factory default:

Ignore CRC

Description: This option is applicable only with G.732 Drop/Insert bearers and controls the processing of any terrestrial checksum.

Edit-Tx-Baseband-Advanced-Framing-CRC-Frame Re-acquisition Screen

Frame re-acquisition on CRC loss: [Normal] New: Normal
--

Options:

Normal

Specifies that no attempt is made to re-acquire terrestrial Drop/Insert frame synchronization if CRC synchronization cannot be achieved within 8ms.

Resync if CRC lost for 8ms

Specifies that re-acquisition of the terrestrial Drop/Insert frame synchronization should occur if CRC synchronization cannot be achieved within 8ms.

Factory default: *Normal*

Description: This option is applicable only with G.732 Drop/Insert bearers when the 'Process bearer CRC' option is set to 'Check CRC'. It controls whether a strict implementation of ITU G.704 is carried out, forcing re-acquisition of the terrestrial Drop/Insert frame synchronization if CRC synchronization cannot be achieved within 8ms.

Edit-Tx-Baseband-Advanced-Timeslots Menu

Timeslots:1:Number used 2:Timeslots 3:Maintain ID 4:Idle code
--

This menu contains the following options:

- *Number used.* This controls the number of timeslots dropped off the terrestrial bearer and sent over the satellite.
- *Timeslots.* This option is used to select which timeslots are dropped.
- *Maintain ID.* This controls whether timeslot identity is maintained over satellite (i.e. whether the timeslots represent different data streams or are all part of the same stream).
- *Idle code.* This controls whether dropped timeslots are replaced with Idle code.

Edit-Tx-Baseband-Advanced-Timeslots-Number Used Screen

No. timeslots used:0 to 31
[01] Step 1
New: 01

Units:

Minimum value: 0
Maximum value: 31
Step size: 1
Factory default: 0

Description: Controls the number of timeslots dropped off the terrestrial bearer and sent over the satellite.

Edit-Tx-Baseband-Advanced-Timeslots-Timeslots Screen

Terr slots to drop to satellite
[1]
New:0,18-31,17,16-1

Units:

Minimum value: 0
Maximum value: 31
Step size: 1
Factory default: 0

Description: Controls which timeslots are dropped and in which order. Terrestrial timeslots are mapped into the satellite frame in the order listed on this screen, which allows timeslots to be reordered. For G.732 operation timeslot numbers 1-32 are used, and for T1-D4 and T1-ESF, timeslot numbers 1-24 are used. Timeslots can be entered as individual numbers separated by commas or as an inclusive range denoted by the first and last timeslot numbers in the range with a hyphen between them. For example, '0,18-31,17,16-1' swops timeslots groups 18 to 31 with 1 to 16 and additionally reverses timeslots 1 to 16.

Note that on this screen the *Down* arrow key is used to enter a comma and the *Up* arrow key is used to enter a hyphen. The 0 key pressed together at the same time as the *Right* arrow key deletes the character at the cursor.

If the number of timeslots that are entered differ from the number entered on the *Edit-Tx-Baseband-Advanced-Timeslots-Number Used Screen* then the new value will not be accepted and the modem will

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remain on this screen.

Note that when a valid sequence of timeslot numbers is accepted, it may take several seconds for the display to update due to the level of internal processing involved.

Edit-Tx-Baseband-Advanced-Timeslots-Maintain ID Screen

Maintain timeslot ID over satellite: [Off]

1:Off

2:On

Options:

Off

Timeslot identity will not be maintained.

On

The modem will activate the satellite CAS multiframe in order to provide timeslot identity maintenance for certain numbers of timeslots.

Factory default:

Off

Description: Set to on if timeslots contain different data streams; set to off if timeslots are all part of the same stream.

Edit-Tx-Baseband-Advanced-Timeslots-Idle Code Screen

Dropped timeslots: [Leave on bearer]

1:Leave on bearer

2:Replace with Idle code

Options:

Leave on bearer

The Tx data remains on the bearer and will be accessible to downstream equipment unless Rx data is inserted over it.

Replace with Idle code

The Tx data is replaced as follows (MSB to LSB):
G.732 timeslots are replaced with 01010101
G.732 CAS in TS16 is replaced with 0101 if CAS signalling is active
T1-D4 and T1-ESF timeslots are replaced with 10000000


Factory default:

Leave on bearer

Description: Controls whether dropped timeslots are replaced with Idle code. If the Rx

data is to be inserted into the same timeslots as the Tx data has been dropped from then the Rx data will replace the Tx data and therefore this setting is irrelevant. In G.732, timeslot 0 is never replaced with Idle code.

