User Manual

for

EL170/970/470 IP Satellite Modulator/ Demodulator/Modem

version 4.2

SHAPING THE FUTURE OF SATELLITE COMMUNICATIONS

Newtec

ISO 9001:2008 CERTIFIED

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COMPLIANCY STATEMENTS

TO WHOM IT MAY CONCERN

EC DECLARATION OF CONFORMITY

We,

Newtec Cy N.V.

Declare that the following product:

Product number:

EL170 with type identifier: NTC/2277 (IF) and NTC/2280 (L-Band)
EL470 with type identifier: NTC/2210 (IF) and NTC/2215 (L-Band)
EL970 with type identifier: NTC/2263

to which this declaration relates is in conformity with the essential requirements of European Union Directive 1999/5/EC Radio and Telecommunication Terminal Equipment Directive Essential Requirement 3.1(a), 3.1 (b), 3.2.

Done at St-Niklaas, on 04 July, 2011

Serge Van Herck,

CEO

Newtec Cy N.V. Laarstraat 5 B-9100 Sint-Niklaas Belgium. Tel: +32.(0)3.7806500 Fax:+32.(0)3.7806549

TO WHOM IT MAY CONCERN

Restriction of Hazardous Substances Directive (RoHS) (Directive 2002/95/EC)

The undersigned hereby confirms the following statement:

We hereby declare that this equipment is compliant to the RoHS Directive 2002/95/EC. Done at St-Niklaas, on 04 July, 2011

Serge Van Herck,

CEO

Registration, Evaluation and Authorization of Chemicals (REACH)

European Regulation N°1907/2006 "REACH" (Registration, Evaluation, and Authorization of Chemicals), came into force on June 1st, 2007. It aims at regulating the use of the chemical substances within the European Union.

We are committed to meeting our legal obligations under REACH, as a manufacturer of articles and as a downstream user of chemicals products.

In order to comply with the REACH regulation, Newtec Cy N.V. has put into place processes and procedures to ensure implementation and compliance with the regulation, especially the assessment of the presence of Substances of Very High Concern (SVHC's) and communication along the supply chain to both suppliers and customers.
All products manufactured by Newtec Cy N.V. fall under the category of Articles within the REACH Regulation and none of them present the notion of intentional release of SVHC's, therefore no obligation of registration applies.

Serge Van Herck,

CEO

SAFETY REGULATIONS

Please read this chapter before you install and use this equipment.

To ensure your safety, the equipment has been designed to comply with the following safety standard:

> IEC 60950 Safety of Information Technology Equipment

Before you start to install and operate the device, please make sure you observe the following points:

- The equipment described in this manual is designed to be used by properly trained personnel only. Only qualified personnel who are aware of hazards involved involved shall carry out adjustment, maintenance and repair of the exposed equipment.

> No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

- To use the equipment correctly and safely, it is essential that both operating and servicing personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Warning and caution statements and/or symbols are marked on the equipment when necessary.
- Whenever it is likely that safety protection is impaired, immediately switch off the equipment and secure it against unintended operation. Inform the appropriate servicing authority about the problem. For example, safety is likely to be impaired if the equipment fails to perform the intended measurements or shows visible damage.

> **Caution1:**
> FOR CONTINUED PROTECTION AGAINST FIRE, REPLACE LINE FUSES ONLY WITH SAME TYPE AND RATING (5 X 20mm T3.15 A/250v TYPE T or slow-blow).
>
> **Caution 2:**
> THERE IS RISK OF EXPLOSION IF THE BATTERY IS REPLACED WITH AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

Additional safety requirements for Finland, Norway and Sweden

Telecommunication connections and cable distribution system.

Special conditions apply to the use of this equipment in Finland, Sweden and Norway due to different earthing arrangements in these countries. Therefore it is essential that the installation is done by authorized personnel and according to the national requirements only.

This equipment is specified for use in a restricted access location only, where equipotential bonding has been applied and which has provision for a permanently connected protective earthing conductor.

A protective earthing conductor must be installed by a Service Person.

Additional safety requirements for Norway and Sweden

Equipment connected to the protective earthing of the building installation through the mains connection or through other equipment with a connection to protective earthing - and to a cable distribution system using coaxial cable, may in some circumstances create a fire hazard. Connection to a cable distribution system has therefore to be provided through a device providing electrical isolation below a certain frequency range (galvanic isolator, see EN 60728-11)." NOTE: In Norway, due to regulation for installations of cable distribution systems, and in Sweden, a galvanic isolator shall provide electrical insulation below 5 MHz. The insulation shall withstand a dielectric strength of 1,5 kV r.m.s., 50 Hz or 60 Hz, for 1 min.

Translation to Norwegian:

Utstyr som er koplet til beskyttelsesjord via nettplugg og/eller via annet jordtilkoplet utstyr - og er tilkoplet et kabel-TV nett, kan forårsake brannfare. For å unngå dette skal det ved tilkopling av utstyret til kabel-TV nettet installeres en galvanisk isolator mellom utstyret og kabel-TV nettet.

Translation to Swedish:

"Utrustning som är kopplad till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i vissa fall medfõra risk fõr brand. Fõr att undvika detta skall vid anslutning av utrustningen till kabel-TV nät galvanisk isolator finnas mellan utrustningen och kabel-TV nätet."

EMC Information

Relevant EMC information (to FCC rules)

This equipment has been tested and was found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and radiates radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications.

Do not operate this equipment in a residential area, as it is likely to cause harmful interference. When this is the case, you will be required to correct the interference at your own expense.

Environmental

Operating the equipment in an environment other than that stated in the specifications also invalidates the safety compliance.

Do not use the equipment in an environment in which the unit is exposed to:

- Unpressurised altitudes higher than 2000 metres;
- Extreme temperatures outside the stated operating range;
- Operating temperature range 0 to + 40 °C(*);
- Excessive dust;
- Moist or humid atmosphere above 95% RH;
- Excessive vibration;
- Flammable gases;
- Corrosive or explosive atmospheres;
- Direct sunlight.

(*): DC power supply - Operating temperature range 0 to + 30 °C.

Use a slightly damp cloth to clean the casing of the equipment. Do not use any cleaning liquids containing alcohol, methylated spirit or ammonia etc.

MAINTENANCE

Standard Warranty

Newtec guarantees the durability and satisfactory electrical and mechanical performance of the equipment to a maximum period of one (1) year from the date of delivery, unless otherwise agreed to, in writing. The warranty applies only to manufacturing defects and provided that handling, installation, maintenance and adjustment of the equipment are carried out in line with the instructions provided by Newtec and in line with good practice. The warranty does not apply to items, normally consumed in operation, or which have a normal lifetime inherently shorter than the warranty stated above, such as, without limitation, fuses or lamps. Any defect due to normal wear and tear, or caused by transportation or Force Majeure events, or attributable to the Customer's improper use, neglect, storage, operation handling or maintenance of the goods or any part thereof, are excluded from the warranty. During the warranty period, Newtec shall, at its sole discretion, replace or repair the defective subparts or units at the source factory. All transportation costs shall be borne and prepaid by the Customer.

Care Pack

Guidelines

Order a Care Pack

Care Pack is to be purchased along with Newtec professional equipments. The Care Pack coverage starts from the date of shipment. Please contact sales@newtec.eu for more details.

Register a Care Pack

After purchase the customer needs to register his Care Pack. On the Newtec equipment, the customer will find a registration label inviting him to self-register on portal www.newtec.eu/support

ABOUT THIS MANUAL

This document provides a quick overview on how to use the EL170 – EL470 – EL970 for the most common use cases.

This document is intended to help you:

- Find your way around the Graphical User Interface (GUI);
- Understand the different possibilities of the EL170,– EL470,and EL970;
- Configure the device according to your needs.

Cautions and Symbols

The following symbols appear in this manual:

	A caution message indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. It may also refer to a procedure or practice that, if not correctly followed, could result in equipment damage or destruction.
	A hint message indicates information for the proper operation of your equipment, including helpful hints, shortcuts or important reminders.
	A reference message is used to direct to an internal reference within the document, a related document or a web-link.

Version History and Applicability

Document version	Date	Subject	Comment
Version 2.3	April 3rd 2009	EL470 EL970	NoDE + 10 MHz Reference Inserter + update EL470 data
Version 3.0	January 2010	EL170 EL970 EL470	Release 7
Version 3.1	March 2nd 2010	EL170 EL970 EL470	Add SCPC and MCPC, change use cases titles accordingly
Version 3.1	May 2 nd 2010	EL170 EL970 EL470	Add QoS rules examples, add ACM log files
Version 4.0	September 30th 2010	EL170 EL970 EL470	R8 / New GUI, Rack Mounting, Back Panel info, GSE, AES
Version 4.1	February 2010	EL170 EL970 EL470	Improve GUI description, back panel information
Version 4.2	June 2011	EL170 EL970 EL470	Add warnings to DC output power 48V and UL feedback information. Added safety regulations for Norway and Sweden.

Related Documentation

- The Elevation Reference Manuals describes all the parameters available in the different devices;
- The Equalink User Manual details the linear and non-linear pre-distortion capabilities.
- RMCP Manual: this manual explains how Newtec devices can be remotely monitored and controlled via the serial port or via Ethernet using the Remote Monitor and Control Protocol.
- SNMP Manual: this manual explains how Newtec devices can be remotely monitored and controlled via the serial and port or via Ethernet using the Simple Network Management Protocol.

This manual is delivered on CD-ROM together with the device.

Applicability

Product Range

Elevation

Software ID

M&C ntc6279

Software Versions

Release 8

OPTIONS

EL170 IP satellite modulator		
Default Configuration		Ordering n°
DVB-S/DVB-DSNG-DVB-S2 IP modulator with GbE interface, data piping, MPE, ULE, GSE and XPE encapsulator, CCM, Multi-stream, SNMP Modulation & Baud rate: QPSK-8PSKP, 5Mbaud Output interface: L-band (950 -1750 MHz)		EL 170
Configuration Options Category	Max. 1 option per category	
Output Interface	L-band (950-1750 MHz)	Default
	IF (50-180 MHz)	AA-02
	L-band + 10MHz for BUC	AA-03
	L-band + 10MHz + 24Vdc for BUC	AA-12
	L-band + 10MHz + 48Vdc for BUC	AA-13
	Extended L-band (950-2150 MHz)	AA-18
	IF+ L-band	AA-06
Modulation & Baud rate	QPSK-8PSK 5Mbaud	Default
	QPSK-8PSK 15Mbaud *	AB-06
	QPSK-8PSK 33Mbaud *	AB-07
	QPSK-8PSK 45Mbaud *	AB-08
	QPSK- 8PSK-16APSK 5Mbaud *	AB-09
	QPSK- 8PSK-16APSK 15Mbaud *	AB-10
	QPSK- 8PSK-16APSK 33Mbaud *	AB-11
	Q/8PSK-16APSK-32 APSK 5Mbaud *	AB-13
	Q/8PSK-16APSK-32 APSK 15Mbaud *	AB-14
	Q/8PSK -16APSK -32APSK 33Mbaud *	AB-15
	All Modcods, BBFinput (for use with EL860)*	AR-01
Additional Options Category	Max. 1 option per category	
10MHz reference In/Out	Internal reference : 1ppm	GR-01
	Internal reference : 0,01 ppm	GR-02
Encryption	AES 64 bit encryption	AG-01
Predistortion	Equalink *	AC-01
VCM-ACM	Embedded VCM (no shaping)*	AN-01
		(*) upgradeable via license key
Services Category	Max. 1 option per category	
Assistance	Care Pack Basic	GA-06
	Care Pack Extended	GA-07

Option AA-06 IF+Lband: Switching the IF frequency from 70 to 140MHz or 140MHz to 70MHz has no impact on the L-band frequency.

EL970 IP satellite demodulator		
Default Configuration		Ordering n°
DVB-S/DVB-DSNG-DVB-S2 IP demodulator with GbE interface, data piping, MPE, GSE, XPE and ULE decapsulator,Multistream, VCM, SNMP Input interface: L-band (950 - 2150 MHz) Modulation & Baud rate: QPSK-8PSK 30Mbaud		EL970
Configuration Options		
Category	Max. 1 option per category	
Input Interface	L-band	Default
	L-band + 10MHz	AJ-02
	IF+ L-band	AJ-03
	IF + L-band + 10MHz	AJ-04
Modulation & Baud rate	QPSK-8PSK 33Mbaud	Default
	QPSK-8PSK 45Mbaud *	AL-08
	QPSK- 8PSK-16APSK 33Mbaud *	AL-11
	Q/8PSK 16APSK -32APSK 33Mbaud *	AL-15
Additional Options		
Category	Max. 1 option per category	
10MHz reference In/Out	Internal reference : 1ppm	GR-01
	Internal reference : 0,01 ppm	GR-02
Decryption	AES 64 bit decryption	AA-01
ACM	ACM client	AR-04
		(*) upgradeable via license key
Services		
Category	Max. 1 option per category	
Assistance	Care Pack Basic	GA-06
	Care Pack Extended	GA-07

EL470 IP satellite modem		
Default Configuration		Ordering n°
DVB-S/DVB-DSNG-DVB-S2 IP modem with GbE interface, data piping, MPE, ULE, GSE and XPE encapsulator, Multistream CCM, L-band (950 - 2150 MHz) demod input, SNMP Output interface Modulator: L-band (950 - 1750 MHz) Modulation & Baud rate modulator: QPSK-8PSK 2Mbaud Modulation & Baud rate demodulator: QPSK-8PSK 5Mbaud		EL 470
Configuration Options		
Category	Max. 1 option per category	
Modulator Output Interface	L band (950-1750 MHz)	Default
	IF (50-180 MHz)	AA-02
	L-band + 10MHz for BUC	AA-03
	L-band + 10MHz + 24Vdc for BUC	AA-12
	L-band + 10MHz + 48Vdc for BUC	AA-13
	Extended L-band (950-2150 MHz)	AA-18
Demodulator input interface	dual L-Band	Default
	IF + L-band (only with IF Mod output)	AJ-03
Modulation & Baud rate	QPSK-8PSK 2Mbaud	Default
	QPSK-8PSK 5Mbaud*	AB-05
	QPSK-8PSK 15Mbaud *	AB-06
	QPSK-8PSK 33Mbaud *	AB-07
	QPSK-8PSK 45Mbaud *	AB-08
	QPSK- 8PSK-16APSK 2Mbaud *	AB16
	QPSK- 8PSK-16APSK 5Mbaud *	AB-09
	QPSK- 8PSK-16APSK 15Mbaud *	AB-10
	QPSK- 8PSK-16APSK 33Mbaud *	AB-11
	Q/8PSK-16APSK PtP FlexACM control 2Mbaud *	AB-22
	Q/8PSK-16APSK PtP FlexACM control 5Mbaud *	AB-23
	Q/8PSK-16APSK PtP FlexACM control 15Mbaud *	AB-24
	Q/8PSK-16APSK PtP FlexACM control 33Mbaud *	AB-25
	Q/8PSK-16/32APSK PtP FlexACM control 2Mbaud *	AB-12
	Q/8PSK-16/32APSK PtP FlexACM control 5Mbaud *	AB-19
	Q/8PSK-16/32APSK PtP FlexACM control 15Mbaud *	AB-20
	Q/8PSK-16/32APSK PtP FlexACM control 33Mbaud *	AB-21
	All Modcods, BBFinterface (for use with EL860)*	AR-01

Demodulation & Baud rate	QPSK-8PSK 5Mbaud	Default
	QPSK-8PSK 33Mbaud *	AL-07
	QPSK-8PSK 45Mbaud *	AL-08
	QPSK-8PSK-16APSK 5Mbaud*	AL-09
	QPSK-8PSK-16APSK 33Mbaud*	AL-11
	QPSK-8PSK-16APSK 45Mbaud*	AL-12
	Q/8PSK-16APSK FlexACM Client 5Mbaud *	AL-13
	Q/8PSK-16APSK FlexACM Client 33Mbaud *	AL-14
	Q/8PSK-16/32APSK FlexACM Client 5Mbaud *	AL18
	Q/8PSK-16/32APSK FlexACM Client 33Mbaud *	AL20
Additional Options		
Category	Max. 1 option per category	
10MHz reference In/Out	Internal reference : 1ppm	GR-01
	Internal reference : 0,01 ppm	GR02
Encryption/Decryption	AES 64 bit encryption/decryption	AD-01
Predistortion	Equalink *	AC-01
		(*) upgradeable via license key
Services		
Category	Max. 1 option per category	
Assistance	Care Pack Basic	GA-06
	Care Pack Extended	GA-07

(*) upgradeable via a license key.
Other configurations and options are available upon request.
Contact your sales representative for details (sales@newtec.eu)

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1 INTRODUCTION

1.1 Description

1.1.1 EL170 IP Satellite Modulator

The EL170 is a state-of-the-art satellite modulator designed for IP applications over satellite in full compliance with the DVB standards. As a real IP product, this modulator performs IP processing functions such as packet filtering, routing and encapsulation. Depending on the applications and the activated features, the EL170 can be used in conjunction with consumer satellite IP receiving devices, professional IP receivers such as the EL940, or professional satellite IP demodulators such as the EL970.

The EL170 offers an auto-switching Gigabit Ethernet interface and integrates seamlessly with terrestrial IP networks and equipment. The incoming IP packets can be filtered using e.g. VLAN or MAC addresses, transmitted transparently (data piping mode) or routed to several receiving points and destination addresses. Several routing and addressing mechanisms can be used and even combined.

- Routing to the MAC address of the IP receivers is achieved by using Multi-Protocol (MPE), Ultra Light (ULE) encapsulation, or with the more efficient proprietary Extended Performance (XPE) Encapsulation;
- Addressing using several PIDs (MPE or ULE only);
- Addressing using several stream identifiers (with the DVB-S2 multi-stream mode).

With the Variable Coding and Modulation (VCM) option, the modulator allows each stream to be transmitted with its own set of modulation parameters.

At the output of the modulator, the signal is available on an L-band interface. Extended L-band, IF-band as well as BUC power supply and reference frequency are available as configuration options, providing a compact and cost effective solution.

For maximum bandwidth efficiency, the EL170 can also be used in Adaptive Coding and Modulation (ACM) mode, modifying the modulation parameters dynamically in function of the link conditions. An embedded FlexACM controller option is available for point-to-point applications, while the optional Base-Band Frame input option allows the EL170 to work with the external Shaper, Encapsulator and FlexACM controller EL860 in point-to-multipoint configurations.

When activated, the unique linear and non- linear predistortion option Equalink™ provides an additional link margin improvement of up to 2dB, truly unleashing the full efficiency of higher modulation schemes such as 16 and 32 APSK.

Combining new innovative features and advanced data encapsulations protocols with DVB-S2 technology, the EL170 ensures the highest bandwidth efficiency available on the market.

The following list is an overview of the key features:

- DVB-S2 and DVB-DSNG/S compliant;
- QPSK, 8PSK, 16APSK and 32APSK;
- XPE, ULE, MPE, GSE data piping encapsulation;
- Data rates up to 133 Mbit/s;
- L-band monitoring output;
- Programmable amplitude slope equalizer;
- DVB-S2 multi-stream;
- Optional Extended L-band;
- Optional VCM and ACM operation (FlexACM);
- Optional 10 MHz reference input/output;
- Optional Linear and non-linear predistortion (Equalink^{TM});
- Featured-based pricing and software upgradability.

1.1.2 EL970 IP Satellite Demodulator

The EL970 is a state-of-the-art satellite demodulator designed for IP applications over satellite in full compliance with the DVB-S and DVB-S2 standards. The EL970 connects directly to terrestrial IP network infrastructures via a single auto-switching Gigabit Ethernet interface. The receiver demodulates, restores and filters the data received from the satellite at rates of up to 133 Mbit/sec.

The EL970 comes with several hardware and software options and can be used in Point-to-Point links as well as in Point- to-Multi Point networks. It is compatible with a wide range of encapsulation protocols: data piping, MPE, ULE and Newtec's proprietary XPE (Extended Performance Encapsulation). The EL970 is capable of receiving DVB-S2 Multi- Stream, VCM and ACM streams, and is able to demodulate higher modulation schemes such as 16APSK and 32 APSK.

For maximum bandwidth efficiency, the optional FlexACM client allows the EL970 to provide feedback on the link condition to a FlexACM controller located at the uplink site, so that the modulation parameters can be adapted automatically and dynamically.

The EL970 has a dual L-band input. The active input is selected by the user and can provide DC power and frequency band selection signals compatible with most professional and commercial LNBs. Optionally, one L-band input can be replaced by an IF input.

The integrated Noise & Distortion Estimator tool provides an accurate reading of the satellite link margin even in presence of non-linear distortion and allows the user to easily find the optimum input back-off setting for 16APSK or 32APSK operation, whether or not non-linear predistortion is applied.

Combining new innovative features and advanced data encapsulations protocols with DVB-S2 technology, the EL970 ensures the highest bandwidth efficiency available on the market.

The following list is an overview of the key features:

- DVB-S2 and DVB-DSNG/S compliant;
- QPSK, 8PSK, 16APSK and 32APSK;
- XPE, ULE, MPE, GSE, data piping encapsulation;
- Data rates up to 133 Mbit/s;
- Adaptive equalizer;
- multi-stream and VCM support;
- Noise & Distortion Estimator (NoDE) tool;
- Optional FlexACM client (FlexACM);
- Optional 10 MHz reference input/output
- Featured-based pricing and software upgradability.

1.1.3 EL470 IP Satellite Modem

The EL470 is a state-of-the-art satellite modem designed for the transmission and reception of IP streams over satellite at rates of up to 133 Mbit/s in full compliance with the DVB standards. The EL470 modem connects directly to terrestrial IP network infrastructures via a single auto-switching Gigabit Ethernet interface

The EL470 comes with several hardware and software options and can be used in Point-to-Point links as well as in Point-to-Multi Point networks. It is compatible with a wide range of encapsulation protocols: data piping, MPE, ULE and Newtec's XPE (Extended Performance Encapsulation).
The EL470 is capable of receiving DVB-S2 multi-stream and VCM signals and can optionally transmit in VCM mode.
For maximum bandwidth efficiency an ease of operation, the EL470 has an embedded point-to-point FlexACM controller option that allows to automatically and dynamically adapt its uplink modulation parameters in function of the link condition. The FlexACM client option provides the modulator/modem on the other side of the satellite link with feedback on the conditions of the received signal. When two modems both equipped with the FlexACM controller and client options are connected to each other, they negotiate automatically and dynamically their configuration parameters in both directions.

At the output of the modulator, the signal is available on an L-band interface. Extended L-band, IF-band as well as BUC power supply and reference frequency are available as configuration options, providing a compact and cost effective solution.

The EL470 has a dual L-band input. The active input is selected by the user and can provide DC power and frequency band selection signals compatible with most professional and commercial LNBs. Optionally, one L-band input can be replaced by an IF input.

The integrated Noise & Distortion Estimator (NoDE) tool provides an accurate reading of the satellite link margin even in presence of non-linear distortion and allows the user to find the optimum input back-off setting very easily for 16APSK or 32APSK operation, whether or not non-linear predistortion is applied.

The following list is an overview of the key features:

- DVB-S2 and DVB-DSNG/S compliant;
- QPSK, 8PSK, 16APSK and 32APSK;
- XPE, ULE, MPE, GSE, data piping encapsulation;
- Data rates up to 133 Mbit/s in each direction;
- Adaptive equaliser (demodulator input);
- L-band monitoring output;
- Programmable amplitude slope equalizer (L-band output);
- Noise & Distortion Estimator (NoDE) tool;
- DVB-S2 multi-stream;
- Optional extended L-band;
- Optional VCM and ACM operation;
- Optional embedded point-to-point ACM controller and ACM client (FlexACM);
- Optional 10 MHz reference input/output;
- Optional Linear and non-linear predistortion (Equalink^{TM});
- Featured-based pricing and software upgradability.

2 NETWORK MODELS AND TRAFFIC ROUTING

In this chapter we provide an overview of the different network models and IP network models that are used to set up satellite links and how VLAN forwarding and IP routing is done in these networks.

2.1 IP Network Models

Interconnecting IP networks are done using one of the following methods:

- Ethernet bridging;
- IP routing;
- IP bridging (this is a hybrid model that combines the advantages of bridging and routing, developed by Newtec.).

2.1.1 Ethernet Bridging Inside the Satellite Subnet

The IP devices with build in encapsulator/decapsulator are setup as a bridge inside the satellite subnet:

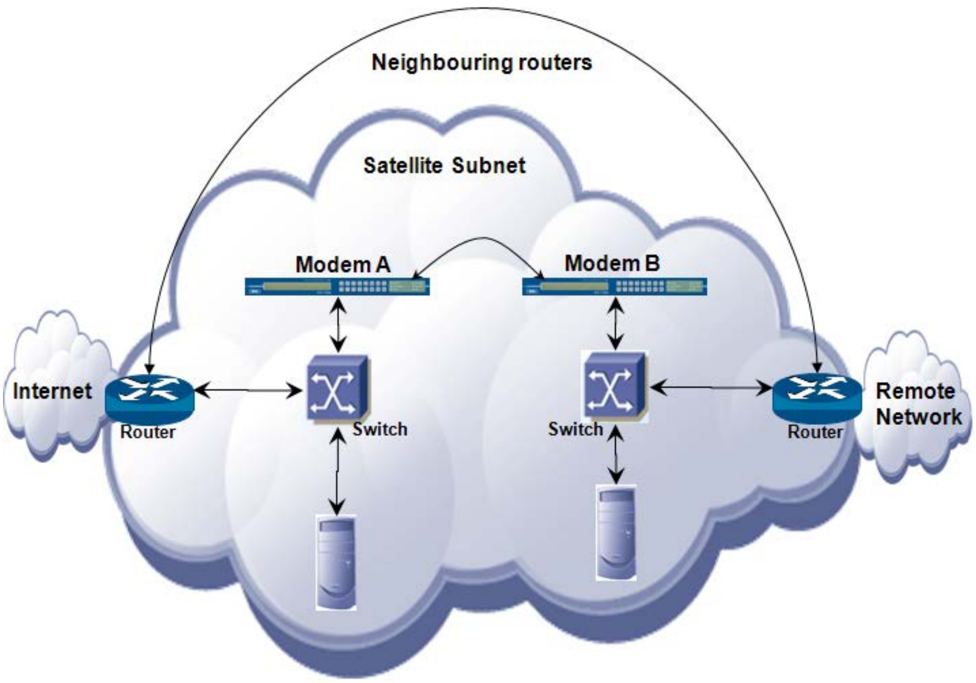


Figure 1 – Satellite Subnet

- The same subnet exists at both sides of the satellite link;
- The routers at both sides of the satellite link are 'neighbour routers'.

Ethernet bridging has the following advantages:

- Plug-and-play: you don't need to configure any IP-level settings;
- All routing protocols pass transparently via the satellite link, because the routers at both ends of the satellite are neighbour routers;
- The IGMP (Internet Group Management Protocol) passes transparently via the satellite link, and can be used to dynamically pull a multicast stream over the satellite link.

The configuration of Ethernet bridging: traffic from a VLAN is bridged to a TS PID or DVB-S2 stream.

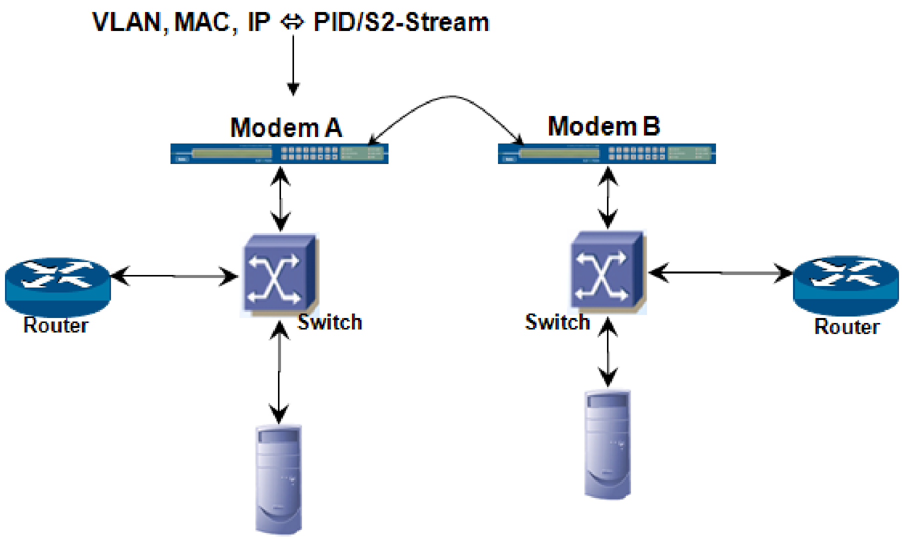


Figure 2 – Ethernet Bridging VLAN to TS PID or DVB-S2

Forwarding messages

- Incoming packets matching a given VLAN and/or destination MAC and/or IP address on the local site are modulated and forwarded to the remote site over the satellite link. The received packages on the remote site are demodulated and available on the router.

2.1.2 IP Bridging in the Satellite Subnet

2.1.2.1 Introduction

IP bridging is more efficient than Ethernet bridging.
IP bridging has the following advantages:

- It reduces the overhead on the satellite link:
  the Ethernet link is terminated in the same way as a router does.
  The Ethernet header and optional VLAN header are not transmitted on the satellite link;
- Ethernet broadcast traffic, ARP traffic and other L2 control packets (pause frames, 802.1x, LACP, ...) are not sent over the satellite link when IP bridging is selected.
  For IP bridging further partition of the satellite subnet into distinct IP ranges is needed. A part of the IP addresses is at the local side of the satellite, part of the IP addresses is at the remote end of the satellite link (there can be multiple remote sites).