Edit-Tx-Baseband-Advanced-Overhead Menu



**Overhead:1:Closed+ESC
2:IBS/SMS
3:IDR**

This menu contains the following options:

- *Closed+ESC*. This controls the overhead in Closed Network plus ESC mode, allowing the high-rate asynchronous ESC channel to be set up. The different options are presented as a sequence of screens that configure all aspects of the overhead.
- *IBS/SMS*. This controls the overhead in IBS/SMS mode, allowing both the low and high-rate ESC channels to be set up. The different options are presented as a sequence of screens that configure all aspects of the overhead.
- *IDR*. This controls the overhead in IDR mode, allowing the IDR 8kbps ESC channel and audio channels to be set up and the routing of multiple backward alarms in IDR mode. It also allows Aux data to be allocated in place of one or both of the IDR audio channels if these are not used or it can be used to reduce the standard 96kbps overhead to 64 or 32kbps. The different options are presented as a sequence of screens that configure all aspects of the overhead.

Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens

The following sequence of screens will appear consecutively when the *Closed+ESC* overhead option is selected.

ESC interface baud rate:
[9600 baud]
New: 9600 baud

ESC Baud Rate Screen

ESC interface character length: [8 bits]
1:7 bits
2:8 bits

ESC Character Length Screen

ESC interface parity polarity:
[None]
New: None

ESC Parity Screen

ESC interface:
[RS485]
New: RS485

ESC Interface Screen

Enable backward alarm: [On]
1:Off
2:On

ESC Backward Alarm Screen

IBS/SMS Aux mode:

[Off]

New: Off

Aux Mode Screen

Aux interface: [RS485]

1:RS232

2:RS422

3:RS485

4:IP

Aux Interface Screen

These screens are explained in the following sections.

ESC Baud Rate

Options:

110 baud

150 baud

300 baud

600 baud

1200 baud

2400 baud

4800 baud

9600 baud

19200 baud

38400 baud

57600 baud

76800 baud

115200 baud

Factory default: *9600 baud*

Description: Sets the baud rate of the ESC UART.

ESC Character Length

Options:

7 bits

8 bits

Factory default: *8 bits*

Description: Sets the number of bits in an ESC UART character.

ESC Parity

Options:

None

Even

Odd

Factory default: *None*

Description: Controls the ESC UART parity setting.

ESC Interface

ESC interface:
[RS485]
New: RS485

Options:

RS232

RS422

RS485

IP

RS485-Local

RS485-Remote

IP to Serial

Factory default: *RS485*

Description: Specifies which of the modem's physical interfaces is to be connected through to the satellite ESC channel. Note RS485 is not available on the IDR card.

Note that the modem back panel Async ESC connector provides either a

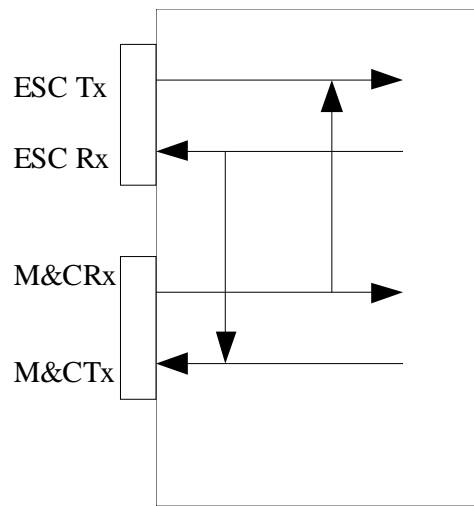
high-rate asynchronous ESC interface for IBS/SMS and Closed Network plus ESC overhead channel data, or it provides the Aux function. When an IDR option card is fitted then the back panel shared Async ESC port is disabled and the IDR card provides separate ESC and Aux ports.

In the case of RS232, RS422 and RS485, the relevant physical interface (on the Async ESC port) is directly connected through to the ESC channel and the data is therefore passed transparently, i.e. whatever is passed through is what comes out on the equivalent interface on the remote modem, without being interpreted in any way by either modem. For example, messages could be passed to control any manufacturer's piece of equipment that is listening on an RS485 multidrop bus hanging off the remote modem.