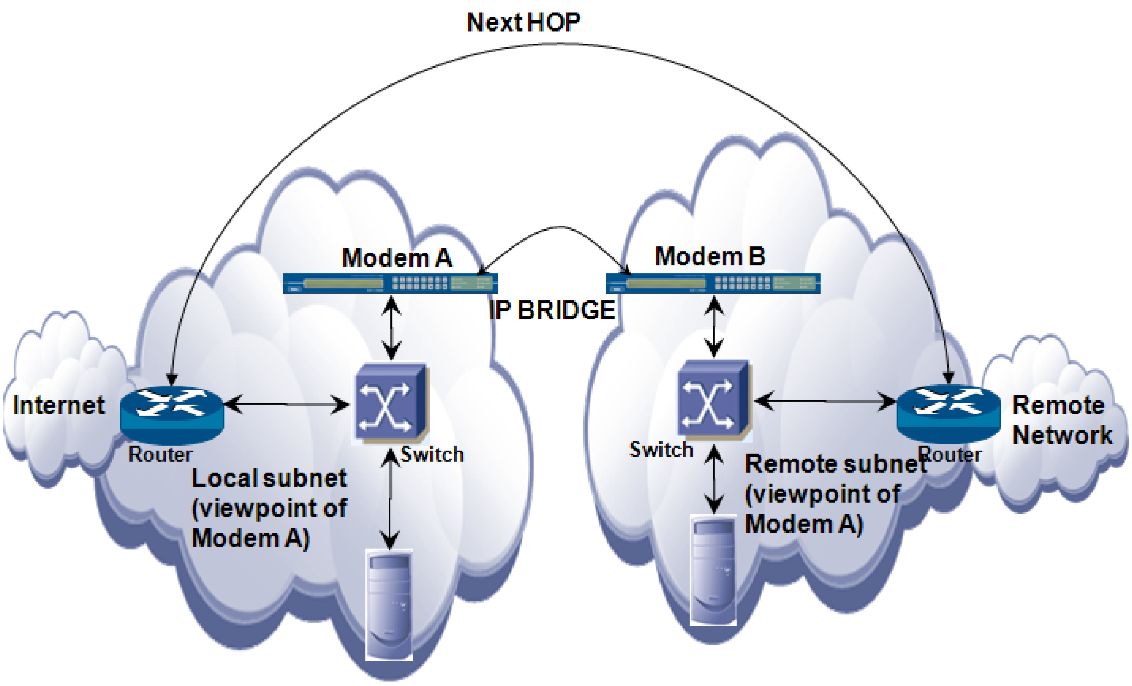


Figure 3 - IP Bridge

The routers and the IP hosts in the satellite subnet think that the local and remote parts of the subnet are 1 big subnet (e.g. a /24 subnet with 256-2 = 254 host IP addresses). Only the modems/modulators/demodulators must know which IP range exists locally, and which IP range is located in a remote site.

2.1.2.2 Router Configuration:

The router is configured with the full satellite subnet (e.g. a /24 subnet), and not the limited local subnet.

The next-hop IP address for the local router is the remote router, and not the local modem (the local modem acts like a bridge).

We refer to Figure 3.

2.1.2.3 Modem Configuration:

On the modem (or modulator, or demodulator), we make a distinction between the local IP range, and the IP range that is at the other side of the satellite link. On each modem, we select an IP range as local subnet (e.g. a /29 subnet, with a limited number of IP addresses) and a remote subnet (e.g. the full satellite subnet: the /24 subnet). The modem has the longest prefix match algorithm, to determine whether an IP address exists locally, or whether it is located at the other side of the satellite link.

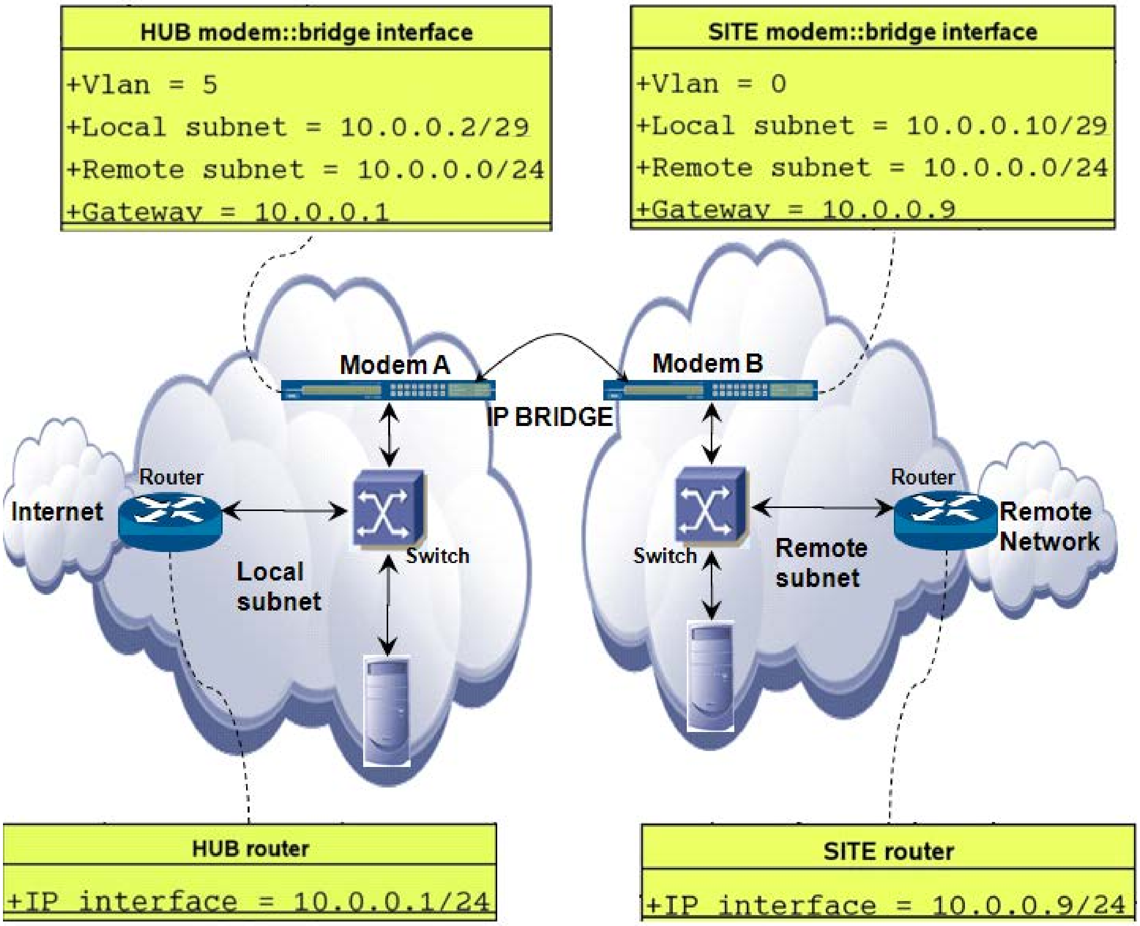


Figure 4 - IP Bridge Configuration

On a modem (or modulator, or demodulator) the satellite subnet is split into different IP ranges, while this partitioning is not known to the routers and the PCs inside the satellite subnet.
This behavior is achieved because the modems perform proxy-ARP for all IP addresses inside the remote subnet that are at the other side of the satellite link(s).

In this example we refer to Figure 4, the configuration for the HUB uses VLANs, and the configuration for the remote sites is without VLANs. Both options are possible. Some more words about the configuration in the picture:

2.1.2.4 HUB Router Configuration:

The HUB router has an IP interface in the satellite subnet: 10.0.0.1/24.

Further it has routes that point to the remote network.
These routes have the 'SITE router' as next HOP IP address.

2.1.2.5 HUB Modem Configuration:

The modem has an 'IP interface' on VLAN 5:

A local subnet on VLAN 5: 10.0.0.2/29: This means that there has been a local IP address assigned (10.0.0.2) and that the IP range 10.0.0.2/29 can be reached locally (at this side of the satellite link).

A remote subnet: 10.0.0.0/24. This means that IP range 10.0.0.0/24 except the local subnet is at the other side of the satellite link: A longest prefix match algorithm excludes the local subnet from remote subnet, because the local subnet has in this case a longer subnet prefix (/29 instead of /24).

A gateway (= 10.0.0.1) on VLAN 5, to reach the IP addresses that are outside the local subnet. Each VLAN is a separate routing domain (separate VRF), so each VLAN has its own gateway.

Besides an 'IP interface entry' on this VLAN, we must create routes from the Ethernet interface to the satellite link, and routes from the satellite link to the Ethernet network. The Ethernet RX route table contains routes that direct traffic from the Ethernet link to a given PID or ISI on the modulator.
The Demodulator RX route table contains routes that direct traffic from a PID or ISI on the satellite link to a VLAN on the Ethernet interface.

2.1.2.6 SITE Router Configuration:

This configuration is similar to the HUB router configuration, but without VLANs.

2.1.2.7 SITE Modem Configuration:

This configuration is similar to the HUB modem configuration, but without VLANs.

2.1.2.8 Directly attached Host Configuration:

The routers as well as the PCs that are drawn inside the satellite subnet don't need to know that the satellite subnet is split into different IP ranges. The subnet of the routers and the directly attached IP hosts must be equal to the full satellite subnet (10.0.0.x/24)!
If the routers and the directly attached IP hosts are not configured inside the complete satellite subnet, the modem is considered as a router instead of a bridge, and the local router and the remote router will no longer be neighbours: this will blocks several routing protocols, and possibly also other high level applications.

2.1.2.9 Example: IP point-to-point configuration (= IP conserving configuration)

Modem_B has only 1 directly attached host, being the router or the PC of an end user. Modem B is configured in an "IP address conserving" way: in this case we have not allocated an IP address to the Ethernet interface of Modem B.

In the IP point-to-point configuration on modem B, the local subnet contains only 1 host IP address. The local subnet on modem B is a /32 subnet that contains only the IP address of the router or the end user PC.

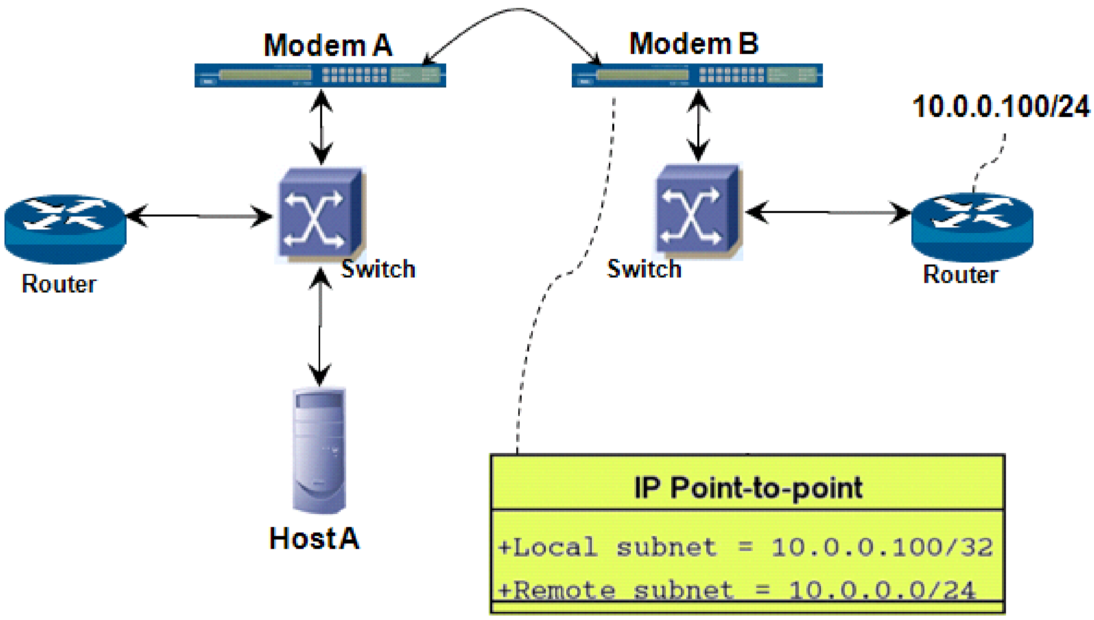


Figure 5 - Point to Point Set-up

2.1.3 IP Routing

2.1.3.1 Introduction

The satellite modems can act as a normal router: the satellite modem or modulator will then be configured as the next HOP of the attached router(s). In such a case there is no need to perform proxy ARP for remote IP addresses (the remote subnet is configured to 0.0.0.0/0).

IP routing has the following advantages:

- It reduces overhead on the satellite link;
- The Ethernet link is terminated in the same way a router does. The Ethernet header and optional VLAN header are not transmitted on the satellite link;
- Multiple VLANs can be terminated on the modem and the data of each VLAN can be send separated from each other on the satellite link. These VLANs can be set up again at the remote end of the satellite link;
- Ethernet broadcast traffic, ARP traffic and other L2 control packets are not sent over the satellite link when IP routing is enabled.

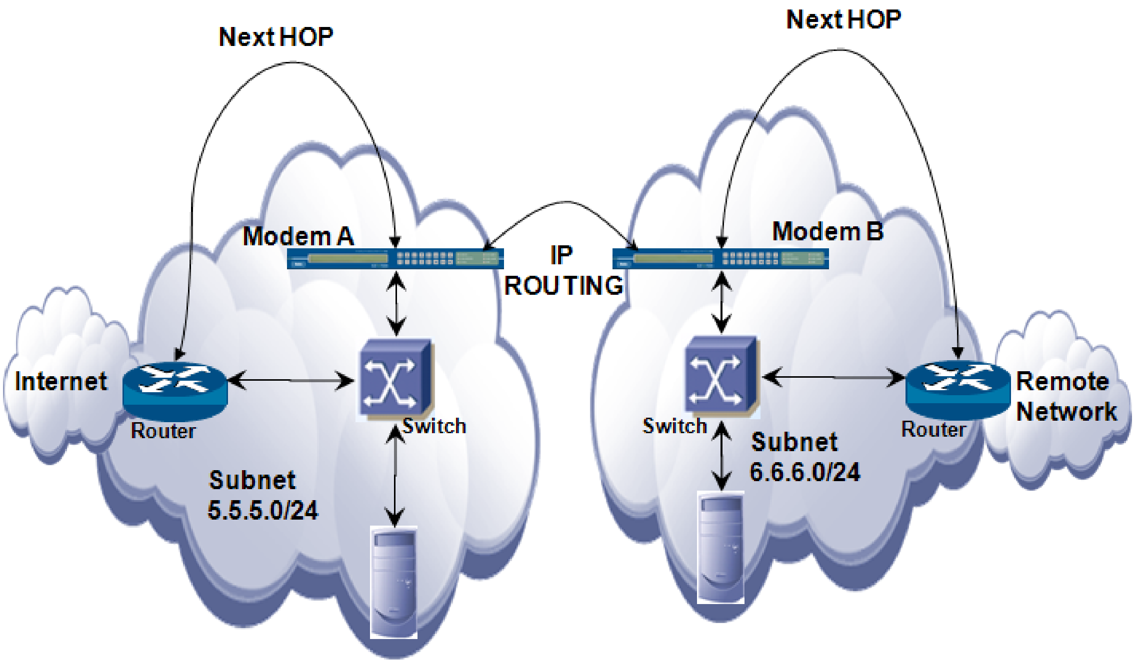


Figure 6 - IP Routing

2.1.3.2 Router Configuration

The IP address of the Ethernet interface on the modem is configured as next HOP for the routes in the router.

Although the modem behaves like any other router in the network, it has no routing protocols, like RIP (Routing Information Protocol), OSPF(Open Shortest Path First), enabled.

2.1.3.3 Modem Configuration

The modem configuration is almost identical to the configuration for an IP bridge: only the remote subnet of the IP interface is set to 0.0.0.0/0. This means that the device will not perform proxy ARP for the remote IP addresses.

In a point to point set up, one default route can be set. It is one default Ethernet Rx route that will filter out the needed traffic and put into a DVB-S2 stream.

In a point to multipoint set up, multiple routes can be set in the Ethernet Rx routes. The result of each Ethernet route can be put in different DVB-S2 streams. Each remote side modem can then filter out the appropriate DVB-S2 stream containing the IP data for its network.

IP bridging is often preferred above IP routing:

The routers at both sides of the satellite link stay neighbours for each other. Routing protocols, IGMP (Internet Group Management Protocol), and many other IP services pass transparently over the satellite link.

2.1.3.4 Remote Router Configuration

It has an IP interface in the remote subnet (6.6.6.0/24 in this example). The next HOP IP address for the return path is the IP address of the Ethernet interface of the modem.

It is not mandatory to assign an IP address to the Ethernet interface of the IP modem. This is especially important when the satellite modem is used in residential configurations.

The In-band IP address of the GBE interface cannot be reached from the other side of the satellite link.

2.2 VLAN Forwarding and IP Routing

2.2.1 VLAN Support

2.2.1.1 Introduction

It is possible to use VLANs (Virtual LAN) on the Ethernet interfaces.

VLANs are virtual Ethernet links on top of 1 physical Ethernet link.

These VLANs are interesting when a HUB modulator gives access to multiple remote sites:

- Without VLANs, the modulator can perform static routing, and send the traffic to the right destination by looking up the destination IP address;
- With VLANs, the modulator forwards IP transparently: there is at least one VLAN to each remote site.
  In this case, the routing is under responsibility of the router. This router can perform dynamic routing, by making use of routing protocols. Routing information can be sent transparently over the satellite link, to the neighbour routers at the other side of the satellite link.

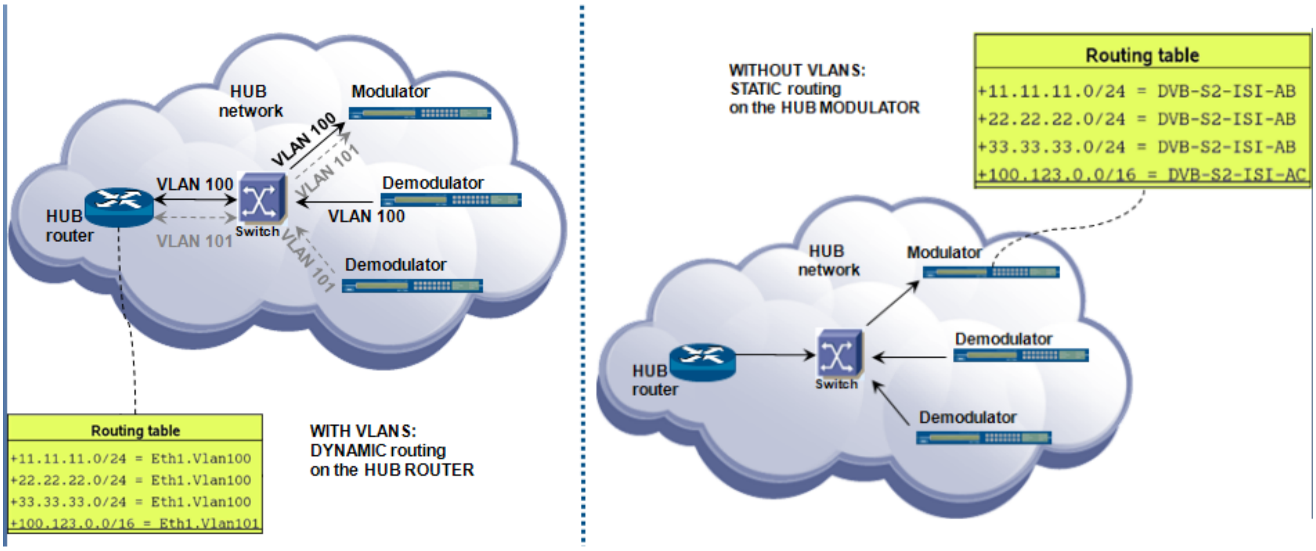


Figure 7 –With / Without VLANS

2.2.1.2 VRF Support

VLAN enabled routers often support the concept of VRFs (Virtual Router Functions). Each VRF has its own routing table.

On the Newtec modem/modulator/demodulator, each VLAN belongs to a different VRF, so this means that each VLAN has its own routing table.

The use of different VLANs as different VRFs makes it possible to implement fully independent IP trunks to different remote sites, where the same (private) IP addresses are used: the same IP addresses can be used for different destinations in different VRFs.

2.2.1.3 Routing Tables

Traffic is always routed between the Ethernet network and the satellite link. Traffic is never routed from the Ethernet link back to the Ethernet link or from the satellite link back to the satellite link: there is a separate routing table from the Ethernet link to the satellite and from the satellite to the Ethernet link.

The name for the routing table from Ethernet link to the satellite link: Ethernet RX route table.

The name for the routing table from the satellite link to the Ethernet link: Demodulator RX route table.

When VLAN support is enabled, this means that there is per VLAN, one routing table towards the satellite link, and another routing table towards the Ethernet link.

IP configuration

The following table is comparison between a generic router configuration and the Newtec IP configuration:

Generic router configuration	Newtec IP configuration
IP interface table: This table contains the IP address and subnet assignment for all physical interfaces (e.g. native Ethernet port) or virtual interfaces (e.g. VLAN interface on Ethernet port).	**IP interface table:** This table contains the IP address and subnet assignment for all physical (e.g. native Ethernet port) or virtual (e.g. VLAN interface on Ethernet port) interfaces. For each local IP interface, you can also define the remote IP subnet, that defines the IP addresses that exist inside the bridged IP satellite subnet, but in another site (multiple remote sites may exist). This remote IP range is relevant for IP bridging: the modulator performs proxy ARP for these IP addresses.
IP route table: This table shows to which physical or virtual interfaces different IP ranges will be routed.	**Ethernet RX route table:** This table shows to which satellite flow (PID, ISI, AirMAC) different IP ranges will be routed. **Demodulator RX route table:** This table shows to which physical or virtual Ethernet interface (=VLAN) data from a given satellite flow will be routed.

Table 1 - IP Configurations

3 INSTALLATION

3.1 Rack Mounting

The equipment is designed to operate in a 19-inch rack system conforming to IEC 60297.

When mounted in a standard 19-inch equipment rack,the device must be sustained by L-profiles. (Refer to Figure 8)

Fixing the device with four front panel screws only will damage it and could result in injury!

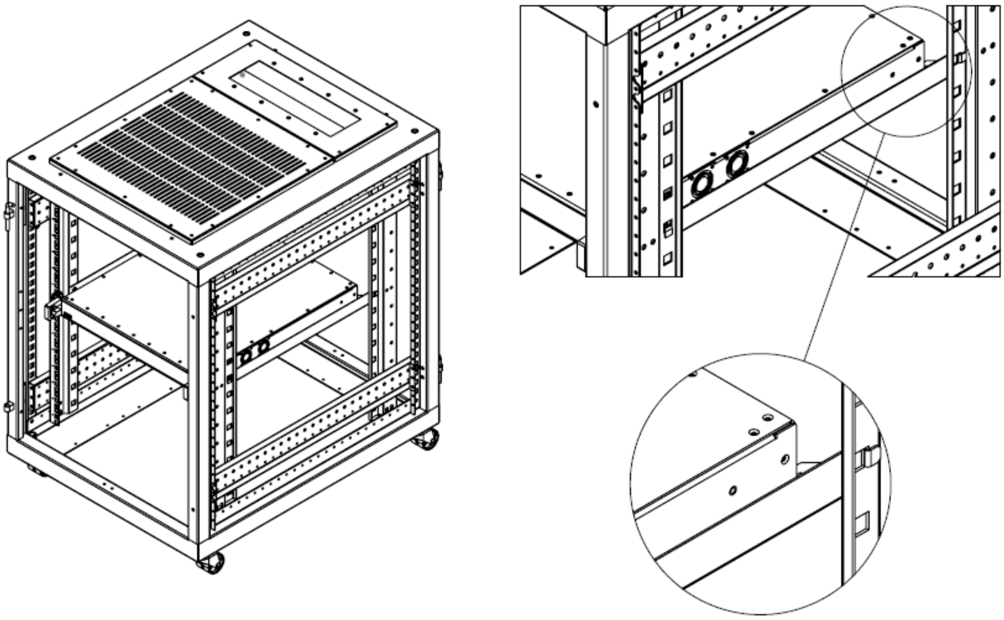


Figure 8 - Mounting with L-Profiles

It is allowed to operate the equipment in transportable installations and vehicles equipped with the means to provide a stable environment. Do not operate the equipment on vehicles, ships or aircraft without the means of environmental conditioning, as this may invalidate the safety compliance.

Mount the equipment in the rack in such a way that the amount of air flow required to safely operate the equipment is not compromised.

3.2 Power Supply

This equipment is provided with a protective earthing incorporated in the power cord. Be careful to insert the mains plug only in a socket outlet provided with a protective earth contact (TN type power supply). Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous. Intentional interruption is prohibited.

Install and connect the equipment to the mains power supply system in compliance with local or national wiring installation standards. Position the equipment so that the mains supply socket outlet for the equipment is near the equipment and can be easily accessed or that there are other suitable means to disconnect from the mains supply.

3.2.1 Main Power Supply

This power supply is set to operate from 100 to 240Vac to 47-63Hz.

3.2.2 DC BUC Power (optional)

This power supply is set to operate from

The output is provided on the N connector.

Remove the power on the equipment before any action is taken on this connector.
The maximum current provided on this connector is 4A.

3.3 Cable Distribution System

Install the equipment in accordance with the applicable provisions of NEC Article 810 for US and with CEC section 54 for Canada.

Before connecting the coax to the equipment, make sure that the equipment is properly earthed. The screen of the used coax cable should be grounded according to the local regulations.

3.3.1 Technical Earthing

On the rear panel of the equipment a technical earthing is available (an unmarked terminal on the right side of the equipment).

It is provided to:

- Ensure that all equipment chassis fixed within a rack are at the same technical earth potential. This is done by connecting a wire between the technical earth terminal and a suitable point on the rack;
- Eliminate the migration of stray charges when connecting between equipment.

4 PHYSICAL DESCRIPTION

4.1 Front Panel Description

Figure 9 – EL170 IP Satellite Modulator Front Panel

Figure 10 – EL970 IP Satellite Demodulator Front Panel

Figure 11 – EL470 IP Satellite Modem Front Panel

The device can be configured, controlled and monitored using the front panel. The front panel consists out of the following parts.

- Display:
  The display consists of a 2 x 40 characters LCD screen. The top row indicates the path in the menu structure while the bottom row displays the selected item. If the value is not indicated, press OK to open the submenu;

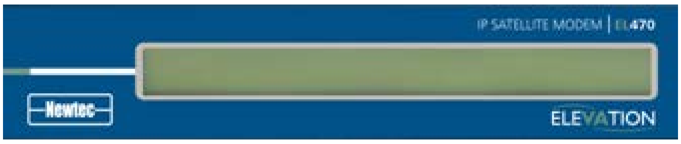


Figure 12 – Display

- Keypad:
  The keypad consists out of 16 keys. Use them to navigate in the menus and change parameters;

Figure 13 - Keypad

- Status LEDs :
  The LEDs provide a basic status of the device.

Figure 14 Modulator

Figure 15 - Demodulator

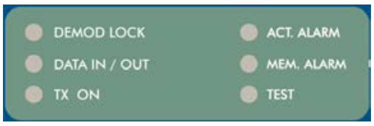


Figure 16 - Modem

4.2 Back Panel Description

The back panel consists of several modules depending on the hardware that is installed.

4.2.1 PSU, M&C Interface and External 10.0 MHz Reference Input

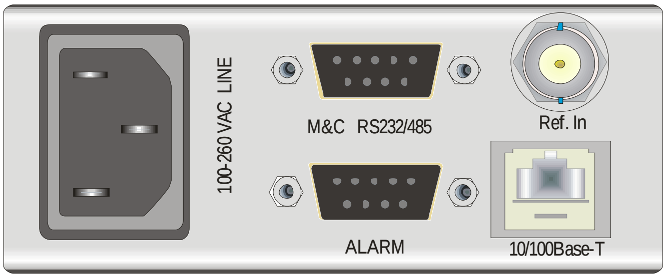


Figure 17 - PSU, Monitor and Control and External 10 MHz Reference

Power socket

This equipment is provided with a protective earth ground incorporated in the power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous.

Serial Monitoring and Control via RS485/RS232

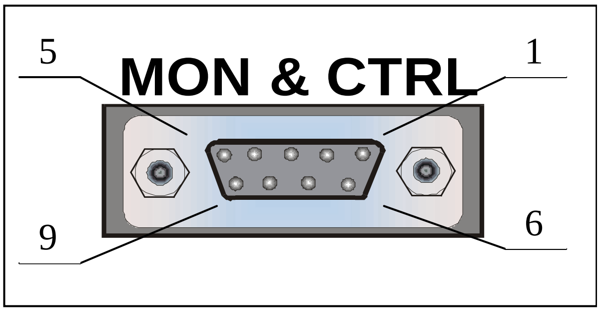


Figure 18 - Serial Monitoring and Control Connector

The device contains the hardware for the RS485 and RS232 interface.

Select the type of serial interface via the front panel or via the GUI but not via the serial port itself.

RS485			RS232		
Pin	**Name**	**Function**	**Pin**	**Name**	**Function**
1	GND	Shield ground	1	GND	Shield ground
2		Not connected	2	Rx-D	Receive Data (input)
3	Tx-A	Send Data A (input)	3	Tx-D	Transmit Data (output)
4	Rx-A	Receive Data A (output)	4	DTR	Data Terminal Ready (output)
5	GND	Signal ground	5	GND	Signal ground
6	Rx-B	Receive Data B (output)	6		Not connected
7		Not connected	7	RTS	Request to send (output)
8		Not connected	8	CTS	Clear to send (input)
9	Tx-B	Send Data B (input)	9		Not connected

Table 2 - Pin Configuration

Contact Closure Alarm Outputs

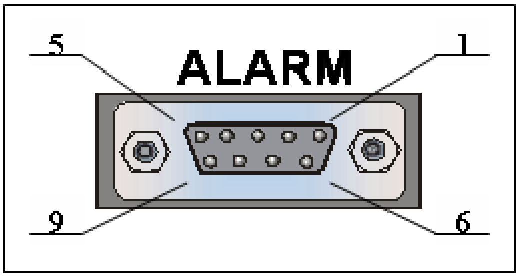


Figure 19 - Contact Closure Alarm Outputs

You can use the dry contact closure alarm to connect to redundancy switching systems.

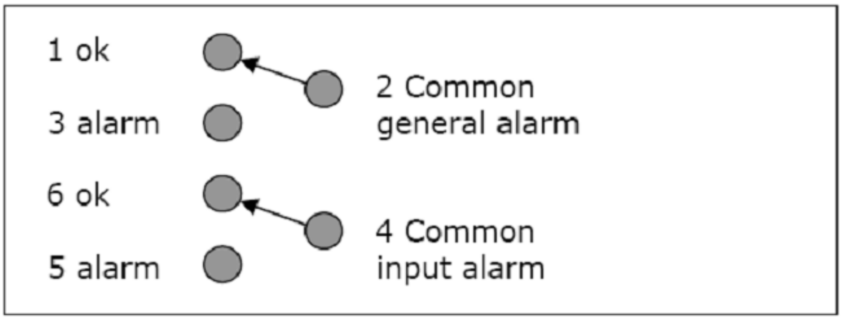


Figure 20 - Contact Closure Alarm Connections of the EL170 and EL470

- The common general alarm is flagged when the device is not working properly. For example: power failure or self test alarm.
- The common input alarm is flagged when the device does not receive an input signal.

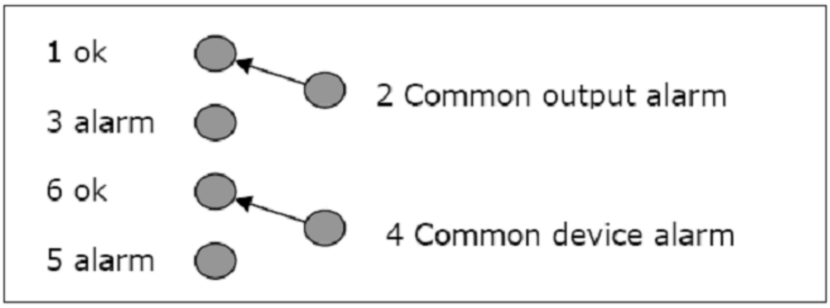


Figure 21 - Contact Closure Alarm Connections of the EL970

Pin 2 and 4 are either floating or tied to chassis earthing.

- Common interface alarm is flagged when there is no demod lock.
- Common device alarm is flagged when there is an issue with the device itself,like power failure or self test alarm.

10.0 MHz Reference Input

This input is used when you need a reference with enhanced stability or when you need several devices to be synchronised to the same clock source. The level should be 0dBm nominally. The 10.0 MHz reference input will only be available if one of the following options is installed.

- GR-01: 10MHz reference In/Out high stability;
- GR-02: 10 MHz reference In/Out very high stability.

Ethernet Connection

A standard RJ-45 connector provides connection to an Ethernet hub in a LAN (10/100BaseT). It is possible to set the IP address and subnet mask from the front panel. The default IP address is: 10.0.0.1.

It is possible to send RMCP (Remote Monitoring and Control Protocol) commands to the device using the Ethernet interface. The commands are sent as data in a TCP/IP stream. The used socket number is 5933. The RMCP protocol is exactly the same as for the serial interface, with one small exception: the receiving device ignores the RMCP address of the device (that is present in an RMCP command).

Also SNMP can be used.

The RMCP manual explains how Newtec devices can be remotely monitored and controlled via the serial port or via Ethernet.
This manual is delivered on CD-ROM together with the device.

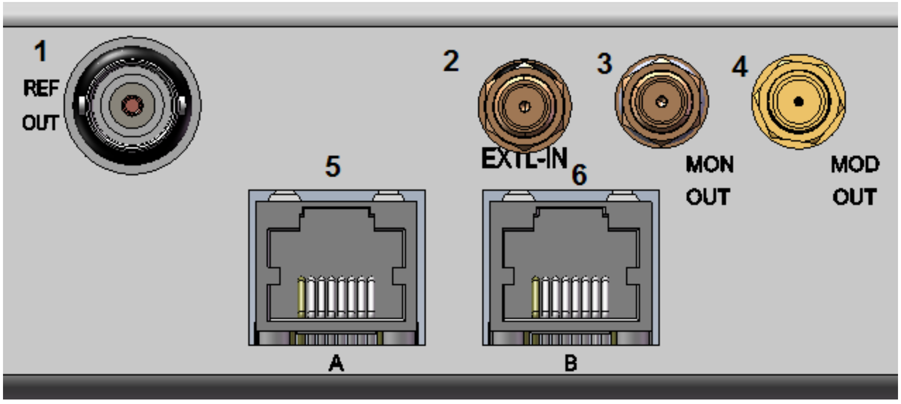
4.2.2 Sub Back Panel Descriptions

In this section the optional back panels for the devices are listed. Depending on the hardware that is ordered a combination of these sub back panels are used.
The different combinations per ordering option is described in the following sections we refer to:

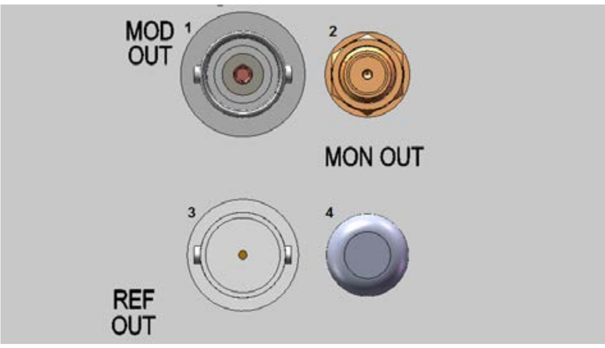
- Section 4.2.3for EL 170;
- Section 4.2.4 for EL 970;
- Section 4.2.5 for EL 470.

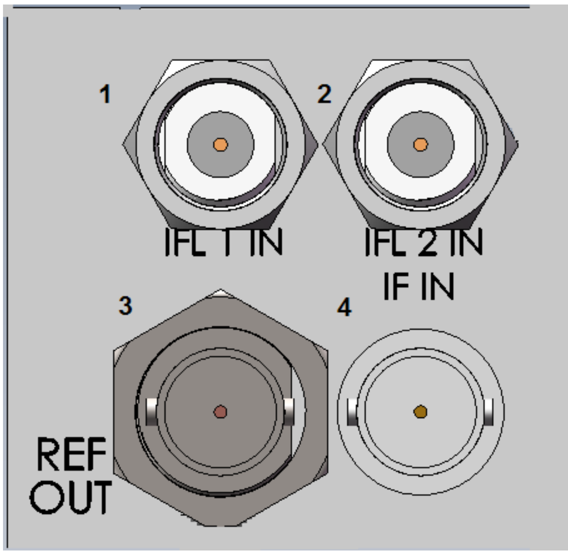
1. REF OUT is used for option GR01 or GR02.
2. Connector two of back panel 01 is never used.

	Back Panel 01 / Description	

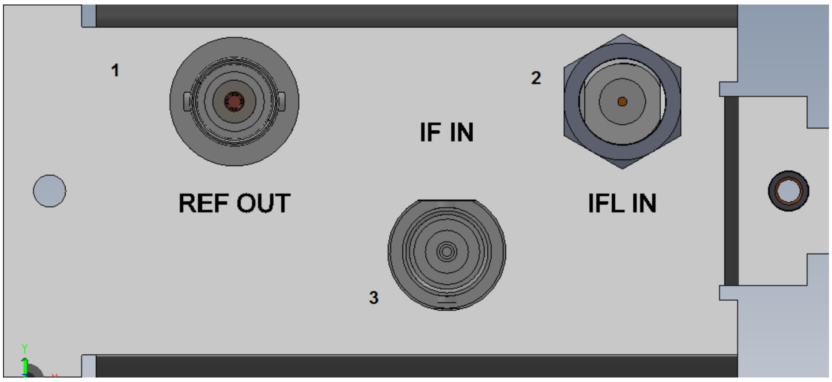


Connector	Technical Specifications	Signalling Type
1. REF OUT	BNC (Female) 50 Ohm	10MHz reference out
2. EXT L IN	Not used	Not used
3. MON OUT	SMA (Female) 50 Ohm	L-band 1080MHz
4. MOD OUT	SMA (Female) 50 Ohm	L-band
5. A (Ethernet Interface, 10/100/1000 BaseT)	RJ45	IP data
6. B (Ethernet Interface, 10/100/1000 BaseT)	RJ45	IP data

	Back Panel 02 / Description	
		
Connector	**Technical Specifications**	**Signalling Type**
1. MOD OUT	BNC (Female) 75 Ohm	IF-band 70MHz – 140MHz
2. MON OUT	SMA (Female) 50 Ohm	L-band 1080MHz
3. REF OUT	BNC (Female) 50 Ohm	10MHz reference output

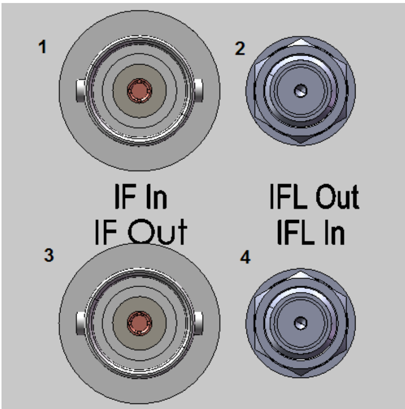
	Back Panel 03 / Description	
		
Connectors	**Technical Specifications**	**Signalling Type**
1. IFL 1 IN	F-type (Female) 75 Ohm	L-band input
2. IFL 2 IN	F-type (Female) 75 Ohm	L-band input
3. REF OUT	BNC (Female) 50 Ohm	10MHz reference out
4. IF IN		IF-band input

	Back Panel 04 / Description

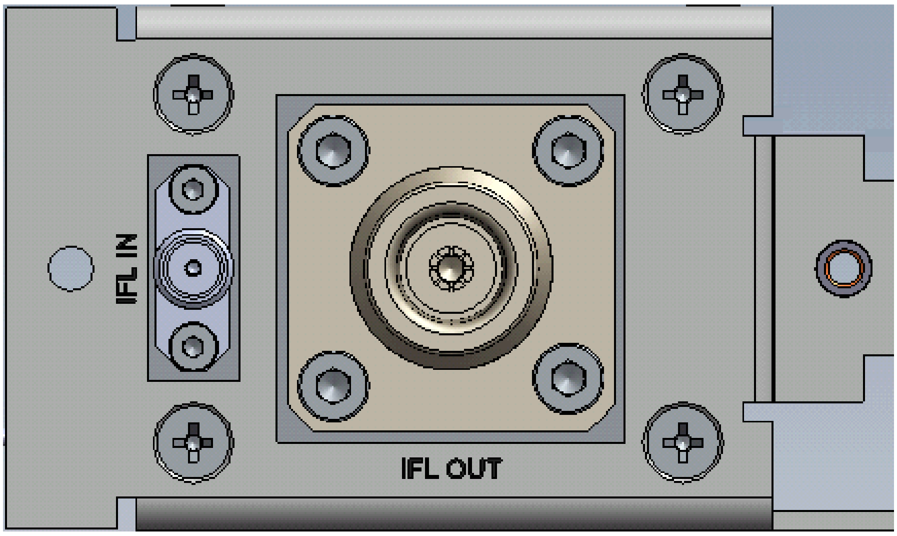


Connector	Technical Specifications	Signalling Type
1. REF OUT	BNC (Female) 50 Ohm	10MHz reference out
2. IFL IN	F-type (Female) 75 Ohm	L-band input
3. IF IN	BNC (Female) 75 Ohm	IF-band input

Connector	Back Panel 05 / Description



Connector	Technical Specifications	Signalling Type
1. IF In	Not Applicable	
2. IFL OUT	SMA (Female) 50 Ohm	L-band output
3. IF Out	Not Applicable	
4. IFL In	Not Applicable	

Connector	Back Panel 06 / Description	
		
Connector	**Technical Specifications**	**Signalling Type**
1. IFL IN	SMA (Female) 50 Ohm	L-band input, looped to Mod out of BP01

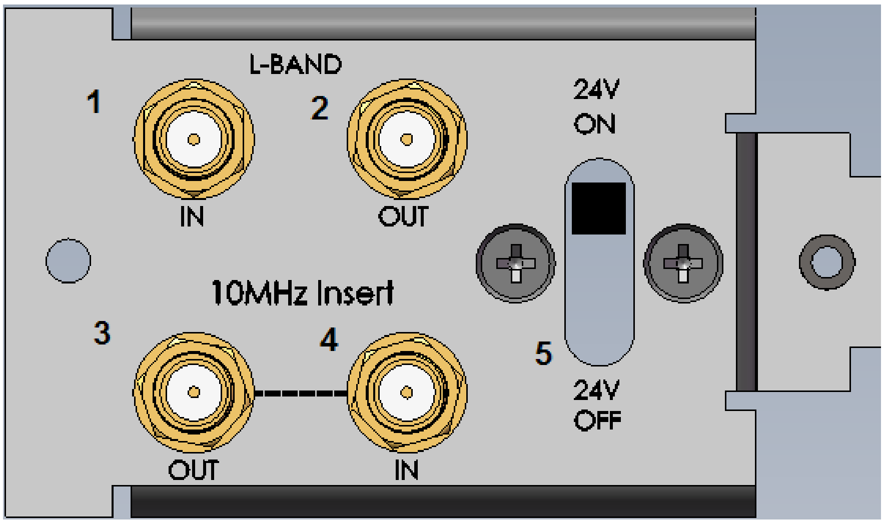
<table>
<tr><th>Connector</th><th colspan="2">Back Panel 06 / Description</th></tr>
<tr><td>2. IFL OUT</td><td>N-Connector (Female) 50 Ohm</td><td>L-band + 10MHz + DC (12V, 24V, 48V)

⚠ Switch of the power of the device before connecting the coax cable.
This to reduce the risk of personal injury from electric shock or damage to the device.

⚠ The following DC voltages can be selected:
• 12V
• 24V
• 48V
The maximum current on this connector is 3A.
Use a coax cable rated for the voltage and current marked on the device.

ℹ The following parameters must be enabled in the device:
• ODU communication control
• Outdoor power supply

Set the parameters on the following location. (Setting parameters refer to chapter 5.)
EL >> Unit >> Control >> Outdoor Unit</td></tr>
</table>

Connector	Back Panel 07 / Description	
		
Connector	**Technical Specifications**	**Signalling Type**
1. L-BAND IN	SMA (Female) 50 Ohm	L-band input, looped to Mod Out of BP01
2. L-BAND OUT	SMA (Female) 50 Ohm	L-band + 10MHz Out
3. 10 MHz Insert OUT	SMA (Female) 50 Ohm	10MHz output, looped to 10MHz input
4. 10 MHz Insert IN	SMA (Female) 50 Ohm	10MHz input, Looped to 10MHz Out
5. 24V ON/24 OFF		

4.2.3 EL 170 IP Satellite Modulator Back Panel

The figure below shows the possible connections on the modulator. The back panel connections available depend on the specific hardware configuration of your device and will differ from the back panels in the figures below. Only a subset of the shown connections will be available on your device.

Figure 22 - EL170 IP Satellite Modulator Back Panel

The sub back panels used per ordering option is listed in the following table.

We refer to section **Options** on page 'xiii 'for ordering information. We refer to section 4.2.2 for the description of the different sub back panels.

Option	Back Panel Combination	Not Used Connectors BP-<number>/<connector>,<connector>
Default	BP 01	BP 01/2
AA-03	BP 01 BP 07	BP 01/2 BP-07/5
AA-02	BP 01 BP 02	BP 01/2,3,4 BP02/3,4
AA-12	BP 01 BP 06	BP 01/2
AA-13	BP 01 BP 06	BP 01/2
AA-06	BP 01 BP 02 BP 05	BP 01/2,3,4 BP 02/3, 4 BP 05/1,3,4
AA 18	BP 01	BP 01/2

4.2.4 EL970 IP Satellite Demodulator Back Panel

The figure below shows the possible connections on the demodulator. The back panel connections available depend on the specific hardware configuration of your device and will differ from the back panels in the figures below. Only a subset of the shown connections will be available on your device.

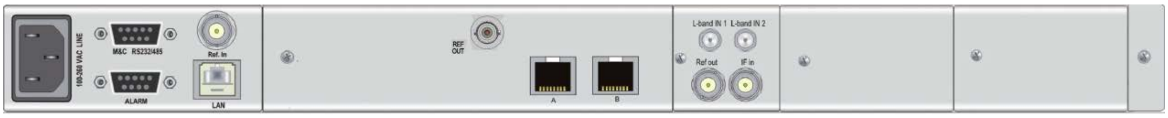


Figure 23 - EL970 IP Satellite Demodulator Back Panel

The sub back panels used per ordering option is listed in the following table.

We refer to page 'xv'for ordering information.
We refer to section 4.2.2 for the description of the different sub back panels.

Option	Back Panel Combination	Not Used Connectors BP-<number>/<connector>
Default	BP 01 BP 03	BP 01/2,3,4 BP 03/4
AJ-02	BP 01 BP 03 BP 07	BP 01/2,3,4 BP 03/4 BP 07/5
AJ-03	BP 01 BP 04	BP 01/2,3,4
AJ-04	BP 01 BP 04 BP 07	BP 01/2,3,4 BP07/5

4.2.5 EL470 IP Satellite Modem Back Panel

The figure below shows the possible connections on the modem. The back panel connections available depend on the specific hardware configuration of your device and will differ from the back panels in figures below. Only a subset of the shown connections will be available on your device.

Figure 24 – EL470 IP Satellite Modem Back Panel

The sub back panels used per ordering option is listed in the following table.

We refer to the section Options on page ‘xvi‘ for ordering information.
We refer to section 4.2.2 for the description of the different sub back panels.

4.2.5.1 Modulator Sub Back Panel Options

Option	Back Panel Combination	Not Used Connectors BP-<number>/<connector>,<connector>
Default	BP 01	BP 01/2
AA-02	BP 01 BP 02	BP 01/2,3,4 BP 02/4
AA-03	BP 01 BP 07	BP 01/2 BP 07/5
AA-12	BP 01 BP 06	BP 01/2
AA-13	BP 01 BP 06	BP 01/2
AA 18	BP 01	BP 01/2

4.2.5.2 Demodulator Sub Back Panel Options

Option AJ-03 is only possible in combination with option AA-02 of the modulator sub back panel options.

Option	Back Panel Combination	Not Used Connectors BP-<number>/<connector>
Default	BP-03	BP-03/4
AJ-03	BP-04	

5 HOW TO MANAGE

This section explains how the devices can be configured and how the parameters in the device are ordered and managed according to your needs.

The device can be managed using one of the following physical interfaces:

- The front panel display;
- The Ethernet port;
- The serial port.

When the management is done using the Ethernet the graphical user interface can be used to display the parameters on a management PC.

The following protocols are used to perform the communication between the management PC and the device.

- Remote Monitoring and Control Protocol
  for more information we refer to 5.5.1
- Simple Network Management Protocol
  for more information we refer to section 5.5.2.

5.1 Menu Tree

Use the front panel or the graphical user interface to set the configurable variables in the device.

The variables are structured in a logical way: in a menu tree we refer to Figure 25, Figure 26 and Figure 27.

The menu tree shows the organisation of the parameters in the device. This menu tree is similar accessing the parameters via the front panel and usage via the GUI (graphical user interface).

The menu structure of the GUI and the front panel are identical except for the ***User Menu*** which is programmable via the front panel.

How to program the User Menu is described in **Appendix A** of this document.

The details on the menu tree and the variables in the menu tree are described in the reference manual of this device.

5.1.1 EL 170 IP Satellite Modulator

EL170	EL170 IP Satellite Modulator		
Unit			
	Setup		
		Serial port settings	
		Ethernet settings	
		Display settings	
		SNMP settings	
		Web Interface	
	Control		
		AES	
	Monitor		
	Architecture		
	Diagnostics		
Modulator			
	Control		
		Common	
		Interfaces	
			Ethernet
		Modulation	
			Main
			DVB-S2 Streams
			BasebandFraming
			ACM control
			PHY
			AES
	Monitor		
		Interfaces	
			Ethernet
		Modulation	
			Packets
			Frames
			ACM control
	Actionkeys		
	Test		
		Interfaces	
		Modulation	
			Frames

Figure 25 – Menu Tree of the EL170

5.1.2 EL970 IP Satellite Demodulator

EL970	EL970 IP Satellite Demodulator		
Unit			
	Setup		
		Serial port settings	
		Ethernet Interface	
		Display settings	
		SNMP settings	
		Web Interface	
	Control		
		AES	
	Monitor		
	Architecture		
	Diagnostics		
Demodulator			
	Control		
		Common	
		Interfaces	
			Ethernet
		Modulation	
			Main
		Demodulation	
			ACM client
			AES
	Monitor		
		Interfaces	
			Ethernet
		Demodulation	
			ModCodStats
			ACM client
	Test		
		Interfaces	
		Demodulation	
			Frames

Figure 26 – Menu Tree of the EL970

5.1.3 EL470 IP Satellite Modem

EL470	EL470 IP Satellite Modem		
Unit			
	Setup		
		Serial port settings	
		Ethernet settings	
		Display settings	
		SNMP settings	
		Web Interface	
	Control		
		AES	
	Monitor		
	Architecture		
	Diagnostics		
Modem			
	Control		
		Common	
		Interfaces	
			Ethernet
			ASI
		Modulation	
			Main
			DVB-S2 Streams
			BasebandFraming
			ACM control
			PHY
			AES
		Demodulation	
			ACM client
			AES
	Monitor		
		Interfaces	
			Ethernet
			ASI
		Modulation	
			Packets
			Frames
			ACM control
		Demodulation	
			ModCodStats
			ACM client
	Actionkeys		
	Test		
		Interfaces	
		Modulation	
		Demodulation	

Figure 27 – Menu Tree of the EL470

5.2 Front Panel Handling

5.2.1 Display

The first line of the display contains your current location in the menu tree of the demodulator. The second line contains the parameter name and its value.

```
ELDeviceType/unit/Setup
Device mode: Normal
```

5.2.2 Keypad

Figure 28 – Keypad Panel

With the 16 front panel keys it is possible to navigate in the menus and change parameters.

Press “**?**” to open a pop-up help screen with more information on the selected item. Press **ESC** to exit this help screen.

Press “←” and “→” to highlight a menu item. Press **OK** to go one level deeper in the menu tree. When arriving at the desired level, press **OK** again to select the desired item. Press **ESC** to move back up in the menu tree.

Press **CLR** to clear the numerical input fields.

Press the digit keys **0** up to **9** to enter numerical values. To enter hexadecimal characters, press the **A** – **F** keys multiple times to bring up the desired hexadecimal character.

5.2.2.1 Read / Set the Device IP Address

The front panel can be used to set or read out the device IP address.

Open the following menu on your front panel:

```
Unit >> Setup >> Ethernet Settings >> Device IP address
Device IP Address: 10.0.0.1
```

5.2.2.2 For Example Change the Front Panel Screensaver

The front panel screensaver is useful to identify a number of units if you have more than one unit.

You can activate the screensaver in the following menu:

```
EL170/970/470 >>Unit>>Setup>>Display settings
```

- Enter the screensaver delay;
- Enter the screensaver message (for example Channel 01   Modem01).

Once the screensaver delay is reached without any key action on the front panel a message is displayed as follows.

```
EL470
Channel 01          Modem 01
```

5.2.2.3 How to Log in as Expert

Proceed as follows to log in as Expert:

- Open the following menu on the front panel

```
Unit >> Setup >> Device: Normal
```

- Press OK

```
Normal <=Expert>
```

- Press OK

```
Enter Password: ***
```

- Enter the number of the device
- Press OK to confirm.

5.2.3 LEDs

The LEDs provide a basic status of the device.

5.2.3.1 LEDs EL170 Modulator

Figure 29 –Modulator LEDs

Data In: green At least 1 data input is active and valid

Data Process:	green	Data is processed prior to transmission
Tx on:	green	Transmit is on
Act. Alm:	red	Actual alarm(s) is/are present
Mem. Alm:	red	Memorised alarm(s) is/are present
Test:	orange	On when the device is in test mode

5.2.3.2 LEDs EL970 Demodulator

Figure 30 – Demodulator LEDs

Demod Lock:	green	Demodulator is locked to the carrier signal

Physical Layer Synchronisation	BaseBand Synchronisation	Demodulator lock LED
Alarm	Alarm	OFF
OK (no Alarm)	Alarm	Blinking
OK (no Alarm)	OK (no Alarm)	ON

Data Process:	green	Data is processed
Data Out:	green	Valid data is present at the output
Act. Alm:	red	Actual alarm(s) is/are present
Mem. Alm:	red	Memorised alarm(s) is/are present
Test:	orange	On when the device is in test mode

5.2.3.3 LEDs EL470 Modem

Figure 31 – Modem LEDs

Demod Lock:	green	Demodulator is locked to the carrier signal

Physical Layer Synchronisation	Base Band Synchronisation	Demodulator lock LED
Alarm	Alarm	OFF

Physical Layer Synchronisation	Base Band Synchronisation	Demodulator lock LED
OK (no Alarm)	Alarm	Blinking
OK (no Alarm)	OK (no Alarm)	ON

Data In:	**green**	At least 1 data input is active and valid
Data Out:	**green**	Valid data is present at the output
Tx on:	**green**	Transmit is on
Act. Alm:	**red**	Actual alarm(s) is/are present
Mem. Alm:	**red**	Memorised alarm(s) is/are present
Test:	**orange**	On when the device is in test mode

5.3 Management Using the Ethernet Interface

5.3.1 Cabling

Use a crossed network cable for a direct connection between the Ethernet port of the demodulator to the Ethernet port of a computer. In case the connection to the device is done via a hub or switch, straight network cables are used.

5.3.2 Settings

The Elevation platform is equipped with a powerful and easy-to-use graphical user interface (GUI) that allows you to remotely monitor and control your equipment through a web browser.

To use the web interface, adapt the TCP/IP properties of the computer so you can manually set an IP address that is within the range of the device IP address. For example: take IP address 10.0.0.2 on the computer and 10.0.0.1 on the device. Make sure that no pop-up blockers or firewall are active!

To adapt the TCP/IP properties on a typical Windows computer:

- Choose **Start** > **Connect To** > **Show all connections**;
- Right-click **Local Area Connection**;
- Click **Properties**;
- Scroll down and click **Internet Protocol (TCP/IP)**;
- Click **Properties**;
- Choose **Use the following IP address;**
- Enter the following data:
  - **IP address**, for example:10.0.0.2;
  - **Subnet mask**, for example: 255.255.255.0.

5.4 Management Using the Serial Interface

5.4.1 Cabling

The cable to connect via the serial iInterface must comply with the pin configurations as described in section 4.2.

5.4.2 Serial Port Settings

The demodulator is set to RS485 by factory default. When you prefer RS232, choose:

▪ Elevation >> Unit >> Setup >> Serial port settings

Default serial port settings:

Elevation/Unit/Setup/Serial port settings:

- Serial interface type RS485;
- Device RMCP address 100 ;
- Serial baud rate 115200.

Alternatively, use an RS232 to RS485 converter to connect the serial communication port of a PC to the Monitor and Control port. Pin layout on the converter can differ depending on the brand and type of the converter. Check the user manual of the converter to select an appropriate cable.

When using RS232, use a null-modem cable with the following layout:

PC	Demodulator	Signal
9 Pin D-types	9 Pin D-types	
2	3	TxD
3	2	RxD
5	5	GND

Table 3 – RS232 Cable Pin Layout

5.4.3 Serial Interface and Port Settings

The main line settings for this serial interface are:

- Asynchronous data transfer;
- 1 start bit (logic “0”);
- 7 data bits (LSB first on line);
- Even parity;
- 1 stop bit (logic “1”);
- 4800, 9600, 19200, 38400, 57600 or 115200 baud.

To set the serial baud rate choose:

Elevation >> Unit >> Setup >> Serial port settings.

There is no flow control on the serial interface. Apart from correctly formatted messages, the only significant character here is the SYNC-character (value 16 hex.). The device sends this character to indicate that it is busy executing the command and preparing the response. This prevents other devices from taking control of the bus if the response cannot be given immediately.