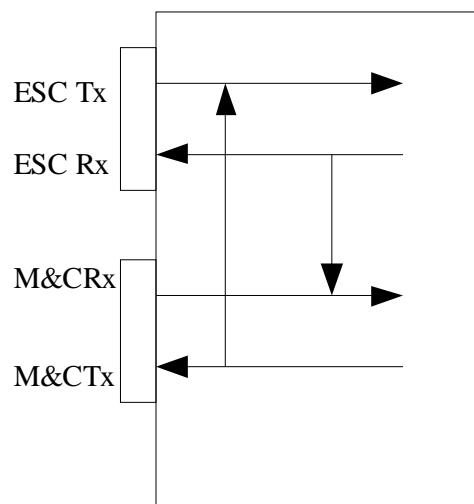
The IP mode allows IP packets to be sent over the satellite ESC channel. The ESC channel forms part of an Ethernet bridge and it therefore learns which IP packets should be sent over the ESC channel. The IP packets need not be destined for the remote modem – they will be passed onto the remote Ethernet network if they are addressed to a device on that network. The IP packets will be interleaved with AUPC messages when AUPC is switched on. It is even possible to send RS485 M&C messages over the satellite ESC channel at the same time as IP packets, provided that the M&C messages are prefixed with *ESC* as described in the document '*Remote M&C Specification for Quantum and Evolution Series Satellite Modems*'.

Both point-to-point and point-to-multipoint IP over the ESC channel are supported. With point-to-point mode, the modem will allocate internal IP addresses to each end of the ESC channel and these will only be visible internally within the modem. In point-to-multipoint mode the modem needs to be told which remote to connect to as it can only connect to one remote modem at a time. Point-to-multipoint IP over the ESC will be active when the *Edit-Unit-Interface-Terrestrial-IP Ethernet Traffic Mode* is set to a point-to-multipoint mode. When using the web user interface *Local/Distant* button in point-to-multipoint mode, the user is prompted for an IP address for the remote modem to connect to over the ESC channel. (If you want to make an ESC connection to a specific remote modem without using the web user interface then you can enter the PUP command 'esc remote x.x.x.x' through a telnet session where 'x.x.x.x' is the IP address of the modem to connect to.)

The *RS485-Local* and *RS485-Remote* modes are referred to as *Link-Local* and *Link-Remote*, respectively. These modes create internal links between the ESC port of the modem and the Remote M&C port in order to facilitate passing M&C messages over satellite to control a remote modem without the need for external loopback cables between the Async ESC and Remote M&C ports. Both point-to-point and point-to-multipoint RS485 over the ESC channel are supported. The following drawing shows the internal connections that are made.



Link-Local



Link-Remote

With both of these options, the physical ESC port is disabled due to being internally linked to the M&C port. The mode must be set according to whether the modem is at the local or remote end of the link.

The effect of *Link-Local* is to transmit whatever is received over the satellite ESC channel out onto the local modem's M&C bus, while at the same time, transmitting all incoming M&C messages out over the satellite ESC channel.

The effect of *Link-Remote* is to loop back whatever is received over the modem's satellite ESC channel to the modem's M&C port and to transmit over the satellite ESC channel whatever is transmitted by the modem out of its M&C port.

IP to Serial supports the transmission of IP-wrapped RS485 messages

through the ESC channel, which are then transmitted as serial messages on the remote RS485 bus.

ESC Backward Alarm

Options:

Off

On

Factory default: *Off*

Description: Controls the ESC Backward alarm setting.

IBS/SMS Aux Mode

Options:

Off

Intelsat over-sampled

Synchronous

Factory default: *Off*

Description: Controls the operating mode of the IBS Aux channel, controlling the allocation of overhead between the Aux and ESC interfaces.

AUX Interface

Aux interface: [RS485]

1:RS232 2:RS422

3:RS485 4:IP

Options:

RS232

RS422

RS485

IP

Factory default: *RS232*

Description: Specifies the Aux electrical interface. Note RS485 is not available on the IDR card. The relevant physical interface (on the shared Async ESC/Aux port on the base modem or the separate Aux port on the IDR card) is directly connected through to the ESC channel.

This interface on the modem provides the IBS/SMS low-rate Intelsat oversampled ESC facility. The ESC and Aux functions are mutually

exclusive unless an IDR card is fitted. If an IDR card is fitted then the Aux port can provide 32 or 64kbps access to the IDR overhead in place of one or both of the IDR 32kbps ADPCM audio ESC channels, or it can provide either the IBS/SMS low-rate Intelsat oversampled ESC facility or a higher rate synchronous channel within the IBS/SMS overhead.