5.5 Protocols Used to Monitor and Control the Device

There are two protocols that can be used to manage your device:

- Remote Monitor and Control Protocol (RMCP);
- Simple Network Management Protocol (SNMP).

5.5.1 Remote Monitor and Control Protocol (RMCP)

This is possible via the serial interface (RS232/485) or over Ethernet.
The commands are described in the Reference Manual of your device.

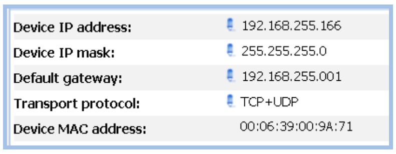
The **RMCP Manual** explains how Newtec devices can be remotely monitored and controlled via the serial port or via Ethernet.
This manual is delivered on CD-ROM together with the device.

5.5.1.1 RMCP over Ethernet

You can send RMCP commands to the demodulator using the Ethernet interface. The commands are sent as data in a TCP/IP stream. The used socket number is 5933.
The RMCP protocol is similar to the RMCP protocol used for the serial interface. The difference is that the receiving device ignores the RMCP address of the device (that is present in an RMCP command).

The Ethernet interface needs to be configured.
We refer to the following menu:

- EL170/970/470 >> Unit >> Setup >> Ethernet settings



Device IP address:	192.168.255.166
Device IP mask:	255.255.255.0
Default gateway:	192.168.255.001
Transport protocol:	TCP+UDP
Device MAC address:	00:06:39:00:9A:71

Figure 32- Ethernet Settings

5.5.1.2 Protocol

The control unit sends a “request” message to a device identified by its unique address. The addressed device interprets the message, performs the requested action and sends a “response” message back.

The receiving device rejects all messages with transmission errors without any further action. Transmission errors are:

- No stop bit;
- Parity error;
- LRC-error; (Longitudinal Redundancy Check)
- Message receive buffer overflow.

The addressed device responds to all correct formatted messages – except for some special system messages – with an acknowledge message. Only in a few restricted cases does the device does not respond to a request from the control unit. This is, for example, the case when a general device reset is requested.

Correctly received messages which the device cannot handle are refused via a no-acknowledge “error” message. This message contains the reason why the message is rejected.

A device never sends messages on its own initiative. It only responds to a request from the control unit. The total transmit time of a complete message may not exceed 250ms. If the message is not completed within this time, it is discarded.

5.5.2 Simple Network Management Protocol (SNMP)

The Newtec MIB allows full monitor and control of the device using any graphical MIB browser. We have a full proprietary MIB, which contains all the OIDs needed to control the device.

The device supports sending of traps. Traps inform the NMS when a change in the device has occurred. After receiving the trap the NMS still has to poll the device to find out the details of the change.

> The SNMP details can be found in the Reference Manual of these devices EL170, EL970, EL470.

6 GRAPHICAL USER INTERFACE (GUI)

6.1 Introduction

The graphical user interface (GUI) is a web application that gives remote access to the device and allows the client to connect :

- Configure the device after physical installation;
- Monitor the status;
- Check past events;
- Adjust parameter settings;
- Change or create configurations.

> The GUI is optimized for displays with a screen resolution of 1024 x 768 or higher.

6.2 Opening the GUI

Proceed as follows to open the GUI for your device on your computer:

➢ Open a web browser on your computer;

> Newtec advises to use Firefox 3 (and higer) or Google Chrome as standard browser, but the GUI can also run on other compatible browsers like Internet Explorer 7, Safari, …

➢ Type the IP address of your device in the address bar of the browser. Do not forget to type **http://** in front of the IP address;

> You can find the IP address of your device via the front panel in the following menu: **Elevation > Unit > Setup > Ethernet settings**. By default, the IP address of all Newtec devices is 10.0.0.1.

➢ Press **Enter**;

➢ If the user profile guest is:

  - Not disabled and not password protected, the user is automatically logged in as a guest.

- Disabled and/or password protected, a User identification dialog box will pop up.
  Enter your username and password;

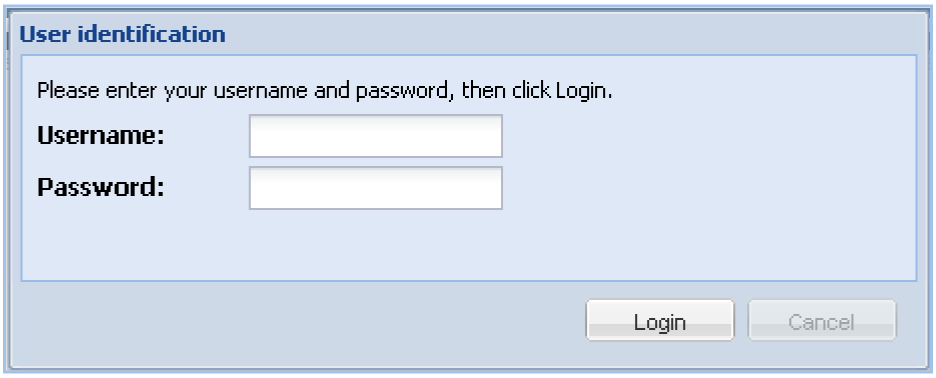


Figure 33 – Logon Dialog Box

➢ If necessary, click **Login**
If you have the user profile:
  - **Guest:** the user has read-only access to the typical configuration and monitoring options;
  - **Normal:** the user has read-write access to the typical configuration options. You can load a configuration but cannot save a configuration. You can execute and see the commands of a custom action;
  - **Expert:** the user has read-write access to all configuration options. The user can load and save a configuration. You can execute and create custom actions.

6.3 Main Areas of the GUI

When the GUI application opens five areas are visible.

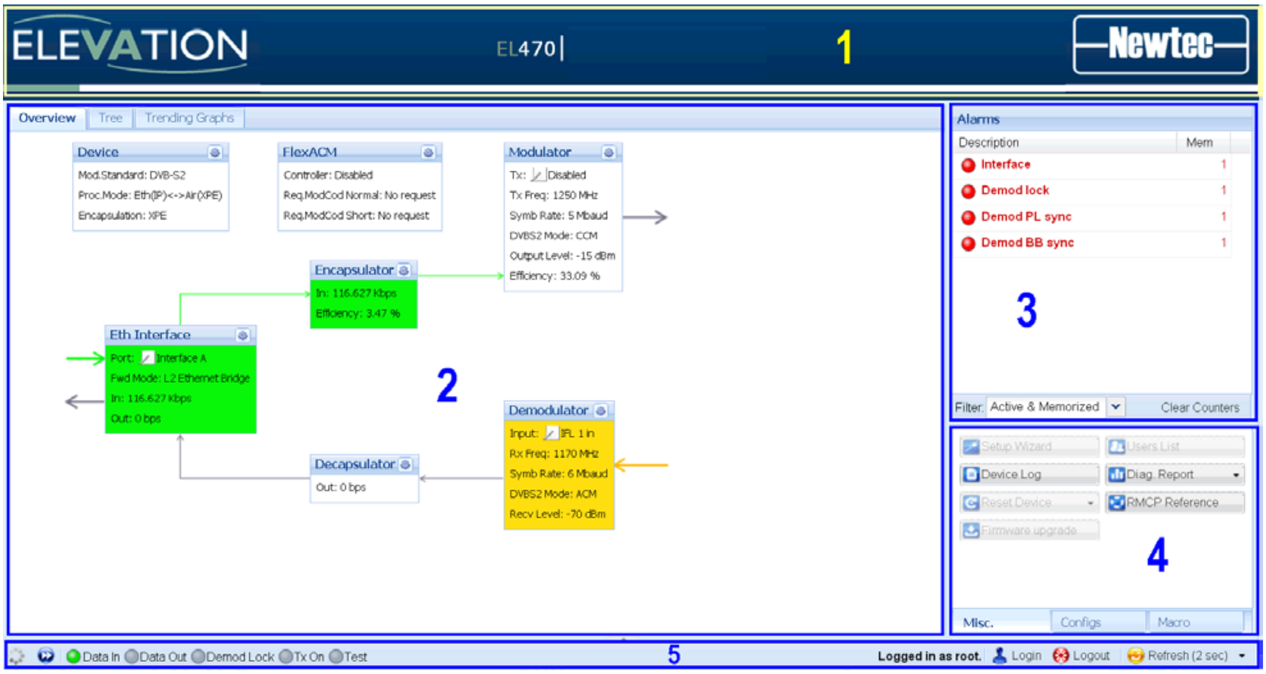


Figure 34 – GUI Window

The table below gives an overview of the areas of the GUI (Refer to Figure 34).

Area No.	Area
1	Banner
2	Central stage window
3	Alarm list window
4	Function controls window
5	Status bar

Table 4 – General Monitor and Control Screen Areas

6.3.1 Banner

The banner contains an editable text field right of the product name. The user can use this text field to assign a unique identifier to the device. Double-click this text to edit the content.

The text displayed in editable text field of the banner is the same as the screensaver message.

6.3.2 Central Stage Window

The central stage window contains three tabs:

- Overview;
- Tree;
- Trending Graphs.

Figure 35 – Default Tabs Central Stage Window

6.3.2.1 Overview Tab

The **Overview** tab contains a diagram representation of the functions that are carried out in the device. These functions are represented by a set of functional blocks with function names, basic settings and counters. The blocks are connected with arrows that illustrate the process flow.

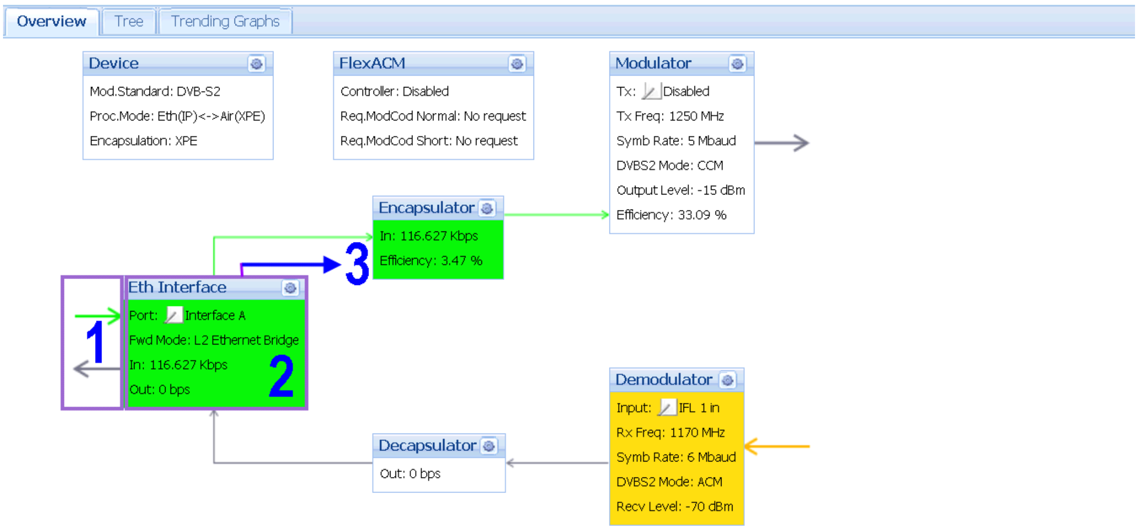


Figure 36 – Example of a Functional Overview

For every functional block of the device you can see the following information:

- Arrows from and towards the functional block;
- Relevant parameters to change and colour of the functional block itself;
- A link at the right top corner. When you click this link you have a detailed; overview page of that specific functional block.

The colour (red, yellow, green or grey) of each block or arrow in the diagram is determined by its condition.

The following conditions can occur:

- **Error**: The block and/or arrow has a red colour. The state is not OK. There is an alarm; a counter indicates an error(s) or a counter does not change as expected.
- **Warn**: The block and/or arrow has a yellow colour. The state is not as expected. There is an alarm or a counter does not change as expected.
- **OK & IN-USE**: The block and/or arrow has a green colour.
- **IDLE**: The block and/or arrow has a grey colour.

Click the detailed view icon () in the block heading to open the detailed overview page of that functional block. A new tab containing the function details opens in the central stage area.

When a value changes in the central stage area it briefly gets a yellow background.

6.3.2.2 Tree Tab

The tree tab shows all device variables arranged in a tree structure. This tree structure is consistent with the structure of the menus accessed via the front panel. Only users with the administrator profile can access and modify all variables in the menu pages of the tree structure. Other user profiles do not see all variables.

The tree structure in this GUI is equivalent with the tree structure in the previous user interface version for this device.

The tree structure contains different types of icons.

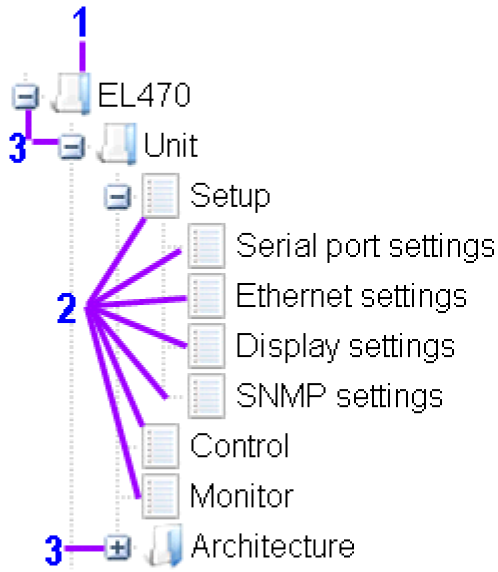


Figure 37 – Tree Navigation Icons

The following table describes the properties of each icon type in the tree structure (refer to Figure 37):

Icon type	Description
1	The folder icon indicates a node that is for navigation only. It does not have a corresponding parameter page.
2	The form icon indicates that the tree structure contains a parameter page on that level with editable parameters.
3	The expand icon (+) indicates that the tree structure can expand one or more levels (branches) below. Lower levels can contain other folders and/or parameter pages. The collapse icon (-) collapses the selected tree branch.

Table 5 – Tree navigation Icon Description

To navigate more easily in the tree structure, you can expand or collapse a branch of the tree or the complete tree with the buttons in the navigation bar above the tree.

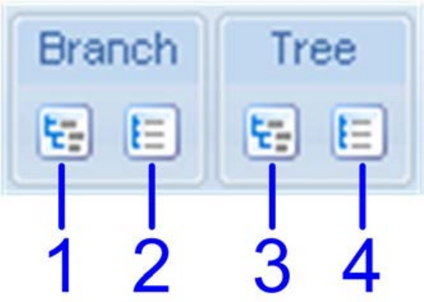


Figure 38 – Tree Navigation Bar

The following table describes the function of each button in the tree navigation bar (Refer to Figure 38):

Button No.	Button function	Description
1	Expand	Expands the selected branch of the tree structure.
2	Collapse	Collapses the selected branch of the tree structure.
3	Expand All	Expands the complete tree structure.
4	Collapse All	Collapses the complete tree structure.

Table 6 – Tree Navigation Bar Buttons

6.3.2.3 Trending Graphs Tab

This tab shows an overview of the following graphs that can be used to monitor the device:

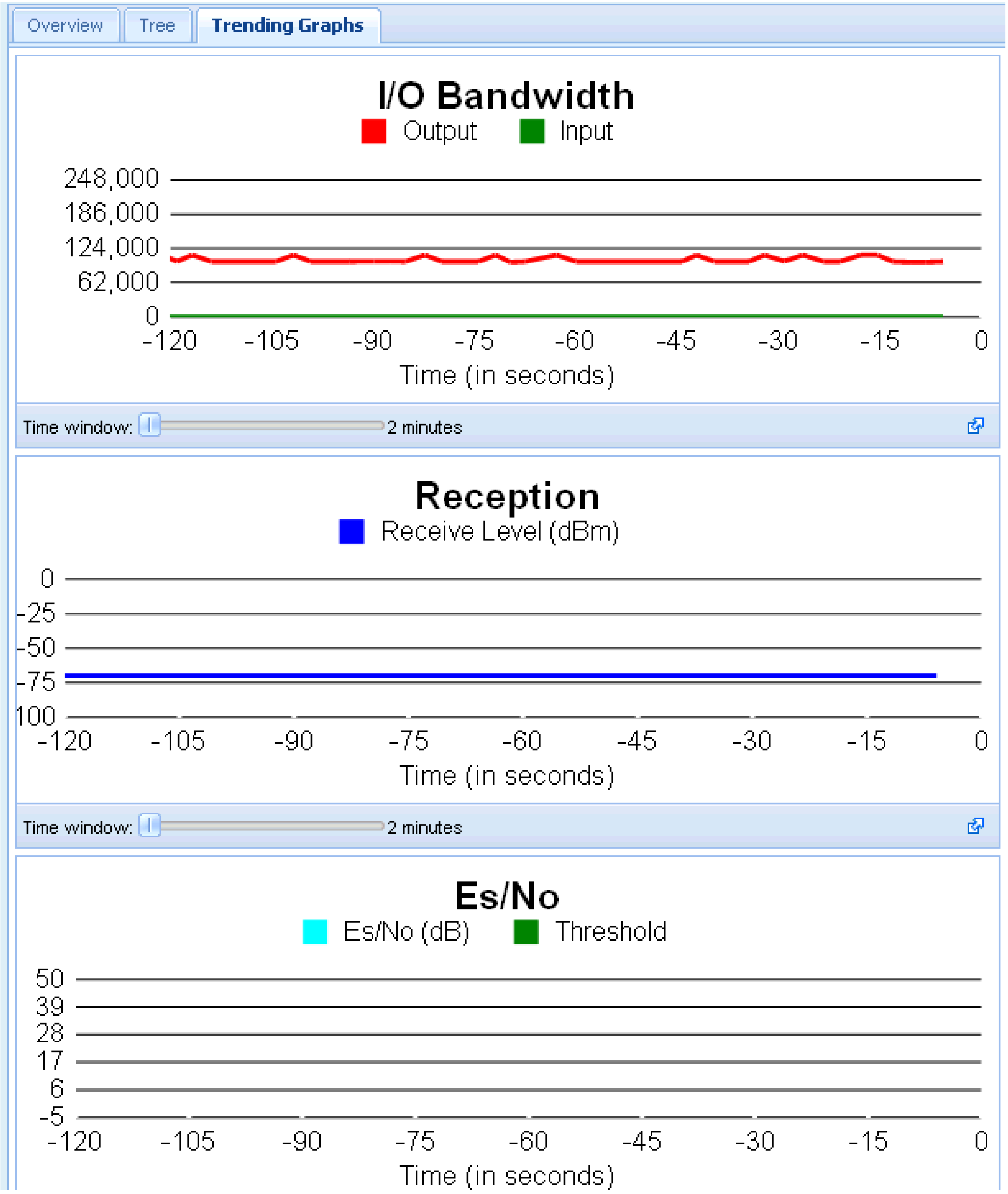


Figure 39 - Trending Graphs

6.3.3 Alarm Window

The alarm window shows the alarms generated by the device. By default only active or memorized alarms that have not been masked by the user are visible. Alarms are sorted first by their activity and then by their severity (from critical alarms to warnings).

It is possible to apply filters to manage the number of alarms shown.

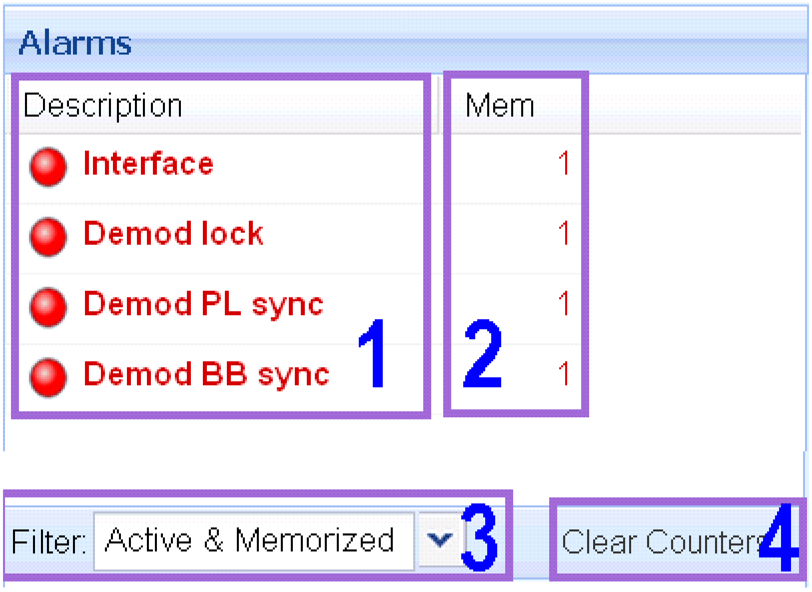


Figure 40 – Alarm Window

The alarm window contains the following information and control buttons (refer to Figure 40):

Area No.	Description
1	This area displays the alarm name.
2	This area displays the number of times an alarm was generated since it was last cleared.
3	This area contains a drop-down list with the following selectable alarm filters: • Active alarms; • Non-masked alarms; • All alarms.
4	Clear the number of times an alarm was generated since it was last cleared with the red cross button in this area. Active alarms can be cleared but the counter will still show 1.

Table 7 – Alarm Window Areas

6.3.4 Function Control Window

The function control window contains three tabs:

- Miscellaneous (Misc.);
- Configs;
- Macro.

Figure 41 –Tabs Function Control Window

6.3.4.1 Miscellaneous Tab

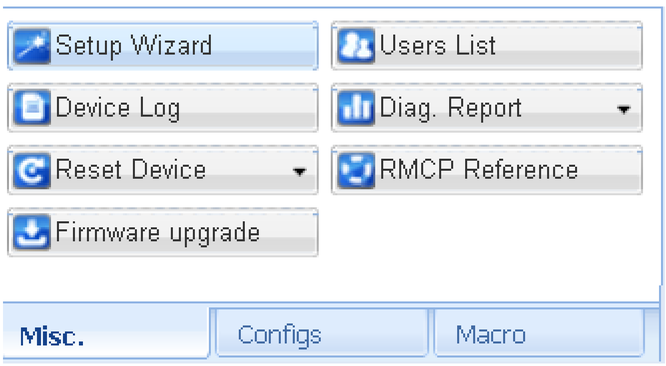


Figure 42 - Miscellaneous Tab

The miscellaneous tab (Misc.) contains seven buttons that allows to perform tasks, consult information or set access or interaction parameters. The following table describes briefly the function of each button:

Button	**Description**
Setup Wizard	With this button you open an easy to use wizard dialog window which guides you through the (initial) setup of the device. Only the parameters relevant for the connection you want to set up are displayed. See also section 6.4.
Device Log	This button is used to consult an event list. Events are e.g. alarms being set or cleared, cable disconnections, …
Reset Device	The drop-down menu behind this button allows resetting the device. Different reset types are possible: • **Soft**: You only reset the software; • **Hard**: You reset the software and the hardware; • **Config**: **Config**: Clears the configuration of the device. The flash memory is empty but the management parameters are kept e.g. IP address. This can only be performed by expert user profiles.
Firmware upgrade	After you have clicked this button you can browse to a zip-file containing a firmware update. The application can automatically upgrade its firmware using this zip-file.
Users List	This button opens a new **Users List** tab in the central stage region. You can view all users and change the user attributes (if you have the expert user profile). Refer to section 6.6.1.
Diagnostic Report	With this button different types of diagnostic reports can be generated: • **Basic**: The basic rapport shows all configuration parameters; • **Full**: The full rapport shows all configuration parameters and all debugging parameters.
RMCP Reference	This button opens an overview of the RMCP commands used for the software of your device.

Table 8 – Miscellaneous Function Controls

6.3.4.2 Configuration Function Controls Tab

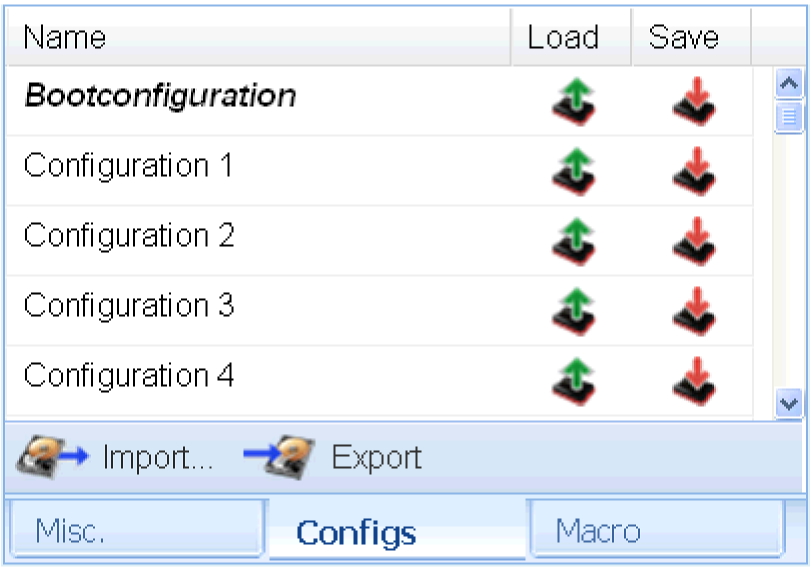


Figure 43 - Configuration Function Controls Tab

After power up the boot configuration (the first configuration) is loaded on the device

The icons behind the configuration names support to:

- **Save** the current configuration to persistent memory ( ).

> If a configuration is not saved to persistent memory it will be lost when the device powers down.

- **Load** a stored configuration ( ).
-

The **Import** and **Export** buttons below the list of different configurations support to:

- **Import** configurations from a ".cfg" file stored on the local PC. Refer to section 0;
- **Export** all saved configurations in a ".cfg" file to a local PC.

It is possible to edit the name of an existing configuration by double clicking on the configuration name that must be renamed.

Example:

Suppose to save the current configuration of the device under the third configuration slot and name it: Newtec_example.

- Click the Configuration tab;
- Click the Save button next to the third configuration slot;
- Double-click the Name field of the third configuration slot. You can now enter a new name for the configuration;
- Type Newtec_example and click outside the text field.

6.3.4.3 Macro Tab

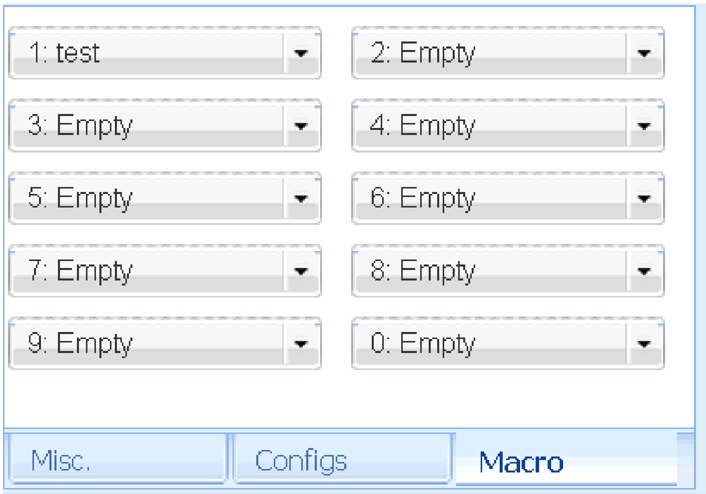
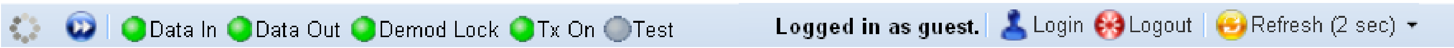


Figure 44 - Custom Function Macro Tab

Use the buttons on the **Macro** tab to store sets of RMCP-commands. Manually insert and assign up to twenty RMCP-commands separated by a “**;**” to one button or change stored RMCP-command sets via the **Edit** option. Click the arrow next to the button to open the **Edit** option.

An overview of all allowed RMCP-commands can be found in the RMCP manual of your device.

6.3.5 Status Bar



The status bar informs on:

- Ongoing interaction with the device via the status field on the left;
- The current user profile.

Log in to or log out from the GUI of the device via the buttons in the status bar.

- **Logout** button, the current user is logged out;
- **Login** button, open the **User identification** dialog box.
- **Refresh button,** updates the synoptic view. Click the arrow to set the automatic refresh time.

6.4 Configuring the Device Using the GUI

6.4.1 Introduction

Configuration of the device is done by changing parameters. Accessing and editing the device parameters can be done via multiple paths in the GUI.

- Common used parameters are set using the functional blocks on the overview tab.
- Non-commonly used parameters can be set on the parameter pages of the tree structure. Experienced users of the device can set all parameters using the tree structure parameter pages.
- A configuration wizard is built into the GUI. This wizard is very useful for non-experienced users. It guides the user step by step through the configuration and gives extra information. The wizard can be accessed through the **Wizard** button on the **Miscellaneous** tab of the function controls.

It is strongly advised to use the wizard to configure the device parameters the first time the device is operated after physical installation.

6.4.2 Parameters

6.4.2.1 Parameter Dialog Box Types

The GUI contains different types of parameter dialog boxes to set up all parameters during a configuration.

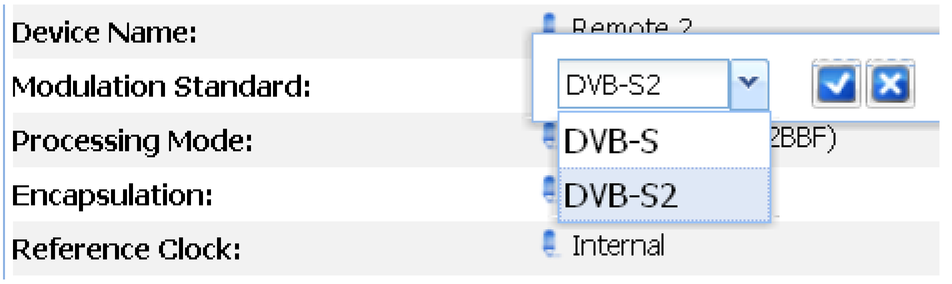
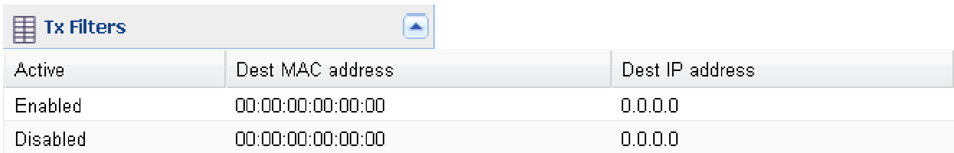
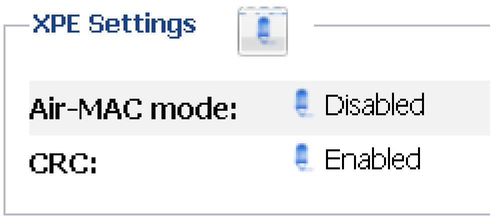
Dialog box type	Example
Drop-down list box	
Data field	
Checkbox	
Table	
Functional group	

Table 9 – Parameter Interface Type Examples

In a table type dialog box, columns can be moved to a different position in the table.

Depending on the dialog box type it is needed to confirm or reject the selected or inserted value for the parameter by clicking one of the following buttons:

Button	Function
 or 	Save the parameter value.
 or 	Do not save the parameter value.

Table 10 – Parameter Save and Cancel Buttons

To accept a value, the user can also use the Enter key on the keyboard. To reject a value, use the Escape key.

When a parameter value changes in the GUI, it briefly gets a yellow background.

6.4.2.2 Applicable Parameters

The number of parameters you see in the tree view and the detailed view of a block depends on your user profile and the current device configuration.

Parameter changes via the front panel or via the management interface are also visible in the GUI .

6.4.2.3 Invalid Values

The GUI does not allow the implementation of invalid values. While you type a value this value is validated. The user interface has several features that help you to insert valid values:

- Place the mouse cursor above a field to be adjusted, the acceptable range is displayed in a tooltip;
- When typing an invalid value for a parameter, the edges of the parameter field turn red and a tooltip displays the reason why the value is invalid;
- It is not possible to save values outside the defined ranges for the device.

6.4.3 Changing Parameters

When logged in as administrator or as normal user, it is allowed to change parameters.

Use one of the following methods to change the parameters.

- Using the editable parameters in the functional blocks (used to edit the common used functions);
- Using the tree structure parameter pages.

The Wizards function is the easiest way to create a new configuration on your demodulator. The Wizards function is only applicable for users with an expert profile. It is highly recommended to perform a ***configuration reset*** (refer to section 6.5) to clear the existing configuration before using the **Wizards**.

Experienced users can adjust individual parameters without the aid of the Wizards.

Proceed as follows to adjust parameters:

- ➢ Click the **Overview** tab or the **Tree** tab;
- ➢ Two possibilities:
  - The **Overview** tab, click the detailed view icon ( ) of the functional block that contains the parameter(s) to be adjusted;
  - The **Tree** tab, navigate to the parameter page that contains the parameter(s) to be adjusted;
- ➢ Click the **Editable** icon ( ) next to the parameter;
- ➢ Insert or choose the new parameter value;
- ➢ Save the parameter value;
- ➢ Edit more parameters in the same way if needed;
- ➢ Save the new configuration.

6.4.4 Setup Wizard

The wizards function helps to setup the device for the first time.

To start up the configuration wizard proceed as follows:

- Click **Misc.** > Setup **Wizard**

The following screen is displayed:

Figure 45 - Initializing IP Setup Wizard

When the device specifications are known the following screen is shown:

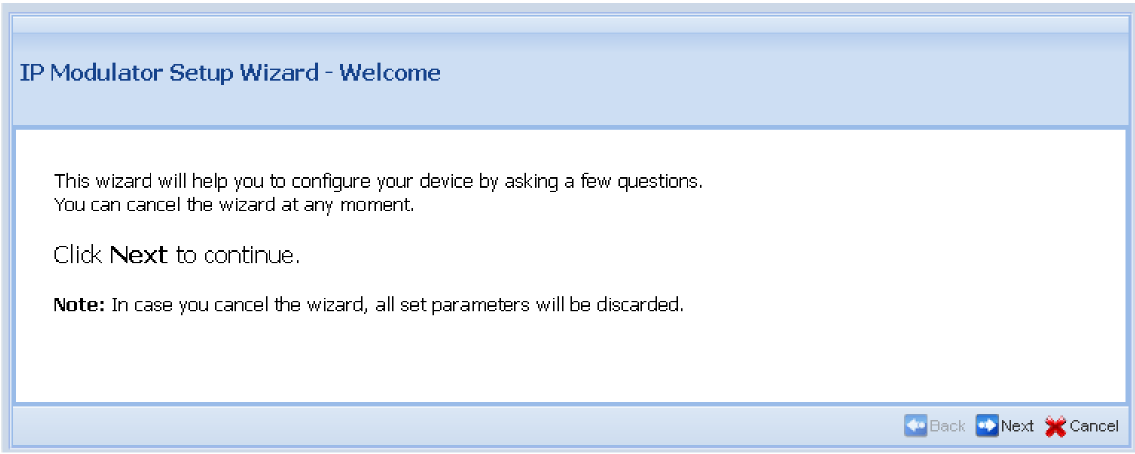


Figure 46 - Welcome Screen

Complete the different steps of the wizard according to your network settings to configure device.

An example can be found in Appendix B on page 177.

6.5 Reset Device

The device can be reset when needed. A reset of a device can only be performed by expert user profiles.

- Click **Misc.** tab;
- The drop-down menu behind the **Reset Device** button allows resetting the device.

Different reset types are possible:

- **Soft**: Resets the software;
- **Hard**: Resets the software and the hardware. Perform a hardware reset after upgrading the capabilities of your device;

Config: Clears the configuration of the device. The flash memory is empty but the management parameters, like management IP address are kept. Perform a configuration reset before a configuring the device via the wizards function.

6.6 Procedure to Perform a Firmware Upgrade

To perform a firmware updates do the following:

- Click **Misc**. tab;

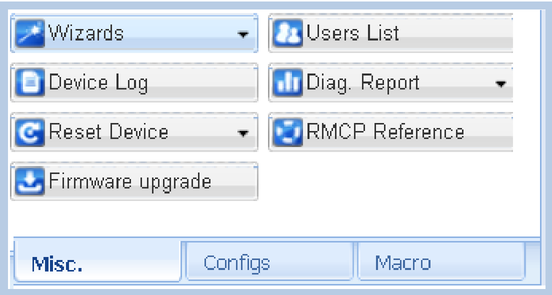


Figure 47 - Misc. Tab

- Click Firmware upgrade;
- Browse to the location of the stored zip-file;
- Select the zip-file and click open;

The application automatically upgrades its firmware using this zip-file.

6.6.1 Access Rights of GUI Users

6.6.1.1 Introduction

By clicking the **Users List** button on the **Miscellaneous** tab, the **Users List** tab opens in the central stage window. To remove the tab from the central stage window, press the -icon in the right upper corner of the tab.

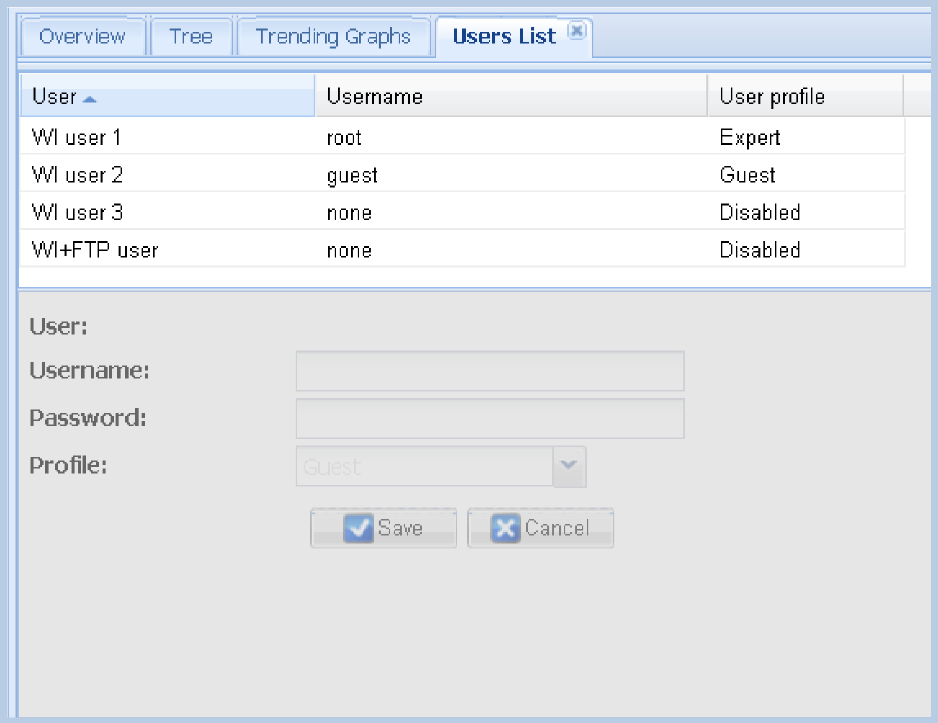


Figure 48 – Users List Tab

Four GUI user accounts with different access rights can be created. At least one user account with expert user profile must be defined. By default **WI user 1** has username **root** and expert user profile.

Users with the user profile expert can:

- Change account passwords;
- Change the user profile for a user account (resulting in a change of the user's permissions).

> When the WI+FTP user is not defined or disabled, no password is required to connect to the ftp-server on the device.

6.6.1.2 Edit a User Account

Proceed as follows to create a new user account:

- Click the **Users List** button on the **Miscellaneous** tab;
- Select a user profile from the list.
  The user properties fields can now be edited.

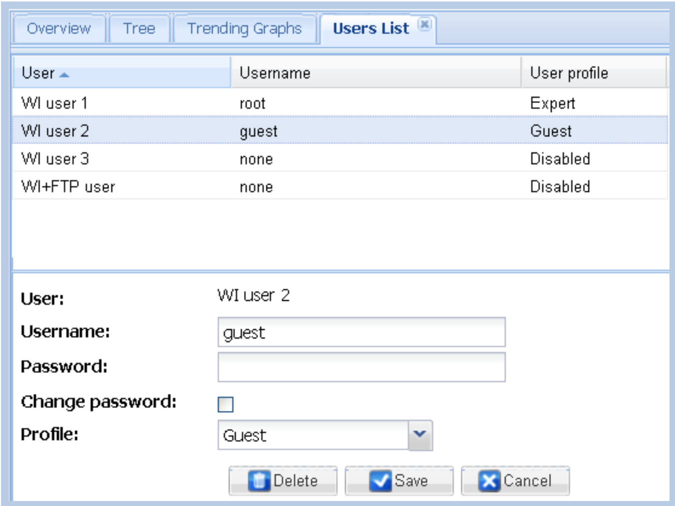


Figure 49 - Users List Tab with User Properties Fields

- Type in the field:
  - **Username**: this is the username the user must use to log in. It is not allowed to duplicate user names.
  - **Password**: this is the password the user must use to log in.

- Select the desired **Profile** from the drop-down list box;
  - **Guest:** the user has read-only access to the typical configuration and monitoring options;
  - **Normal:** The user has read-write access to the typical configuration options. The user can load a configuration but cannot save a configuration. The user can execute and see the commands of a custom action.
  - **Expert:** The user has read-write access to all configuration options. The user can load and save a configuration. The expert user can execute and create custom actions.

- Click:
  - The **Save** button () if you want to save the user account;
  - The **Cancel** button () if you don't want to save the user account.

The user profile of the WI + FTP user is set to Disabled; this indicates that anonymous access is enabled.

6.6.1.3 Disabling a User Account

Only users with the expert user profile can delete user accounts. Deleting a user account which is logged in from another session, will not cancel its session but the user won't be able to log in again. A user cannot delete his user account.

Proceed as follows to disable a user account:

- Click the **Users List** button on the **Miscellaneous** tab;
- Select the user account you want to remove from the list;
- Type in the **Password** field the password for the user account;
- Click the **Delete** button (

).

6.6.1.4 Change a User Account Password

A user can change the password of his user account. Users with the expert profile can change the password of every user account provided. They know the current password of that user account.

Proceed as follows to change a user account password:

- Click the **Users List** button on the **Miscellaneous** tab;
- Select the user account for which to change the password;
- Select the **Change password** checkbox.

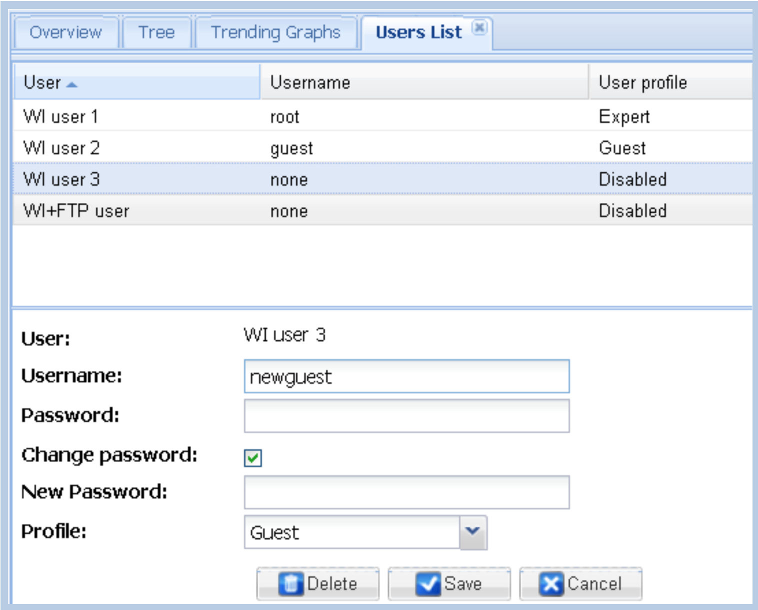


Figure 50 – New Password Field

- Type in the field:
  - **Password**: the old user password;
  - **New password**: the new user password;
- Click the **Save** button () to save the new password.

6.6.1.5 Change the User Profile of a User Account

Only users with the expert user profile can change the user profile for a user account. At least one user must contain the Expert profile. It is impossible to remove the last Expert user.

Proceed as follows to change the user profile for a user account:

- Click the **Users List** button on the **Miscellaneous** tab;
- Select the user account for which you want to change the user profile;
- Type in the **Password** field the password for the user account;
- Select a user profile from the **Profile** drop-down list box;

Click the Save button () to save the new user profile for the user account.

6.7 Create a Diagnostics Report

Perform the following steps to create a diagnostics report.

- Click **Misc.** tab;
- Click **Diag. Report**.

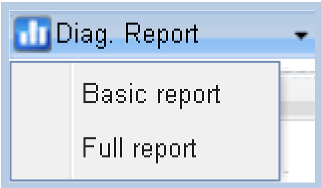


Figure 51 - Create a Diagnostic Report

- **Basic**: The basic rapport shows all configuration parameters;
- **Full**: The full rapport shows all configuration parameters and debugging parameters.

- Click **Basic report** or **Full report**;

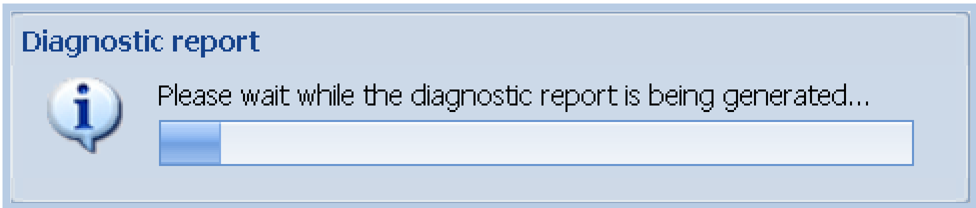


Figure 52 - Diagnostic Report Generation

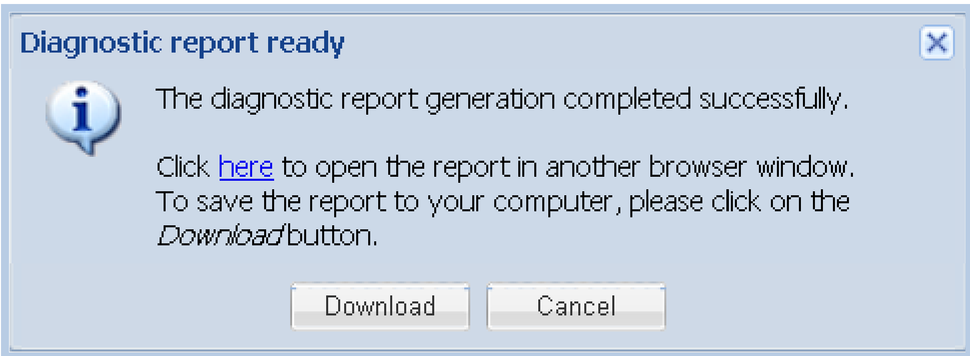


Figure 53 - Diagnostic Report Ready

- Click **download** to store the diagnostics report as an html file or click **here** to open the report in another browser window.
  The following screenshot displays an extract of a basic diagnostics report.

```
################ DIAGNOSTICS REPORT ##################

EL170/Unit/Setup

   Device mode                    1
   RMCP version                   v2.0
   System time                    08:45:56 18/11/2010
   System uptime                  0 day 23:07:35
   User menu

EL170/Unit/Setup/Serial port settings

   Serial interf. type            RS485
   Device RMCP address            100
   Serial baudrate                115200

EL170/Unit/Setup/Ethernet settings

   Device IP address              192.168.255.166
   Device IP mask                 255.255.255.0
   Default gateway                192.168.255.001
   Transport protocol             TCP+UDP
   Device MAC address             00:06:39:00:9A:71
```

Figure 54 – Extract of a Diagnostics Report

6.7.1 Copy a Configuartion on a Different Device

It is possible to exchange a configuration between devices of the same product line (with the same capabilities and options) by exporting and importing configurations.

6.7.1.1 Exporting a Configuration

The possibility exists to export all 48 stored device configurations at once as a ".cfg" file on a local computer.

Proceed as follows to export a configuration set:

- Click the **Configs** Tab;
- Click the **Export** button;
- Browse to the location where to store the ".cfg" file (the browsing window depends on your browser configuration);
- Click **Save**.

6.7.1.2 Importing a Configuration

The possibility exists to import all 48 device configurations at once as a “.cfg” file from a local computer.

Proceed as follows to import a configuration set:

- Click the **Configs** Tab;
- Click the **Import** button;
- Browse to the location of the stored “.cfg” file;
- Select the “.cfg” file and click **Open**. The stored configurations are loaded into the Newtec device;

It is possible to load any of the 48 configurations to view or test them.

- The user has two options:

- The user can keep the imported configurations. In this case, the user must save the current imported configuration in bootconfiguration;

The user can decide to delete the imported configurations. In this case the user must restart the device. The device will start up using the same ootconfiguration as the previous start up..

7 BLOCK DIAGRAM

The following block diagrams refer to the default configuration with L-band options.

7.1 Monitoring and Control

This block is used for monitoring and control of the device.
This block is generic for all devices.

The following actions are available:

- Alarm Output;
- Remote Monitoring and Control over LAN or RS232/RS485;
- Front Panel.

For more information refer to section 4.2.1.

7.2 EL 170 Modulator

In this diagram the modulator is split up into the following functionalities.

- Monitor and Control;
- Modulator Functionality.

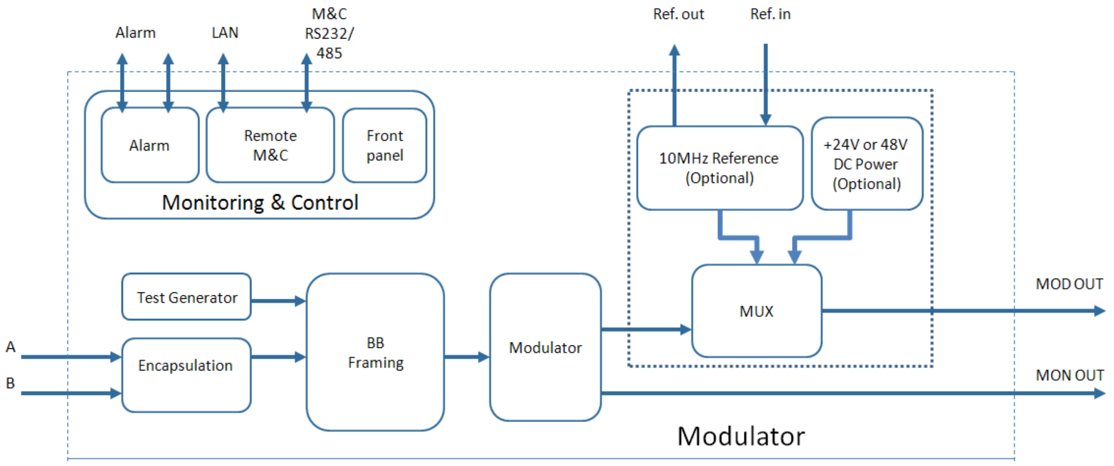


Figure 55 - EL170 Modulator

The EL170 offers an auto-switching Gigabit Ethernet interface and integrates seamlessly with terrestrial IP networks and equipment. The incoming IP packets can be filtered using e.g. VLAN or MAC addresses, transmitted transparently (data piping mode) or routed to several receiving points and destination addresses.

The IP data entering the modulator using the Ethernet connector A is encapsulated.

The signal is framed into baseband frames.
The framed signal is modulated by the L-band modulator.

The modulated (L-band) signal is forwarded to a multiplexer, in this multiplexer the following options can be added:

- 10MHz reference (we refer to the section Options for ordering information);
- 24V or +48V DC Power (we refer to the section Options for ordering information).

At the output of the modulator, the signal is available on an L-band interface, MOD OUT and MON OUT connector.

Test Generator

The modem is equipped with a build in test generator. This generator can be used to simulate IP data.

Option IF OUT

Optionally the L-band modulator can be replaced by an IF-band modulator. When this option is available the IF signal is directly available on the output of the modem as IF OUT. In this case the multiplexer is not used. For ordering information we refer to the section Options.

This option is not shown in the block diagram.

7.3 EL 970 Demodulator

In this diagram the demodulator is split up into the following functionalities:

- Monitor and Control;
- Demodulator Functionality.

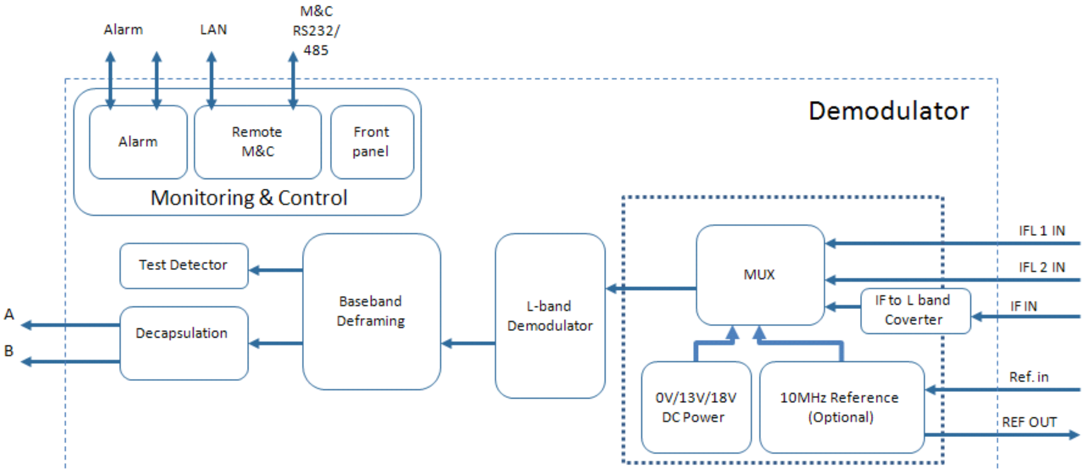


Figure 56 - Combined block diagram – L-band

The EL970 has a dual L-band input. The active input is selected by the user and can provide DC power and frequency band selection signals compatible with most professional and commercial LNBs.

The L-band signal is demodulated by the L-band Demodulator. This demodulated signal is deframed and decapsulated. The data is available on the Ethernet connector A or B depending which one is activated by the user.

Test Generator

The demodulator is equipped with a build in test generator. This generator can be used to detect/monitor IP data.

Option IF OUT

Optionally, one L-band input can be replaced by an IF input.

This option is not shown in the block diagram.

7.4 EL 470 Modem

In this diagram the modem is split up into the following functionalities:

- Monitor and Control;
- Modulator Functionality;
- Demodulator Functionality.

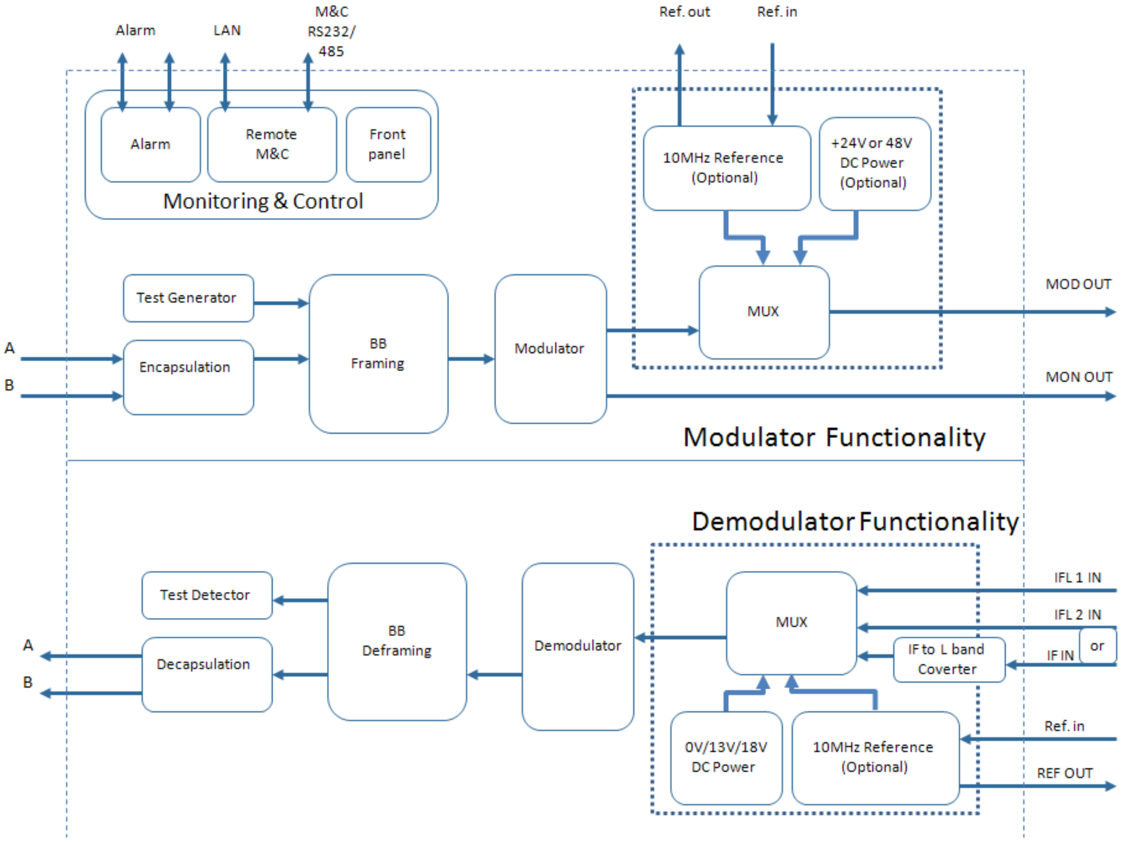


Figure 57 - EL 470 Modem

7.4.1 Modulator Functionality

The IP data entering the modulator using the Ethernet connector A is encapsulated.

The signal is framed into baseband frames.
The framed signal is modulated by the L-band modulator.

The modulated (L-band) signal is forwarded to a multiplexer, in this multiplexer the following options can be added;

- 10MHz reference (we refer to the section Options for ordering information);
- +24 or +48V DC Power (we refer to the section Options for ordering information).

At the output of the modulator, the signal is available on an L-band interface, MOD OUT and MON OUT connector.

Test Generator

The modem is equipped with a build in test generator. This generator can be used to simulate ASI/TS or IP data.

Option IF OUT

Optionally the L-band modulator can be replaced by an IF-band modulator. When this option is available the IF signal is directly available on the output of the modem as IF OUT. In this case the multiplexer is not used. For ordering information see section Option.

This option is not shown in the block diagram.

7.4.2 Demodulator Functionality

The modem has a dual L-band input on the receiving side. The active input is selected by the user and can provide DC power and frequency band selection signals compatible with most professional and commercial LNBs.

The L-band signal is demodulated by the L-band Demodulator. This demodulated signal is deframed and decapsulated. The data is available on the Ethernet connector A or B depending which one is activated by the user.