Edit-Tx-Baseband-Advanced-Overhead-IBS/SMS Screens

The following sequence of screens (depending on what SAF options are enabled) will appear consecutively when the *IBS/SMS* overhead option is selected.

High-rate ESC mode:

[Asynchronous]

New: Asynchronous

High-rate ESC Mode Screen

High-rate ESC usage: [Maximum overhead]

[P230 compatible]

New: Maximum overhead

High-rate ESC Usage Screen

Max ESC rate: [9600]

Maximum ESC Baud Rate Screen

ESC interface baud rate:

[9600 baud]

New: 9600 baud

ESC Baud Rate Screen

ESC interface parity polarity:

[None]

New: None

ESC Parity Screen

ESC interface character length: [8 bits]
1:7 bits
2:8 bits

ESC Character Length Screen

IBS/SMS Aux mode:
[Off]
New: Off

Aux Mode Screen

ESC Interface: [RS485]
[RS485]
New: RS485

ESC Interface Screen

Aux interface: [RS485]
1:RS232 2:RS422
3:RS485 4:IP

Aux Interface Screen

ESC level ch1:0 to 38dB
[0] Step 2dB
New: 0

ESC Audio Levels Screen

Enable backward alarm: [On]
1:Off
2:On

Backward Alarm Mode Screen

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These screens are explained in the following sections.

High-rate ESC Mode

Options:

Off

Asynchronous

Requires the ESC SAF feature (standard on base modem).

Factory default: *Off*

Description: Controls whether the IBS high-rate asynchronous ESC channel is enabled.

High-rate ESC Usage

Options:

P230 compatible

Maximum overhead

Factory default: *Maximum overhead*

Description: Allows backward compatibility with Paradise P230 unit. Requires Custom SAF feature.

Maximum ESC Baud Rate

IBS/SMS uses a fixed frame format and therefore the amount of overhead is limited. This screen displays the maximum ESC baud rate that may be selected. The actual selection of the baud rate is done on the next screen.

ESC Baud Rate, ESC Character Length, ESC Parity, ESC Interface

See the descriptions under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

IBS/SMS Aux Mode

Options:

Off

Intelsat over-sampled

Synchronous

Factory default: *Off*

Description: Controls the operating mode of the IBS Aux channel, controlling the

allocation of overhead between the Aux and ESC interfaces.

ESC Interface

See the description under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

AUX Interface

See the description under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

ESC Audio Levels

Units: dB
Minimum value: 0
Maximum value: 38
Step size: 2
Factory default: 0

Description: Sets the input/output levels for the IDR audio ESC channels. The two channels can be configured independently.

ESC Backward Alarm

Options:
Off
On
Factory default: Off

Description: Controls the ESC Backward alarm setting.

Edit-Tx-Baseband-Advanced-Overhead-IDR Screens

The following sequence of screens will appear consecutively when the *IDR* overhead option is selected.

IDR 8k ESC: [Off]
1:Off **2:Asynchronous**
3:Synchronous

IDR 8k ESC Screen

ESC interface baud rate:
[9600 baud]
New: 9600 baud

ESC Baud Rate Screen

ESC interface character length: [8 bits]
1:7 bits
2:8 bits

ESC Character Length Screen

ESC interface parity polarity: [None]
[None]
New: None

ESC Parity Screen

ESC interface: [RS485]
[RS485]
New:RS485

ESC Interface Screen

IDR ESC audio encoding: [2x32K in V1,V2]
[2x32K in V1,V2]
New: [2x32K in V1,V2]

IDR ESC Audio Encoding Screen

IDR Aux data: [Off]
1:Off 1:32K
2:64K

IDR Aux Data Screen

Aux interface: [RS485]
1:RS232 2:RS422
3:RS485 4:IP

Aux Interface Screen

Backward alarm mode:
[1-4 external]
New: 1-4 external

Backward Alarm Mode Screen

ESC level ch1:0 to 38dB
[0] Step 2dB
New: 0

ESC Audio Levels Screen

These screens are explained in the following sections.

IDR 8k ESC

Options:

Off
Asynchronous

Requires ESC SAF feature (standard on base modem). Provides up to a 9600-baud asynchronous channel.

Synchronous

Factory default:

Off

Description: Controls the operating mode of the low-rate IDR ESC channel.