Test Generator

The demodulator is equipped with a build in test generator. This generator can be used to detect/monitor IP data.

Option IF OUT

Optionally, one L-band input can be replaced by an IF input.

This option is not shown in the block diagram.

8 TECHNOLOGY

This chapter describes the DVB-S and DVB-S2 modulation standards and the processing mode of the EL170/970/470 devices.

8.1 Modulation Standards

8.1.1 DVB-S

DVB-S is the first generation of a standard for digital broadcasting via satellite.

DVB-S was designed to carry MPEG-2 transport streams over satellite. MPEG-2 transport streams typically carry one or several television or radio services multiplexed into a synchronous bit stream. All service components are divided in short packets of 188 bytes, each identified by a Program Identification (PID) tag in the header of the packet.

Generic data can also be carried in MPEG transport streams, provided that it is first encapsulated in the transport stream packets. The most common way to encapsulate IP data into MPEG streams is called Multi Protocol Encapsulation (MPE) and is also specified by a DVB standard.

The total bit rate of the transport stream is constant but can typically be adjusted to match the needs of the satellite link. If the desired transport stream rate is greater than the sum of the carried components, null packets are added to the stream by the multiplexer or the modulator. This operation is called rate adaptation.

DVB-S uses QPSK modulation and concatenated error protection based on a convolutional Viterbi code and a shortened RS code.

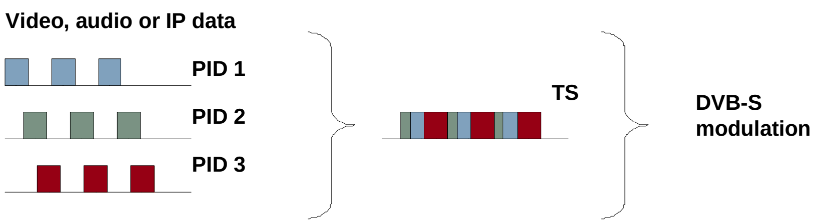


Figure 58- DVB-S used to Carry Video, Audio and Data in an MPEG Transport Stream

8.1.2 DVB-DSNG

The DVB-DSNG standard is an extension to the DVB-S standard introduced for professional applications such as Digital Satellite News Gathering or television contribution services. DVB-DSNG introduces higher order modulation schemes (8PSK and 16QAM) and additional signal roll-off factors.

The transported signals are the same as for DVB-S.

8.1.3 DVB-S2

DVB-S2 is the second generation of the DVB standard for broadcast of satellite. It introduces new correction codes (BCH and LDPC) that are typically 30% more efficient then the codes used in DVB-S. The DVB-S2 standard also introduces a range of new features such as:

- Higher order modulation schemes 16 APSK and 32 APSK;
- Sharper roll-off factors;
- A new framing structure called “Baseband frames”;
- The ability to vary the modulation parameters dynamically. This is used in modes called “Variable Coding and Modulation” and “Adaptive Coding and Modulation”;
- The ability to carry several signals on a single satellite carrier, without multiplexing in front of the modulator. This is called “multi-stream””;
- The ability to carry signals other than MPEG transport stream. This is called “Generic Stream”.

These features are further explained in the following sections:

8.1.3.1 DVB-S2 Framing Structure

DVB-S2 applies the error correction coding and the modulation to large frames of data called Baseband frames. A DVB-S2 baseband frame is either 16200 bits (short frames) or 64800 bits (normal frames). The content of a frame can be a section of a transport stream, or any type of data, framed or unframed (Generic Stream). Note that the DVB-S2 standard specifies how to encapsulate transport streams into Baseband frames, but not how to encapsulate IP data into Baseband frames.

Newtec has developed a proprietary encapsulation format called XPE (Extended Performance Encapsulation), which is much more efficient than MPE.

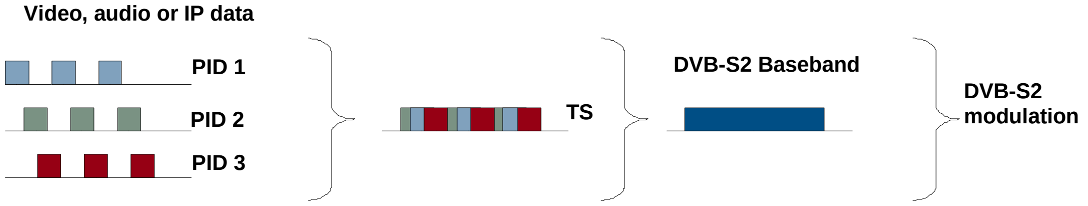


Figure 59- Transport Stream Carried over DVB-S2

8.1.3.2 DVB-S2 Multi-Stream

A unique feature of DVB-S2 is the ability to carry different transport streams and/or generic streams into separate baseband frames, on the same satellite carrier. Each Baseband frame is identified with an Input Stream Identifier. A sequence of DVB-S2 baseband frames with the same ISI number is called a DVB-S2 stream. A satellite carrier that transports several DVB-S2 streams is said to operate in multi-stream mode.

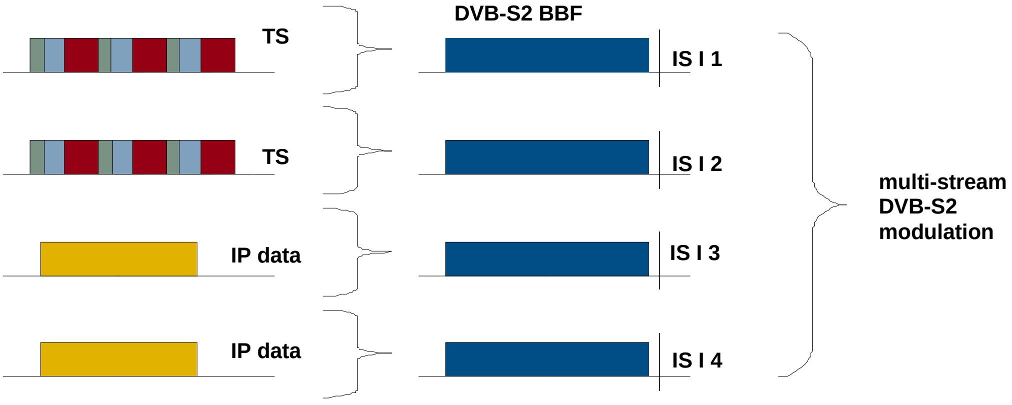


Figure 60- DVB-S2 – Multi-Stream

8.1.3.3 DVB-S2 CCM, VCM and ACM

CCM

In DVB-S2 each Baseband frame can be modulated with different error correction and modulation parameters (in short, ModCod, for example QPSK 4/5). A DVB-S2 modulator is capable of detecting these parameters on the flight, without loosing synchronization from one frame to the next.

When the same parameters are used for all frames of the DVB-S2 carrier, the mode of operation is called CCM (Constant Coding and Modulation).

A DVB-S2 CCM uplink signal must be dimensioned according to the smallest receiving station and the higher possible signal fading, to ensure adequate signal availability in all receiving stations.

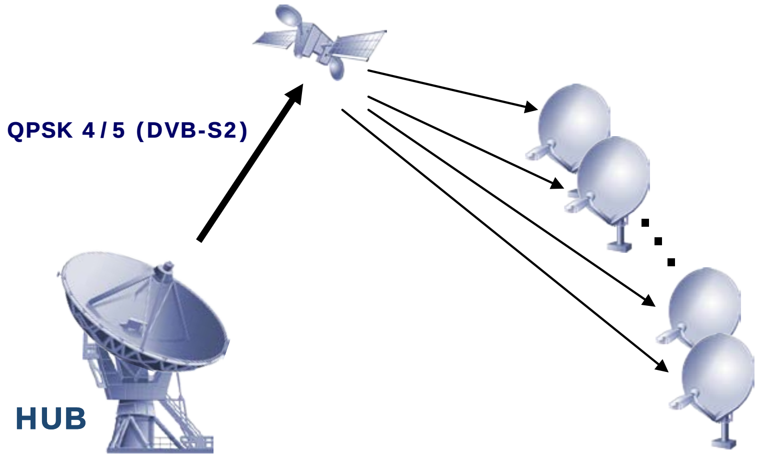


Figure 61- CCM

Auto-CCM is a demodulation capability that indicates that the demodulator can automatically detect the coding and modulation parameters used by the modulator operating in CCM mode. The advantage of auto-CCM compared to CCM, is that auto-CCM does not require the knowledge and configuration of the ModCod on the demodulator (plug-and-play configuration).

VCM

Variable Coding and Modulation is a mode of operation that allows different modulations parameters to be applied to the different DVB-S2 streams of a multi-stream signal. If each of the stream is intended for a different receiving site, VCM allows optimizing the parameters of each stream to be optimized for each receive station, instead of dimensioning the whole link according to the smallest station.

ACM

In Adaptive Coding and Modulation mode, the modulation parameters of the Baseband frames can vary over time, according to the instantaneous receiving conditions of the site where the frames will be received. In ACM a feedback mechanism is used between the demodulator and the modulator. This feedback mechanism dynamically tells the modulator which modulation parameters to use for each Baseband frame. ACM allows operating satellite links with almost no margin, since the system adapts automatically to fading or interference conditions.

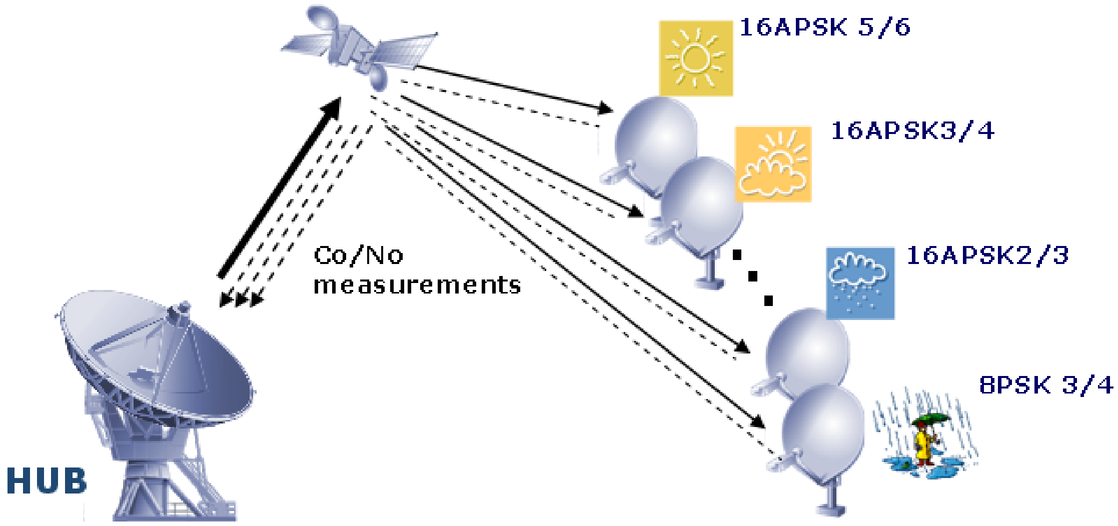


Figure 62- ACM

Newtec's implementation of ACM for applications is called FlexACM. It relies on a unique very accurate linear and non-linear distortion measurement technology in the demodulator (called NoDE) and advanced traffic shaping technologies in the hub.

8.2 Pilots in DVB-S2

8.2.1 What are Pilots

Pilots are unmodulated symbols grouped in blocks that can be added on the physical layer framing level.

8.2.2 Why are pilots used in DVB-S2

- Reduce the phase noise influence;
  Phase noise is created by the frequency components around the main carrier frequency.
  This noise contains components at many frequencies with randomly changing phase.
- Pilots are used to increase the reliability and the continuous receiver synchronization.

8.2.3 When are Pilots Used in DVB-S2

It is adviced to use pilots in the following cases.

- In ACM mode (always on).
- When a noticable amount of phase noise is present;
- At low data rates;
- When distortion is present on the signal for example due to non linearity.
- When using one of the following ModCods. (this is due to the ModCod structure)
  - 8-PSK 3/5 and 2/3
  - 16-APSK 3 /4
  - 32 APSK 3/5

8.3 Single Channel Per Carrier (SCPC) and Multiple Channel Per Carrier (MCPC)

This section describes SCPC and MCPC two possibilities that can be used to transmit data over satellite.

8.3.1 Single Channel Per Carrier

When using this option a single carrier is used at a fixed frequency and bandwidth. A SCPC system is used when the satellite bandwidth is dedicated to a single carrier (source).

8.3.2 Multiple Channel Per Carrier

When using this option several subcarriers are combined into a single stream before they are modulated onto a carrier. This carrier is transmitted from a single location to one or more remote sites. MCPC has the advantage to use the satellite bandwidth more efficiently taking into account the maximum power (dB/Hz) allowed by the satellite operator on the transponder.

8.4 Processing Modes

Newtec Elevation devices can operate in several processing modes to carry IP data.

These processing modes indicate how the incoming data or signal is interfaced to the modulator or demodulator and how it is transmitted over the modulated carrier.

The IP modulator/modem/demodulator supports:

- IP encapsulation into Transport Stream (TS) packets. This is done by first encapsulating IP packets with protocol header (data piping/MPE/ULE) and subsequently packing these variable-sized packets into fixed-size frames (DVB-S TS). The TS packets are either converted to DVB-S or DVB-S2 symbols;
- IP encapsulation into DVB-S2 baseband frames. This is done by first encapsulating IP packets with protocol header (XPE) and subsequently packing these variable-sized packets into fixed-size frames (DVB-S2 BBF);
- Transparent forwarding of baseband frames to the satellite link. Transparent forwarding means that the baseband frames are forwarded unmodified between the Ethernet interface (GbE / Eth(ntS2BBF)) on one hand, and the satellite interface on the other.

The possibilities for the incoming signal are:

- **Eth(IP)**: The incoming signal is IP and is entering the modulator or leaving the demodulator via an Ethernet interface (Eth).
  Note that any regular Ethernet frame is acceptable, but most often it is used for Internet Protocol (IP) traffic;
- **Eth(ntS2BBF)**: The incoming signal enters the modulator via an Ethernet interface (Eth). The incoming Ethernet frames must consist of encapsulated DVB-S2 Baseband Frames.

In this manual the abbreviation for the Gigabit Ethernet interface is **GbE.**

The signal can be modulated using:

- **Air(TS)**: A Transport Stream is carried in a DVB-S or DVB-S2 carrier. The transported data is first encapsulated in a Transport Stream in MPE, ULE or data piping mode. The encapsulation/decapsulation is performed in the modulator/demodulator;
- **Air(XPE)**: IP data is encapsulated in XPE and carried directly in DVB-S2 Base Band Frames. XPE encapsulation/decapsulation is performed in the modulator/demodulator;
- **Air (GSE):** IP data is encapsulated in GSE and carried directly in DVB-S2 Base Band Frames. GSE encapsulation/decapsulation is performed in the modulator/demodulator;
- **Air(S2BBF)**: Incoming baseband frames are modulated directly on the DVB-S2 carrier without additional processing.

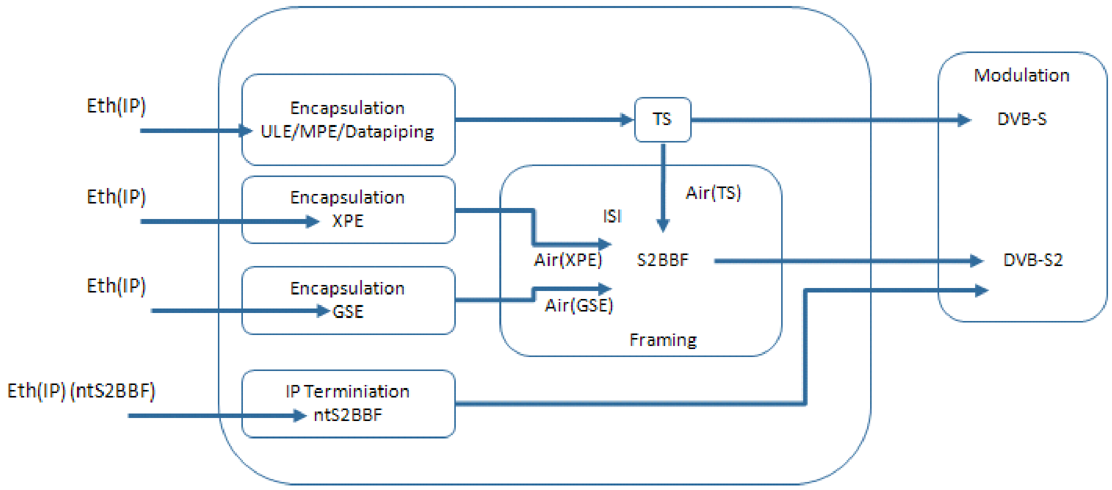


Figure 63- GbE Processing

Figure 64 shows a screenshot of the available processing modes and details the properties of each processing mode.

Figure 64- Processing Modes Selection

Processing mode	Interface	Interface Data Type	Over Air	DVB-S	DVB-S2	Ethernet Mode
Eth(IP) <-> Air (TS)	Ethernet	IP	TS	✓	✓	L2 Ethernet bridge L3 IP bridge L3 IP router
Eth(IP) <-> Air (XPE)	Ethernet	IP	S2BBF	✗	✓	L2 Ethernet bridge L3 IP bridge L3 IP router
Eth(ntS2BBF) <-> Air (S2BBF)	Ethernet	S2BBF	S2BBF	✗	✓	Transparent BBF Forwarding
Eth(IP) <-> Air (GSE)	Ethernet	IP	S2BBF	✗	✓	L2 Ethernet bridge L3 IP bridge L3 IP router

Table 11 - - Processing Modes in IP Applications

8.4.1 Processing Mode 1 – Eth (IP) -> Air(TS)

The processing mode “Eth(IP)<->Air(TS)” is typically used when compatibility with legacy receiver products or interoperability with low cost IP receivers or set top boxes are necessary. It is also the only processing mode that can be used in DVB-S. The interoperability comes at a cost of lower bandwidth efficiency due to the overhead of the encapsulation of the IP packets into an MPEG transport stream.

Typical applications of this mode of operation are the distribution or primary distribution of IPTV, the distribution of multicast content, or the forward link of satellite broadband access systems. It is also used when the IP content needs to be multiplexed with traditional MPEG video content at some point in the network.

The characteristics of this processing mode are:

- Support of DVB-S and DVB-S2 single-stream modulation (multi-stream not possible);
- The following schemes are supported depend on the Multi Encapsulation Protocol.
  MPE supports no L2 Ethernet bridge. All other protocols support all routing schemes: L2 Ethernet bridge, L3 IP bridge and IP routing;
- Flex ACM is supported in combination with XPE encapsulation.

8.4.1.1 Multi Protocol Encapsulation

Data casting technology is available using a variety of protocols that include Multi Protocol Encapsulation (MPE). MPE is based on the ETSI EN 301 192 standard. The hub equipment used to perform the MPE function is referred to as an Internet Protocol (IP) to Digital Video Broadcasting (DVB) decoder. The IP to DVB encoder acts as a router, a gateway, an encapsulator and, in some cases, a Quality-of Service (QoS) engine and a statistics logging device for billing purposes. The resulting output of the IP to DVB encoding is an MPEG transport stream that is fully compatible with the open DVB standards. Thus, the IP to DVB encoder can be used directly, or multiplexed together with other MPEG transport streams.

MPE supports unicast, multicast and broadcast data transmissions. It offers exceptional bandwidth efficiency in the multicast and broadcast modes of transmission because the data is only transmitted one time to a host of receiving clients. MPE systems can support one-way “pushing” of data, or two-way communications.

To transmit IP Packets over DVB-DSNG or DVB-S2, the Protocol Data Units (PDUs, i.e. IP packets) need to be processed by a device known as an encapsulator. The encapsulator can perform the function of either a bridge or router.

The variable-sized PDUs are first encapsulated by adding encapsulation overhead to form a SubNetwork Data Unit (SNDU). The overhead includes a field to indicate the length of the subnetwork data unit and an AIRMAC address to associate the protocol data units with a link-layer flow.

This is then fragmented into a series of fixed-size TS Packets (i.e. link-layer frames of 188 bytes). This is displayed in Figure 58.

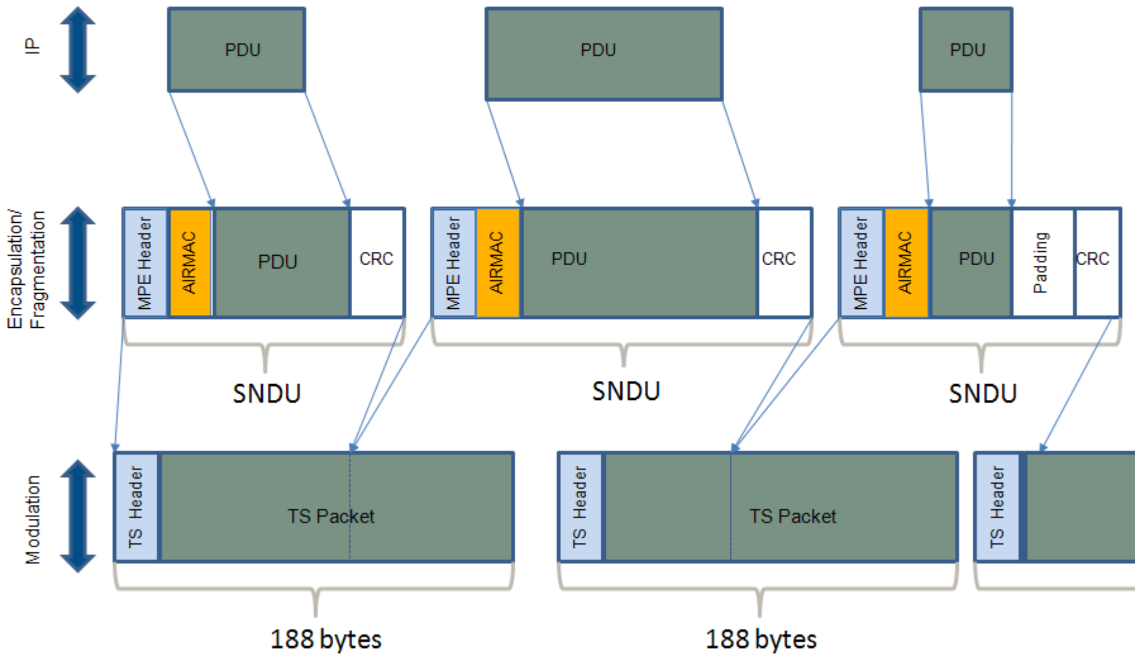


Figure 65 - MPE Encapsulation of IP Packets

MPE encapsulates network-layer packets in a way that resembles the control-plane SI tables used in a DVB network. This design can utilise existing processing logic developed for handling the control plane functions.

At the encapsulator, each subnetwork data unit initially starts at the beginning of a TS Packet, with the last TS packet being padded to its end. This is done to prevent jitter when a timeout is detected. Refer to Figure 66.

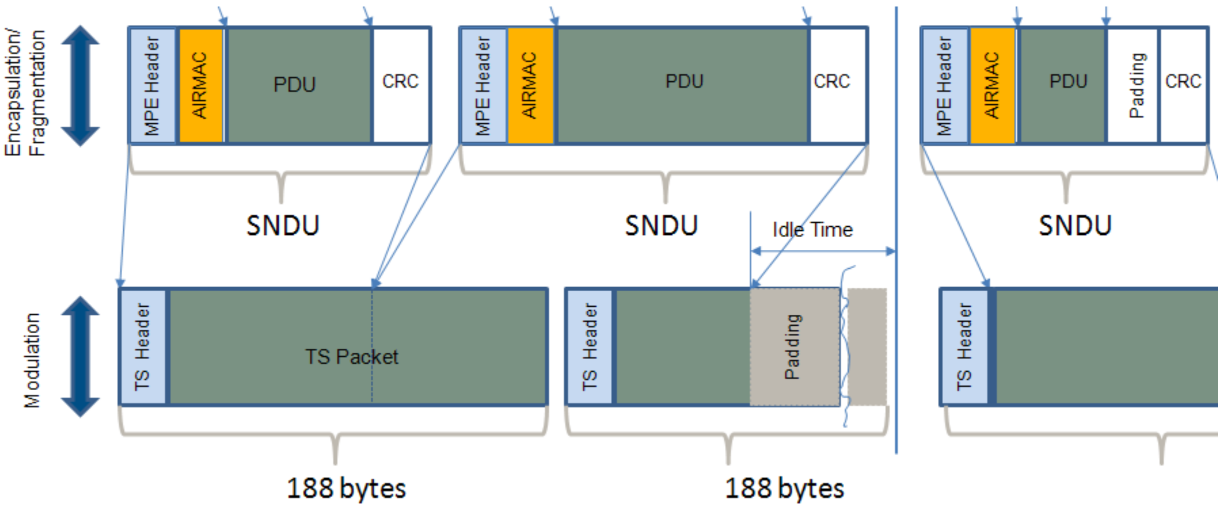


Figure 66- MPE Encapsulation of IP packets with Time Out

The whole process of modulation and encapsulation takes place at different layers as shown in Figure. The modulation takes place in the physical layer. The encapsulation is performed in the MPEG transmission layer and the convergence layer.

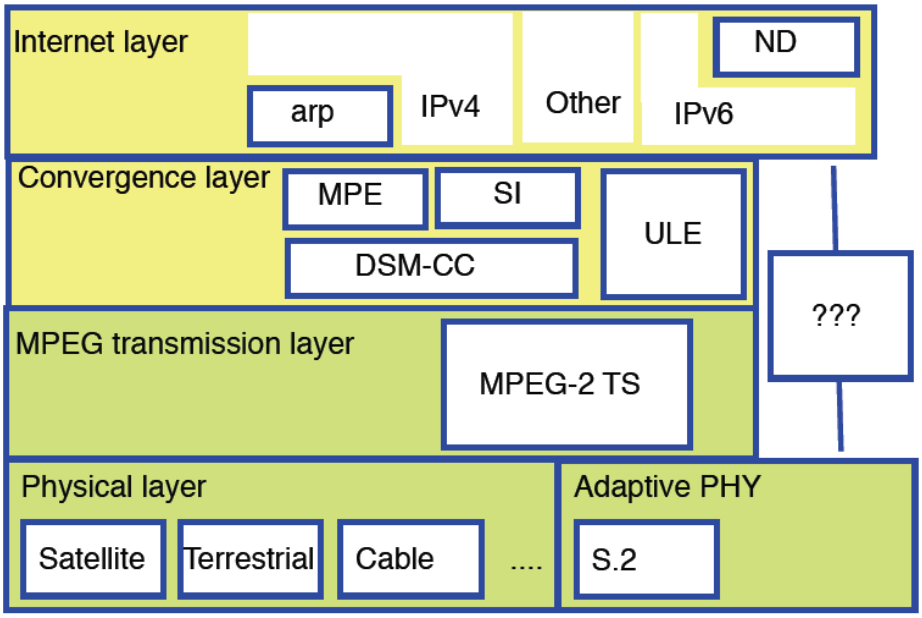


Figure 67- Modulation and Encapsulation Layered Model

The IP receiver supports IP decapsulation from MPEG TS frames or from DVB-S2 baseband frames. This is done by first de-packing these fixed-size frames (MPEG TS or DVB-S2 BBF) into variable-sized MPE packets and subsequently decapsulating into IP packets. This is illustrated in Figure 68.

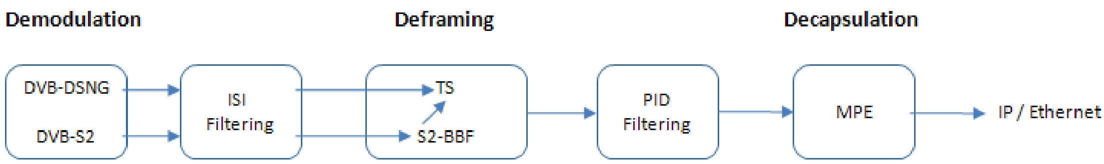


Figure 68- Demodulation, Deframing and Decapsulation

MPE and DVB-DSNG

- The satellite interface carries TS frames; the Ethernet interface carries Ethernet frames;
- TS frames are directly demodulated from the satellite link;
- DVB-DSNG symbols are demodulated into TS frames and subsequently unpacked into MPE packets. These packets are then de-capsulated into IP packets and sent over the Ethernet interface. The IP packets are transmitted over Ethernet according the routing table.

MPE and DVB-S2

- The satellite interface carries DVB-S2 baseband frames; the Ethernet interface carries IP data;
- Baseband frames (BBF) are directly demodulated from the satellite link.

The S2-BBF are decapsulated into TS frames and subsequently de-packed into MPE packets. These packets are then de-capsulated into IP packets and sent over the Ethernet interface. The packets are transmitted over Ethernet according to the routing table.

8.4.2 Processing Mode 2 – Eth(IP)<->Air(XPE)

The processing mode "Eth(IP))<->Air(XPE)" is used in applications where bandwidth efficiency is important, such as IP backbone or IP trunking applications. XPE is a proprietary technology so Newtec equipment is necessary on both ends of the transmission chain.

The characteristics of this processing mode are:

- Only supported with DVB-S2 modulation;
- Possible multi-stream operation (up to 32 streams, each tagged with a separate ISI);
- All routing schemes are supported: L2 Ethernet bridge, L3 IP bridge and IP routing;
- Full support of VCM and FlexACM.

The AIRMAC address or destination address of the receiver can be switched on or off.

You can enable or disable the AIRMAC address.

This depends on the used symbol rate and the allowed jitter in the network.

- Low symbol rate: the AIRMAC address is enabled to reduce the amount of jitter;
- High symbol rate: the AIRMAC address can be disabled, this to use the bandwidth in a more efficient way.

8.4.3 Processing Mode 3 - Eth(IP)<->Air(GSE)

The processing mode “Eth(IP))<->Air(GSE)” is used in applications where bandwidth efficiency is important, such as IP backbone or IP trunking applications. GSE is necessary on both ends of the transmission chain as no interoperability tests are performed up till September 2010).

GSE carries "native" IP content with a significant reduction in overhead compared to using MPE (Multi Protocol Encapsulation).

IP datagram’s, Ethernet Frames, or other network layer packets, which are scheduled for transmission, are encapsulated in one or more GSE Packets (we refer to Figure 69). The encapsulation process delineates the start and end of each network-layer PDU (Protocol Data Unit), adds control information such as the network protocol type and address label, and provides an overall integrity check when needed.

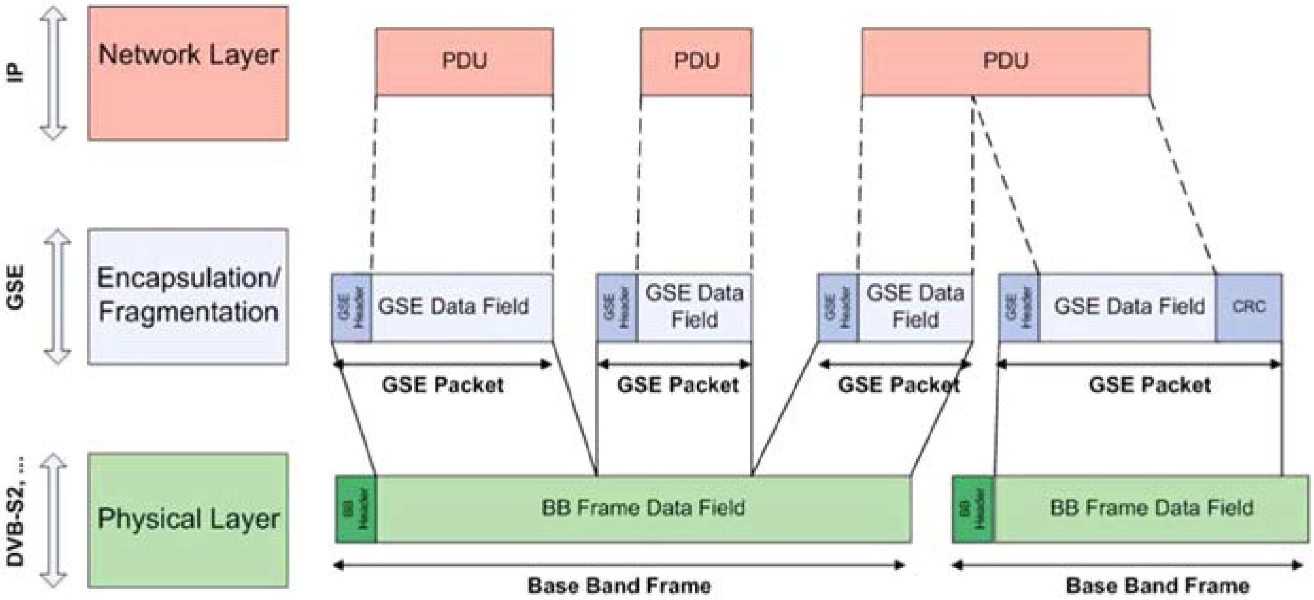


Figure 69 - GSE Layer

GSE guarantees that no fragmentation at the IP layer occurs. Fragmentation (if any) needed to adapt to the DVB broadcast bearer’s baseband frames is performed entirely within the GSE layer and thus hidden from the IP layer. The reassembly process is robust against loss of baseband frames.

The characteristics of this processing mode are:

- Only supported with DVB-S2 modulation;
- Possible multi-stream operation (up to 32 streams, each tagged with a separate ISI);
- All routing schemes are supported: L2 Ethernet bridge, L3 IP bridge and IP routing;
- Full support of VCM and FlexACM.

8.4.4 Processing Mode 4 – Eth(ntS2BBF)<->Air(S2BBF)

The processing mode “Eth(ntS2BBF))<->Air(S2BBF)” is available on a modulator and is only used when the encapsulation/encapsulation must be performed externally to the modulator in DVB-S2 mode. This is the case in the hub of FlexACM or VCM Point-to-Multipoint IP trunking systems, where the encapsulation is performed in an external EL860 shaping, encapsulator and ACM controller device. The BBF interface is the interface between the EL860 and the modulator. The content of the Base Band Frame is fully determined by the external encapsulator, while the modulator only adds the FEC and performs the modulation function.

The characteristics of this processing mode are:

- Only supported with DVB-S2 modulation;
- The modulator is fully transparent to the content;
- Functions such as IP routing, encapsulation, QoS or traffic shaping must be performed by external devices;
- The BBF input cannot be mixed with other IP inputs;
- Readily compatible with the output of the EL860.

9 FEATURES

9.1 FlexACM

9.1.1 Introduction

In a satellite link operated with FlexACM, the modulator and demodulator parts must exchange signalling information with each other in order to control dynamically the modulation parameters in function of the instantaneous receive conditions in the demodulator. This signalling consists of short messages in IP format. The average bit rate of this communication is very low (only a few hundred bits per second).

The ACM forward signalling is transmitted over the satellite link (RF). The return signalling can be transmitted over any communication channel between the modulator and demodulator, being a satellite link or a terrestrial link.

Since there is by definition always a satellite link between the modulator and demodulator, the communication from the modulator to the demodulator is in most cases transmitted in the satellite signal itself. It is possible to send this signalling message in the same stream as the IP payload, or to isolate it from the payload in another DVB-S2 stream (multi stream configuration).

For the FlexACM communication between the demodulator and the modulator, the implementation depends on the topology of the network. For two-way DVB-S2 transmissions, the FlexACM signalling can be transmitted in the DVB-S2 return link, mixed with the IP payload or in a separate DVB-S2 stream. The FlexACM signalling can also be transmitted in any other type of satellite return channel (for example VSAT) or terrestrial link (ADSL, GPRS, etc…).

The ACM signalling is generated and received by the Monitoring and Control module of the modulator, demodulator, modem, or by the EL860 Controller and Shaper when such unit is used in front of the modulator.

9.1.1.1 ModCods in Satellite Communication

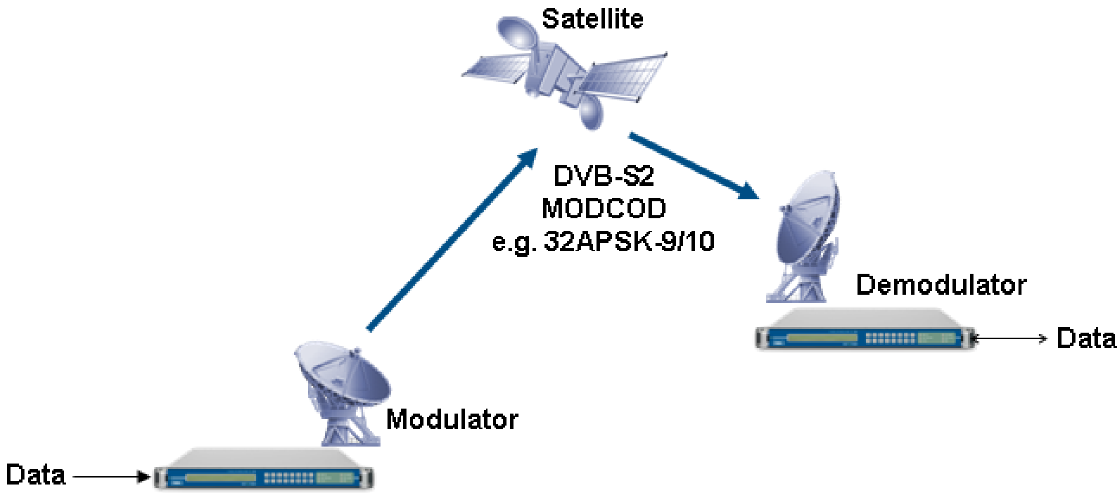


Figure 70 – Data Transmission via Satellite

Data transferred via a satellite is modulated and coded at the sending side and demodulated and decoded at the receiving end.

The used modulation and coding (FEC) is called the ModCod. Each combination of a specific modulation and coding has a certain spectral efficiency determining the data throughput. This spectral efficiency refers to the amount of information that can be transmitted over satellite in a given bandwidth, the larger the spectral efficiency, the more information can be send over the satellite link in the same bandwidth.

A high ModCod is linked to a high data rate but requires a good signal-to-noise ratio at the receivers end.

A low ModCod functions with a lower signal-to-noise ratio at receivers end but has a lower data rate.

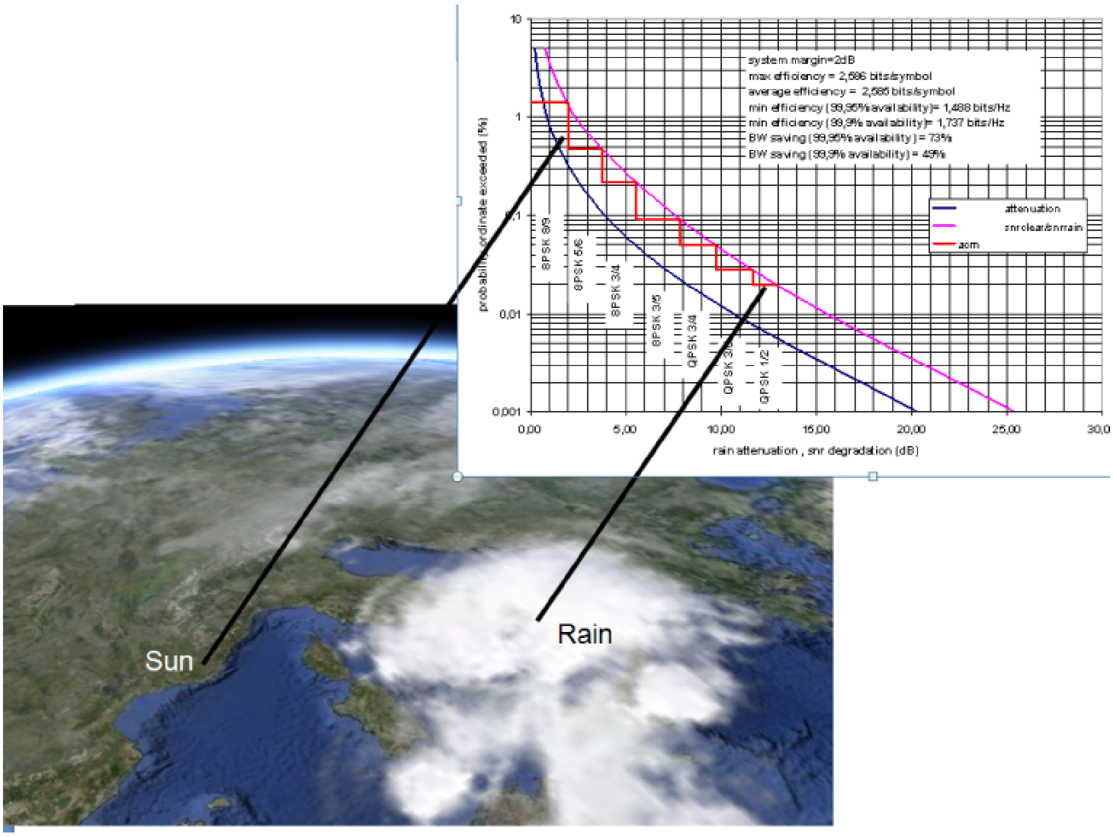
As an example: the ModCod 32 APSK-9/10 has a spectral efficiency of **4.45** while ModCod QPSK-1/4 has a spectral efficiency of **0.49**.

9.1.1.2 Why ACM

An ACM system provides two major benefits:

- It always maximizes the throughput of a satellite link, doubling the capacity in average;
- It guarantees the availability of the link reception.

The circumstances in which satellite connections are active can change all the time, due to e.g. changing weather conditions.



Imagine we have an optimal satellite connection between two sites in clear weather.

At this moment the satellite link has the following settings:

- High ModCod;
- High throughput;
- Good signal quality;

In these ideal circumstances and without fade, a high ModCod can be used, and the throughput over the satellite link is high.

Imagine it starts raining heavily at the receiving end.

The consequence is that the signal quality is decreased.

When the rain fade exceeds a maximum, as shown in Figure 71, the receiving demodulator is not able to demodulate the incoming data any more and the satellite link is interrupted.

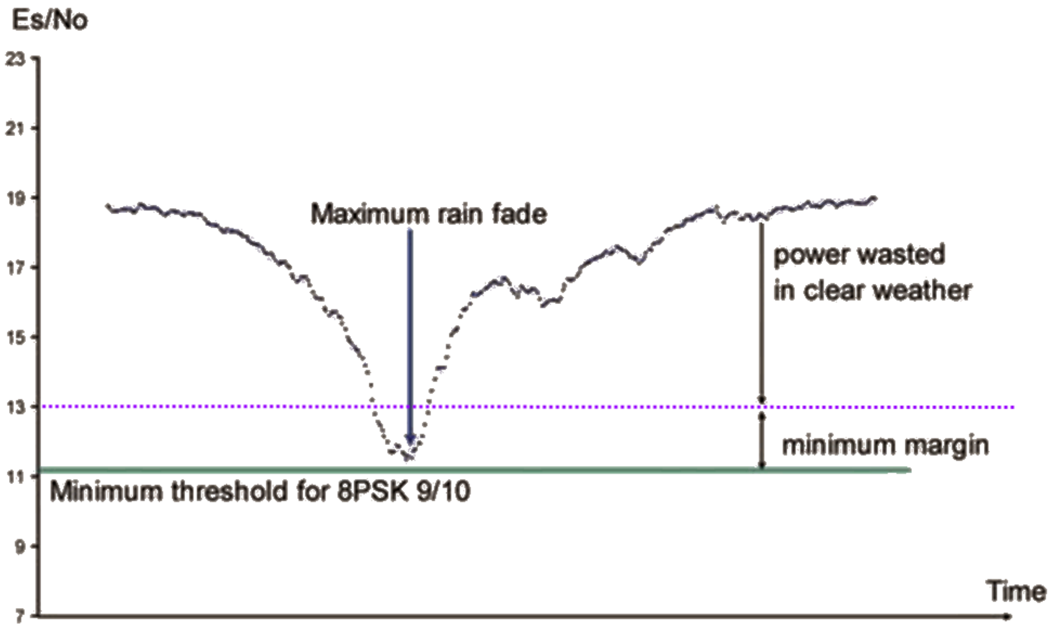


Figure 71 - Interrupted Satellite Link

To prevent this, the satellite link can be configured in a lower ModCod as shown in Figure 72, resulting in a link working for example 99,5% of the time. On the other hand, in good weather conditions, this ModCod will not be optimal, thus costing money because of the not used bandwidth.

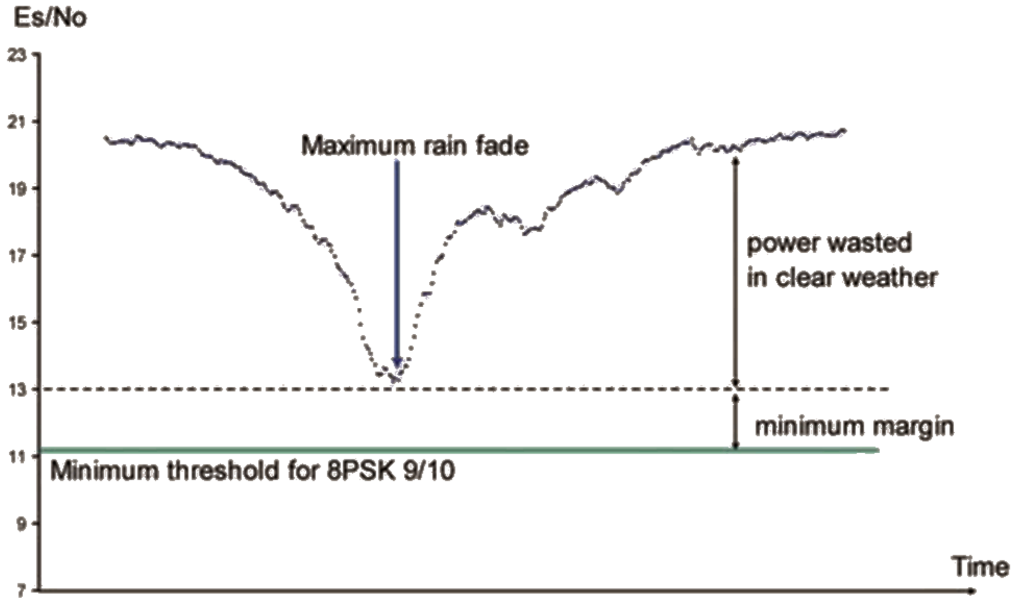


Figure 72 – Reduced ModCod

What we need is a ModCod delivering the highest throughput at all time.

A FlexACM® equipped satellite network delivers a very stable link with a variable bit rate, depending on the conditions.

FlexACM is a solution that makes the implementation of ACM in IP trunking and IP backbone systems not only straightforward but also very efficient.

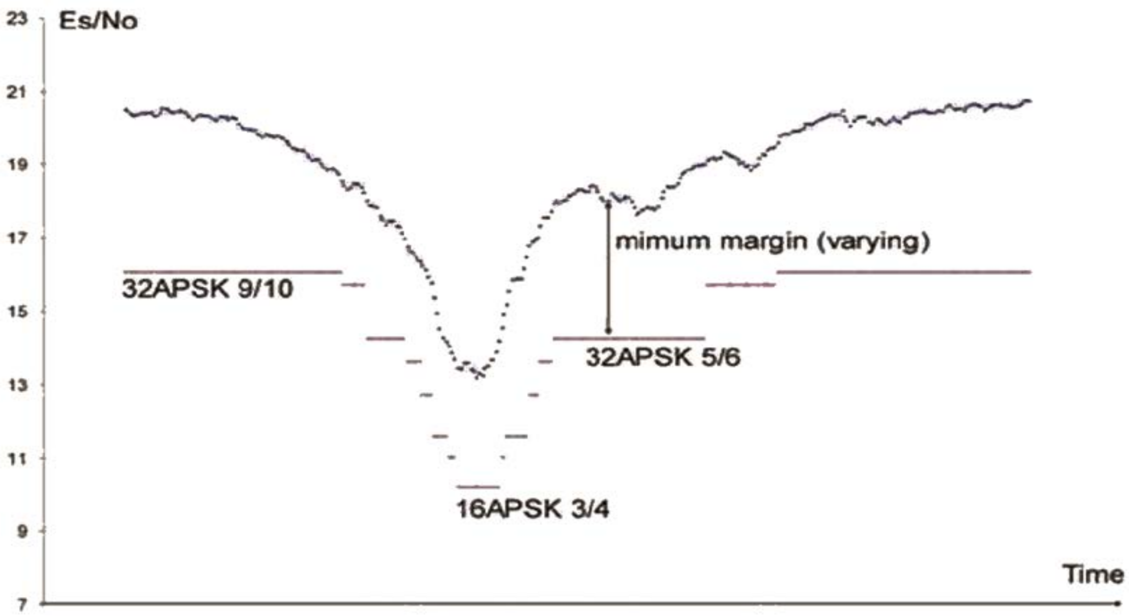


Figure 73 - FlexACM

FlexACM allows modification of the modulation parameters of a satellite signal on the fly, without interrupting the transmission and without losing data.

ACM allows using the highest possible modulation scheme and the lowest possible level of error correction at all times. When the condition of the link gets worse because of fade, the system automatically changes the parameters to avoid loss of signal reception. This is shown in Figure 73.

9.1.1.3 How Does FlexACM work

FlexACM can be implemented on any satellite link using modulator and demodulator functions. The following devices can be used:

- Modems;
- Modulator (standalone);
- Demodulator (standalone);
- EL860 CCM/VCM/ACM Shaper and Encapsulator.

Point to Point Flex ACM Configuration

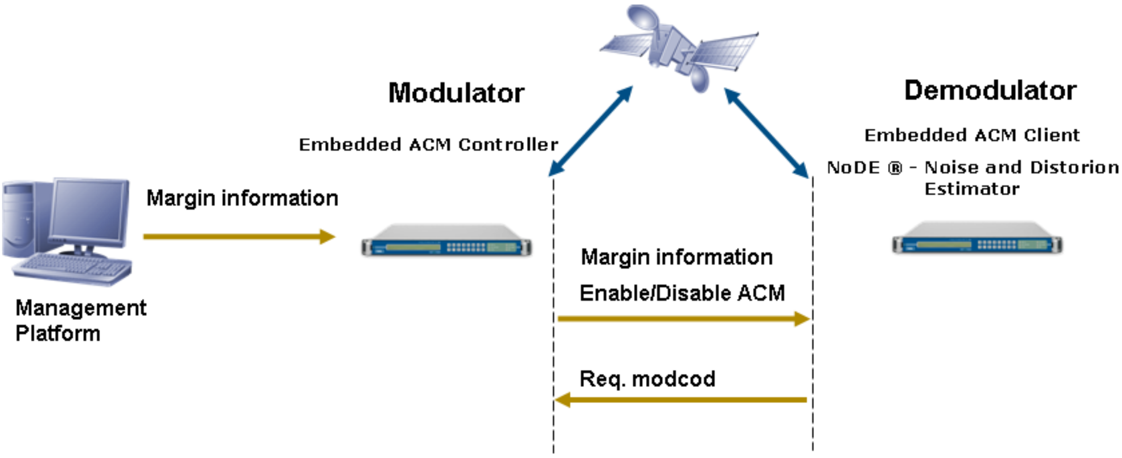


Figure 74 – Point-to-Point FlexACM Configuration

To be able to keep the optimal ModCod at all time there must be ***feedback*** from the demodulator to the modulator telling the modulator if another ModCod should be chosen and what that ModCod should be.

Following applications are handling the FlexACM feature:

- The ***ACM client*** at ***demodulator*** side;
- The ***ACM controller*** at the ***modulator*** side.

Feedback from the ACM client (Demodulator) to the ACM Controller (Modulator)

The ACM client embedded in the demodulator determines the optimal ModCod based on the real-time detected link quality. It has following inputs at its disposal for its calculations:

- The demodulator characteristics;
- Margin information pushed from the modulator side;
- The measured EsNo of the received signal;
- NoDE® (Noise and Distortion Estimator) link margin.

If the demodulator concludes that another ModCod than the current used one is optimal, he sends a feedback message to the modulator with a request for the new ModCod.

Point to Multi Point

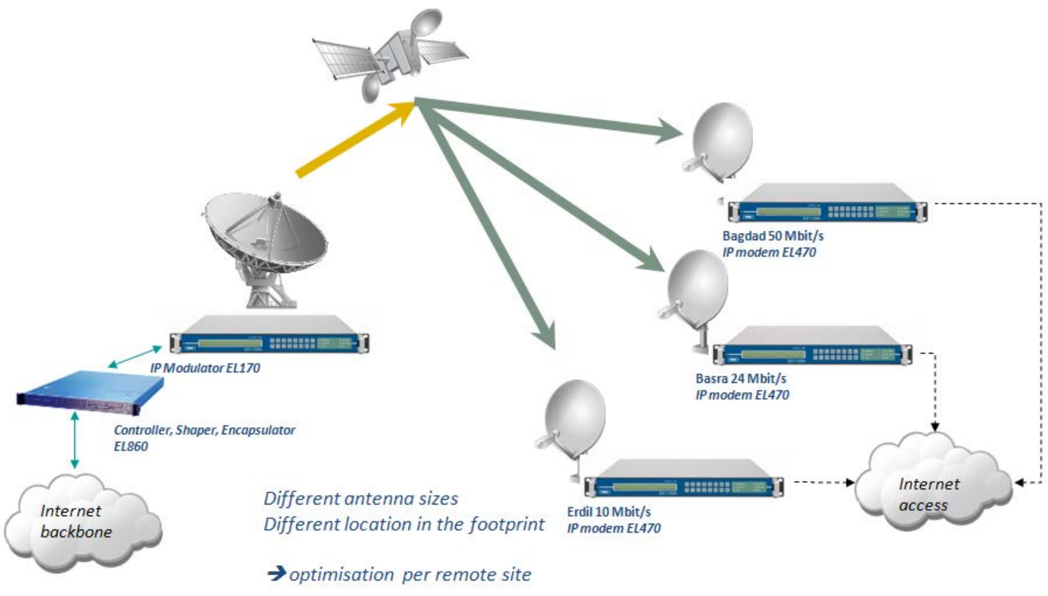


Figure 75 - Point to Multipoint

In point to multipoint networks we use an EL860 controller and shaper to manage multiple ACM controllers.

The demodulators of the different sites provide their feedback to the EL860. The corresponding ACM controller changes the ModCod according to this feedback.

Optimal ModCod Based on EsNo

The demodulator detects the received EsNo of the signal. Based on this value it selects the optimal ModCod. This mode is used when there is no distortion, for example in a multicarrier transponder with sufficient output back off.

The ACM client application compares this measured value with the sum of:

- Threshold: Each ModCod has its own EsNo threshold. This is the required EsNo value, needed to decode the frames correctly. This value is characteristic for the demodulator and can be found in the datasheet of the device;
- Distortion Margin: For each ModCod, there may be a different level of distortion added to the received signal. This type of distortion is caused by non-linearity in the transmission chain, e.g. a saturated transponder;
- Hysteresis: When the signal quality improves and the following limit is reached:
  Threshold + **Target margin** (step up margin)
  a higher ModCod is selected.
  When the signal quality decreases and goes under the following limit:
  Threshold + **Minimum margin** (step down margin)
  a lower ModCod is selected.
  The **Minimum margin** is set smaller then the **Target margin** to create a hysteresis of **Target margin – min margin** in dB. This prevents toggling of ModCods at a certain value.

This is shown in Figure 76

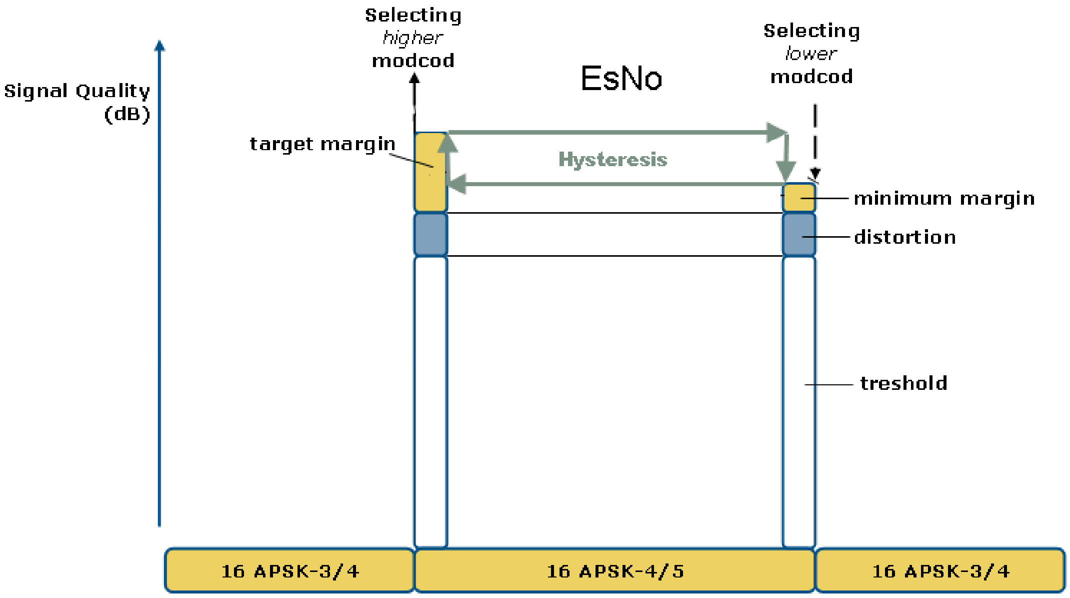


Figure 76 - Hysteresis

A higher ModCod is selected when the measured EsNo is higher than the sum of the threshold of the higher ModCod, the configured distortion for this higher ModCod, and the target margin for this higher ModCod.

A lower ModCod is selected when the measured EsNo is lower than the sum of the threshold for the current ModCod, the configured distortion for the current ModCod and the minimum margin for the current ModCod.
These selections are visualised in Figure 77.