ESC Baud Rate, ESC Character Length, ESC Parity, ESC Interface

See the descriptions under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

ESC Interface

See the description under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

IDR ESC Audio Encoding

Options:

Off

When off, V1 and V2 are omitted and consequently only 32kbps overhead is transmitted (or the 64kbps of V1 and V2 overhead can be reallocated to Aux data via the IDR Aux mode setting). The 32kbps overhead includes FAS, backward alarms and an 8kbps synchronous ESC channel.

2x16k in V1

Two 16kbps ADPCM channels are provided in V1 (with V2 either being omitted or being replaced with Aux data as determined by the IDR Aux mode setting)

1x32k in V1

32kbps is provided in V1 (with V2 either being omitted or being replaced with Aux data as determined by the IDR Aux mode setting)

2x32k in V1,V2

The normal full 96kbps of IDR overhead is used, including two audio ESC channels encoded as 32kbps ADPCM, as well as the standard 32kbps for FAS, backward alarms and an 8kbps synchronous ESC channel .

Factory default:

Off

Description: Controls audio data format for the ESC overhead in IDR mode. The overhead can be set to 32, 64 or 96kbps. 64kbps of this can be not transmitted, allocated to voice or allocated to Aux data via the Aux controls.

IDR Aux Data

Options:

Off

No Aux data is placed in the overhead.

32K

32kbps of Aux data replaces the data in IDR audio ESC channel V2 (requires the IDR audio mode setting to be *2x16k in V1* or *1x32k in V1*).

64K

64kbps of Aux data replaces the data in IDR audio ESC channels V1 and V2 (requires the IDR audio mode to be set to *Off*).

Factory default:

Off

Description: Controls the Aux channel in IDR mode. Allocates Aux data in place of one or both of the IDR voice channels if these are not used or can be used to reduce the 96k overhead to 64k or 32k. Requires Aux SAF feature.

Aux Interface

See the description under *Edit-Tx-Baseband-Advanced-Overhead-Closed Network Plus ESC Screens*.

ESC Audio Levels

Units: dB

Minimum value: 0

Maximum value: 38

Step size: 2

Factory default: 0

Description: Sets the input/output levels for the IDR audio ESC channels. The two channels can be configured independently.

Backward Alarm Mode

Options:

Backward alarm 1-4 external

Backward alarm 1 internal, backward alarm 2-4 external

Backward alarm 1 internal, backward alarm 2-4 forced okay

Backward alarm 1-4 internal

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Factory default: *Backward alarm 1-4 external*

Description: Controls routing of multiple backward alarms in IDR mode. When internally linked from Rx-Fail to BA1 or BA1-4, these alarms respond similarly to the normal single backward alarm. Requires Custom SAF feature.

Chapter 15 Glossary

8PSK	Eight Phase Shift Keying
16QAM	Sixteen Quadrature Amplitude Modulation
ADPCM	Adaptive Differential Pulse Code Modulation
AGC	Automatic Gain Control
AUPC	Automatic Up-link Power Control
BER	Bit Error Rate
BERT	Bit Error Rate Tester
BPSK	Binary Phase Shift Keying
BSC	Base Station Controller
BTS	Base Transceiver Station
BUC	Block Up Converter
CAS	Channel Associated Signalling
CRC	Cyclic Redundancy Check
CW	Continuous Wave
ESC	Engineering Services Channel
FEC	Forward Error Correction
LCD	Liquid Crystal Display
IBS	Intelsat Business Service
IESS	Intelsat Earth Station Standard
IDR	Intermediate Data Rate
M&C	Monitor and Control
MIB	(SNMP) Management Information Base
MSC	Mobile Switching Centre
Mux	Multiplexer
OQPSK	Offset Quaternary Phase Shift Keying
PCB	Printed Circuit Board
PUP	Paradise Universal Protocol
PLL	Phase Locked Loop
PRBS	Pseudo-Random Bit Sequence
PSTN	Packet Switched Telephone Network
QPSK	Quaternary Phase Shift Keying
RBS	Robbed Bit Signalling
RF	Radio Frequency
RS	Reed-Solomon
Rx	Receive or Receiver
SAF	Software Activated Feature
SMS	Satellite Multiservice System (Eutelsat)
SNMP	Simple Network Management System
TCM	Trellis Coded Modulation
TPC	Turbo Product Coding
TRAU	Transcoding and Rate Adaption Unit
Tx	Transmit or Transmitter

Chapter 16 Customer Technical Support

Customer 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.
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Witham, Essex, CM8 3HA, England.
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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 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 Paradise Datacom. Within the UK, fax the paperwork and return the goods to Paradise UK.