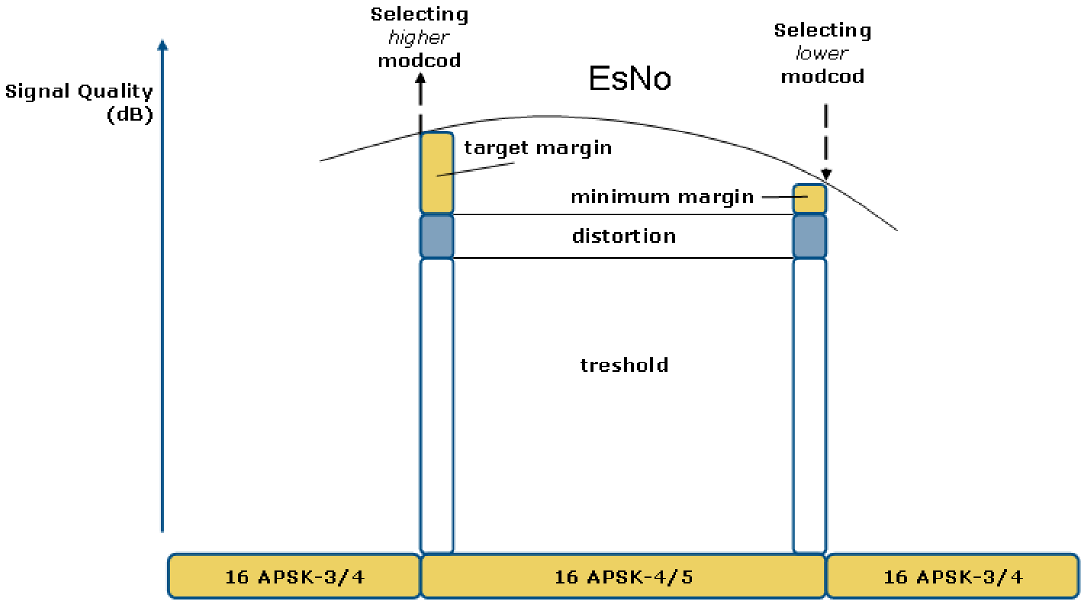


Figure 77 - Selecting the Optimal ModCod Based on EsNo

Optimal ModCod Based on NoDE

The NoDE (Noise and Distortion Estimator) estimates the margin (in dB) for each ModCod that it receives in multi-stream operation. NoDE also takes the distortion (typically caused by a saturated transponder) into account. When the NoDE function has been able to estimate the link margin, this link margin is used to determine the optimal ModCod instead of the measured EsNo.

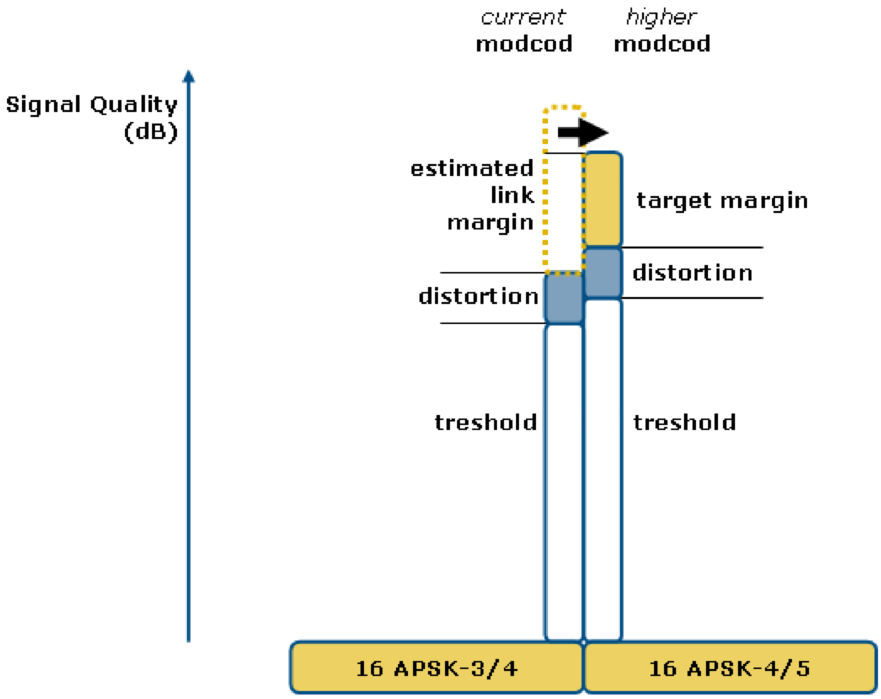


Figure 78 - Selecting a higher ModCod Based on Estimated Link Margin

A higher ModCod is selected if the estimated link margin, marked in Figure 78 by the dotted lines is larger than:

The sum of:

- The higher ModCod threshold;
- The higher ModCod distortion;
- The higher ModCod target margin.

This sum is visualised at the right hand side in Figure 78.

Minus

- The current ModCod threshold;
- The current ModCod distortion

This is visualised in Figure 78.

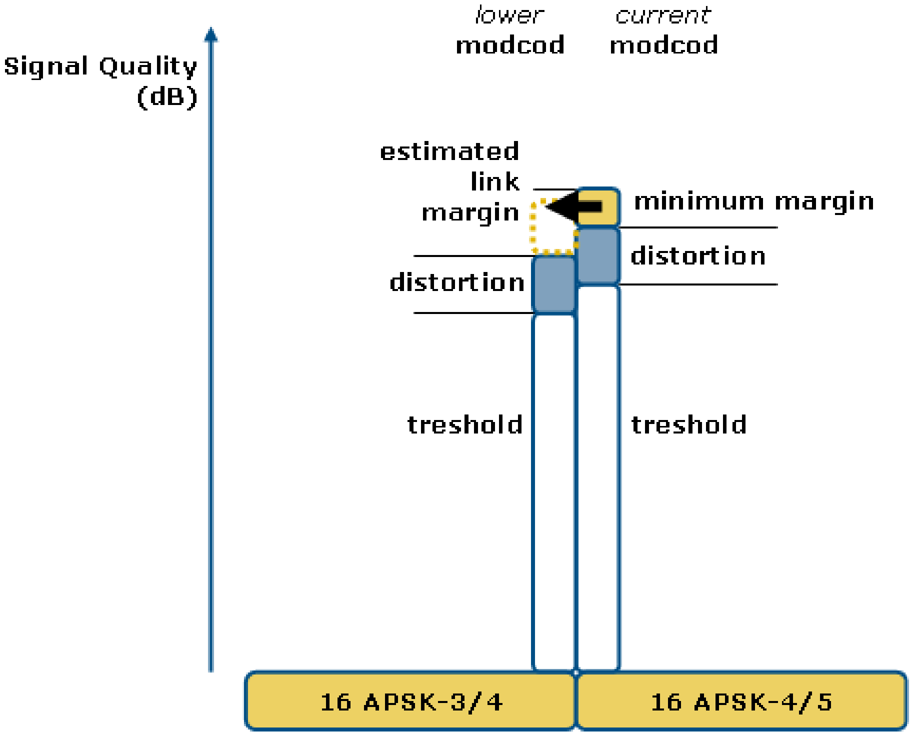


Figure 79 - Selecting a Lower ModCod Based on Estimated Link Margin

A lower ModCod is selected if the estimated link margin, marked in Figure 79 by the dotted lines, is smaller than:

The sum, visualised in Figure 79 at the right hand side, of:

- The current ModCod threshold
- The current ModCod distortion
- The current ModCod minimum margin

Minus:

- The lower ModCod threshold
- The lower ModCod distortion

9.1.1.4 FlexACM Configuration

Following steps, as described in Figure 74, are used to configure and activate the FlexACM feature.

- The margin information to be used by the demodulator is configured via the management platform in the modulator.
- The ACM controller application:
  - Forwards the margin information towards the ACM client application on the demodulator.
  - Enables or disables the ACM feature on the modulator and demodulator;
- The ACM client application:
  - Sends feedback messages including ModCod change requests towards the ACM controller application on the modulator;
- The ACM controller application on the modulator/EL860 changes the ModCod.

9.1.1.5 FlexACM Control

The ACM controller is used to configure and activate/deactivate the FlexACM feature.

EL470 >> Modem >> Control >> Modulation >> ACM control

The following parameters can be defined.

Parameter	Description
ACM Ctrl	Enables or Disables the ACM controller
MIN ModCod	This is the lowest ModCod that is set by the ACM controller. For example when Max ModCod=32APSK 9/10 set the Min ModCod=QPSK3/4.
Max ModCod	This is the maximum ModCod used. This is defined in the link budget. Set this parameter always a few ModCods higher then what has been defined in the link budget for optimal performance.
Comm failure ModCod	This is the fallback ModCod to ensure that the link stays up as long as possible. Set this parameter to the Lowest ModCod defined in the MIN ModCod parameter.
Min margin	This is the minimum margin (step down margin) (refer to Figure 79) needed to stay in a certain ModCod. When a lower margin is reached a lower ModCod is selected. This is different per ModCod.
Tgt margin	This is the target margin (step up margin), this is an added margin that is needed to select a higher ModCod. (Refer to Figure 78.) This is different per ModCod.

Parameter	Description
Distortion	This value is added to the Min margin and Tgt margin value. (Refer to Figure 78) This is different per ModCod.
ACM Monitoring only	Set this parameter to Disabled to activate FlexACM. When **ACM monitoring only** is set to enabled, then the ACM messaging is copied to a log file and not carried out.. This is used to represent the impact of FlexACM without changing the ModCod parameters.
ACM fw sig plane	Select the control plane for the ACM controller forward signalling: • MonCon management IP network • Inband RF channel

9.1.1.6 ACM Client

The ACM client is used to communicate with the controller. Define the following parameters to configure the client.

EL470 >> Modem >> Control >> Demodulation >> ACM client

The following parameters can be defined.

Parameter	Description
Virtual ACM client id	This parameter identifies an ACM demodulator within the ACM controller. Redundant demodulators for which ACM is enabled must be configured with the same **Virtual ACM client id**. When the embedded ACM controller is used on the modulator, this parameter is the MonCon IP address of the active demodulator. When the EL860 ACM controller is used, this parameter is the AIRMAC address on which the demodulator listens. When inband RF is used this parameter is set to “-“. This disables the Virtual ACM client id. In this state the MAC address of the interface port is used as id.
ACM rt sig plane	Select the controle plane for the ACM controller return signalling: • MonCon management IP network; • Inband RF channel.

Parameter	Description
	ℹ Inband return RF-channel is only possible on modems.
ModCod selection algo.	This parameter is used to overrule the ModCod selection. By default the controller determines the algorithm for the ACM client. Three possible options: **Option** — **Description** **Learn from ctrl** — Use the configuration of the external EL860 ACM-controller. **Link margin** — Use the link margin as selection criteria to determine if the ModCod must be changed (up/down). The actual “link margin estimation” is derived from the actual ModCod’s stored threshold that is updated with a value that is determined by the C/D estimation. This way a new threshold is defined by taking the distortion into account. Use this in single carrier per transponder. (refer to section 8.4.10 for more information about C/D estimation). **Header Es/No** — Use the Es/No as selection criteria to determine if the ModCod must be changed. Use this in a multi-carrier setup in one transponder. This because C/D can not be defined accurate enough in a multi-carrier setup transponder. (Refer to for more information on Es/No)

9.1.1.7 QoS and FlexACM

If the link carries IP data, quality of service ensures that real-time data is prioritized over non-real-time data. This ensures that voice and video is not delayed, and that web browsing and others is slowed down in case of a reduction of available throughput due to a lower ModCod selected in case of (e.g.) rain fade.

The QoS ruler (determines which traffic is what class) can be configured in the modulator. (The EL860 can be used for advanced QoS and shaping rules.)

9.1.1.8 ACM Log Files

The log files are stored as .csv (Comma Separated Values). The files are stored per six hours interval.
A log file history of the previous 24hours can be consulted. (**Note**: Four log files of six hours.)

When a log file is downloaded, the following information is displayed:

```
Timestamp,Demod,RqModCod,EsNo,CarrierBitrate,
2000-02-06 00:00:02,1,QPSK-1/4,0.00,6376
2000-02-06 00:00:12,1,QPSK-1/4,0.00,6380
2000-02-06 00:00:22,1,QPSK-1/4,0.00,6376
2000-02-06 00:00:32,1,QPSK-1/4,0.00,6371
2000-02-06 00:00:42,1,QPSK-1/4,0.00,6380
2000-02-06 00:00:52,1,QPSK-1/4,0.00,6371
2000-02-06 00:01:03,1,QPSK-1/4,0.00,6376
2000-02-06 00:01:13,1,QPSK-1/4,0.00,6380
2000-02-06 00:01:23,1,QPSK-1/4,0.00,6371
2000-02-06 00:01:33,1,QPSK-1/4,0.00,6371
2000-02-06 00:01:43,1,QPSK-1/4,0.00,6376
```

Figure 80 - ACM Log Files

Parameter	Description
Timestamp	Time of the ACM feedback message.
Demod	ACM client ID, this refers to the DB-S2 Stream Id.
RqModCod	The requested ModCod at that time.
EsNo	Noise and Distortion Estimator value at that time.
CarrierBitrate	Bit rate on the carrier at that time.

Table 12 – ACM Log File Parameters

The log files can be consulted on the ACM controller and client side.

Monitor the ACM Controller

- Click on the Synoptic on the FlexACM block;

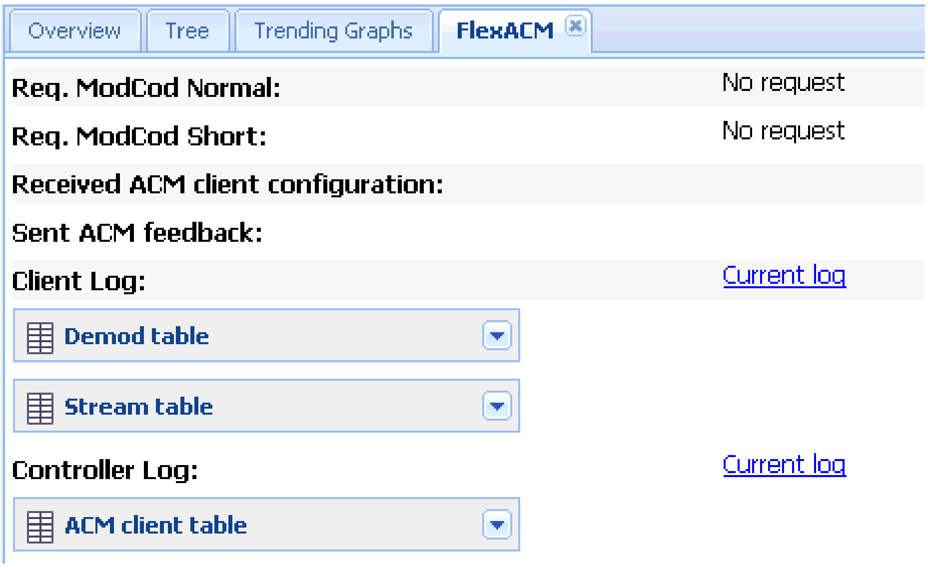


Figure 81 – Monitoring ACM Controller

- Click **ACM current log** to check the current log file;
- An excel file opens with an overview of all received feedback messages within the current six hours, refer to Figure 82);

1	Timestamp	Demod	RqModCod	EsNo	CarrierBitrate
2	23/09/2009 06:00	1	8PSK-9/10	34.7	116794
3	23/09/2009 06:00	1	8PSK-9/10	34.7	102932
4	23/09/2009 06:00	1	8PSK-9/10	34.7	117069
5	23/09/2009 06:00	1	8PSK-9/10	34.7	88701
6	23/09/2009 06:00	1	8PSK-9/10	34.7	92677
7	23/09/2009 06:00	1	8PSK-9/10	34.7	106666
8	23/09/2009 06:01	1	8PSK-9/10	34.7	102599
9	23/09/2009 06:01	1	8PSK-9/10	34.7	113346
10	23/09/2009 06:01	1	8PSK-9/10	34.7	113955
11	23/09/2009 06:01	1	8PSK-9/10	34.7	96000
12	23/09/2009 06:01	1	8PSK-9/10	34.7	92439
13	23/09/2009 06:01	1	8PSK-9/10	34.7	106348

Figure 82 – Extract from ACM current log file

- Click on Demod Table to Check the **ACM status**:
- The following screen is shown;

Demod table

Demodulator IP	DVB-S2 Stream Id	EsNo	MODCOD	#rxed	#timeouts	#contiguous timeouts
0.0.0.0	1	0.00 dB	no request	0 errors	0 errors	0 errors

Figure 83 – Monitoring ACM Controller status

The Demodulator table shows an overview of the last received ACM feedback messages from the different ACM clients. In this case, the ACM client is located on modem B with management address 192.168.255.187. The last received EsNo and Requested ModCod are displayed in the table as well as a counter showing the total amount of received feedback messages so far. (Num rx value).

Monitoring the ACM client

➢ Go to:

EL470 >>modem>> Monitor >> Demodulation >> ACM client

Location: EL470 | Modem | Monitor | Demodulation | ACM client

ACM client cfg:	49:rec=all;fip=192.168.255.197:49154;fiv=2500;lpi=500;sm=4-28;ft=n;mm=4-11:1 12-28:0.5;tm=4-11:1.7 12-17:1.3 18-22:1.5 23-28:1.7;ds=4-17:0 18-28:1
ACM poll:	48:rec=all;fip=192.168.255.197:49154;fiv=2500;fro=2500;rc=100
ACM feedback:	200:rec=00:00:00:00:00:03;mcn=4-28;cni=19.60;

ACM status normal frames

ref MODCOD N:	32APSK-9/10
ref threshold N:	16.5 dB
Corrected ref EsNo N:	19.6 dB
req MODCOD N:	32APSK-9/10
req threshold N:	16.5 dB

Hdr EsNo variation:	0.02 dB
ACM log:	Current log

Figure 84 – Monitoring ACM Client status

➢ The **ACM client config** shows the latest ACM client config message received from the ACM controller, this message is send via the signalling channel:

➢ The **ACM poll** shows the latest poll message received from the ACM controller, this message is send via the signalling channel;

➢ The **ACM feedback** shows the latest ACM client feedback string sent to the ACM controller;

➢ Again **ACM log, ACM logs today** and **ACM logs yesterday** provide a link to the appropriate log files of the received ACM client config messages.

9.1.2 In-band Signalling

In-band signaling means that the ACM signaling traffic is routed directly in the equipment, without any external connection needed:

9.1.2.1 Why

This is used to create a link that is independent of a terrestrial network.

This provides the following advantages:

- Better security;
- Non-routable encapsulated IP packets;
- Management LAN independent;
- Simplifies the setup.
  Only the devices in the setup of the satellite link have to be configured.

9.1.2.2 What

In-band Forward Signalling

In-band forward signalling is sending the messages from the ACM controller site as non-routable encapsulated IP packets to the satellite link. The IP packets are decapsulated and processed by the ACM client.

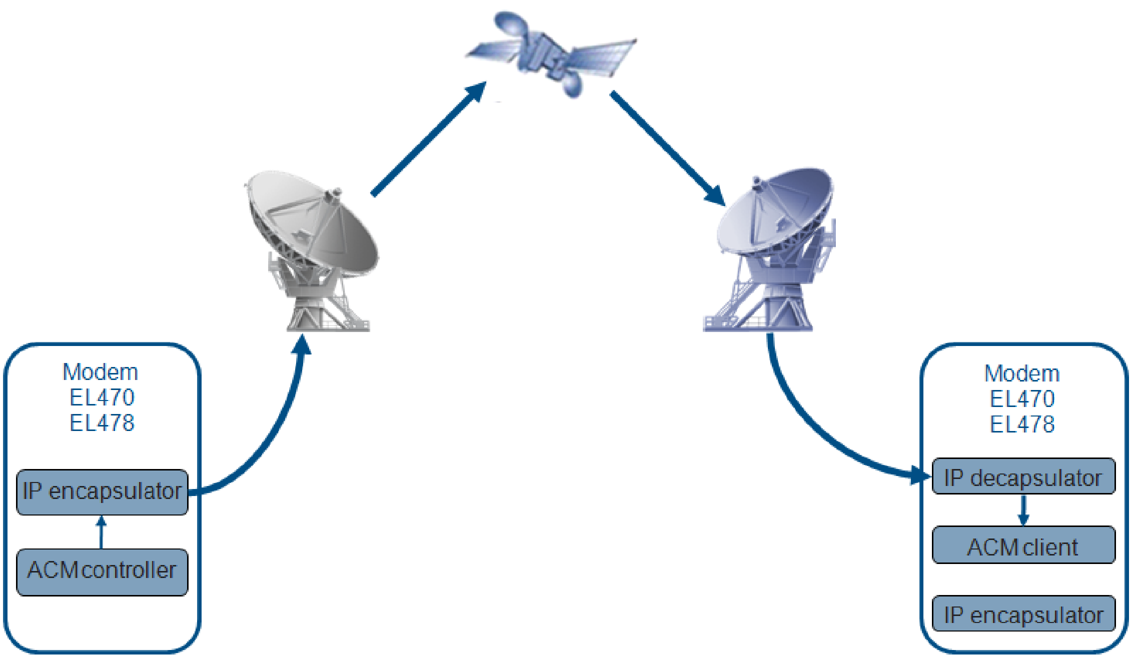


Figure 85 - In-band Forward Signalling

In-band Return Signalling

In-band return signalling is sending the signalling messages from the modem on the ACM client site as non-routable encapsulated IP packets to the satellite link.

As you can see in Figure 85 and Figure 86 there is no connection with external devices to return the ACM signalling.

The modem on the ACM controller site receives these signalling messages and sends them to the ACM controller. The ACM controller adapts the ModCod if needed.

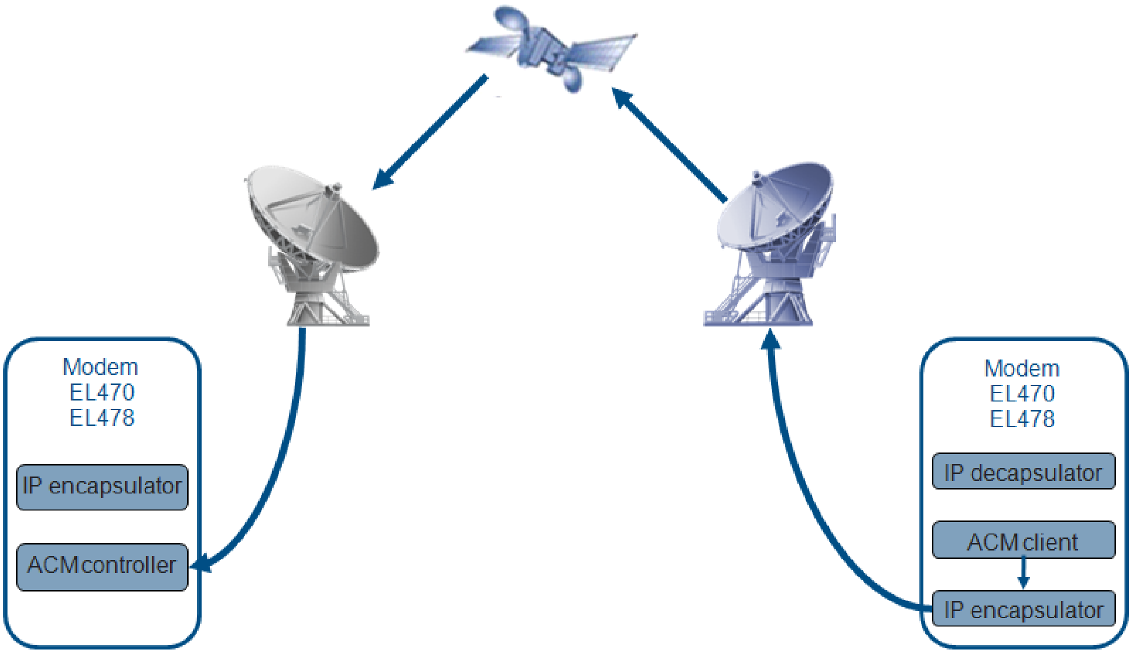


Figure 86 - In-band Return Signalling

Info 1
In-band and out-band signalling are selected independent for forward signalling messages and return signalling messages.
Info 2
In-band forward signalling works both with modems and modulators.
In-band return signalling only works with modems.

9.1.2.3 When is In-band Return Signalling Used

This is used when the remote side of a FlexACM link does not have additional switches, routers or VLANs that allow providing feedback towards the ACM controller. For example:

- Only a modem is present at the ACM client site;
  (The satellite link provider only delivers the modem.);
- A connection to the LAN is prohibited
  (military environment);
- Only the satellite link is available to provide feedback to the ACM controller;
- The management networks (M&C LANs) on each side of the satellite link are owned by different companies and cannot be linked;
- Customers that do not allow any additional traffic to be added to their own traffic;
- Customers/network owners that do not allow any mix of signaling and payload traffic.

9.1.2.4 Possible Routing Options

The following options are possible:

- In a modulator (EL170 or EL178): to transmit ACM signaling from the on-board FlexACM controller to a remote FlexACM client;
- In a modem (EL470 or EL478): to transmit ACM signaling from the on-board FlexACM client to a remote FlexACM controller;
- In a modem (EL470 or EL478): to receive ACM signaling from a remote FlexACM controller and route it to an on-board FlexACM client;
- In a demodulator (EL970 or EL978): to receive ACM signaling from a remote FlexACM controller and route it to an on-board FlexACM client.

These routing options can be chosen and configured independently from each other, and can be combined with out-of-band and/or off-satellite routing options (for example in-band forward signaling and terrestrial return).

It is also possible to program the equipment to transmit in-band ACM signaling on separated DVB-S2 streams (separated ISI in multi-stream mode), so there is no mixing at all between signaling traffic and payload traffic. This needs to be configured by the user as by default the payload and the signaling are sent in the same stream.

9.2 The Noise and Distortion Estimator (NoDE)

9.2.1 Introduction

NoDE (Noise & Distortion Estimator) simplifies ground station operation activities and enables an efficient usage of transponders. NoDE is a unique and innovative tool that simplifies ground station operation activities by providing a means to monitor the quality of the satellite link. It performs a continuous and accurate measurement of the noise margin and the amount of non-linear distortion on the received satellite signal. NoDE allows operators to easily fine tune their satellite links to their optimal operational point under any circumstances. Regular fine tuning of the satellite link parameters will increase the efficiency of the transponder and at the same time provide financial benefits.

In addition, NoDE enables the operator to view the linear and non-linear effects from changes in the uplink power. It can help to prevent errors in operations such as the addition of too much power and distortion that could lead to the total loss of the communication links.

NoDE is the perfect tool to provide operators full control over transmission performance when linear and non-linear distortions are present. It enables higher modulation schemes such as 16APSK and 32 APSK and helps operators to get the most out of their transponder.

9.2.2 How Does NoDE work

In digital satellite communications the energy per symbol related to the noise power spectral density (Es/No) is an important parameter used to determine the quality of the transmission. The Es/No measurement at the receiver side needs a certain threshold to ensure an error-free transmission.

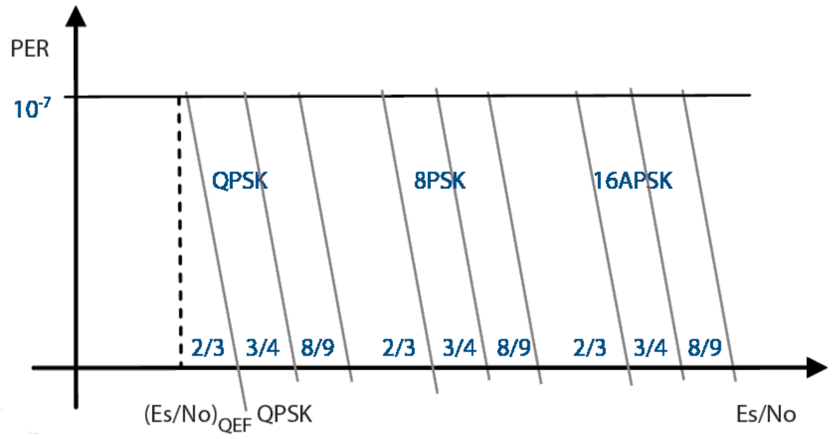


Figure 87 - PER Vs Es/No

It is commonly accepted that a transmission is considered as error-free when the PER (Packet Error Rate) at the reception side is below 10^{-7}. For each DVB-S2 ModCod, as shown in Figure 87, a minimum value $(Es/No)_{QEF}$ guarantees quasi error free transmission.

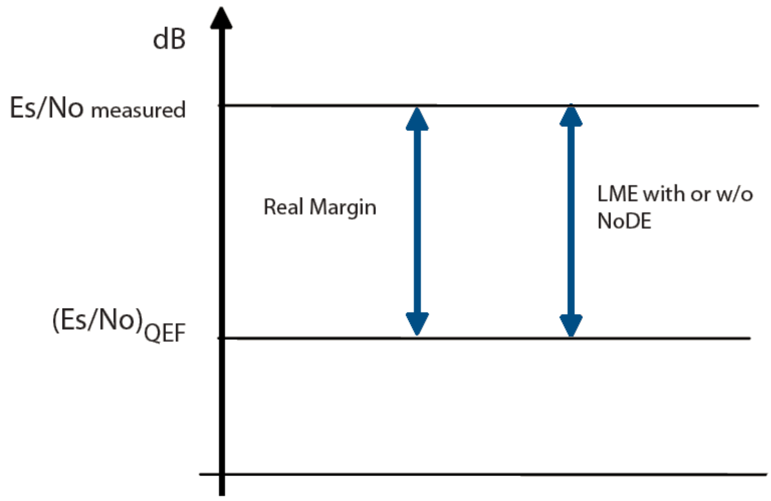


Figure 88 - LME – Linear Environment

In a linear environment, as described in Figure 88, the Link Margin Estimates (LME) provided with or without NoDE is identical. They correspond with the difference between the channels Es/No and the $(Es/No)_{QEF}$ of the corresponding ModCod, which is the real operation margin of the transmission.

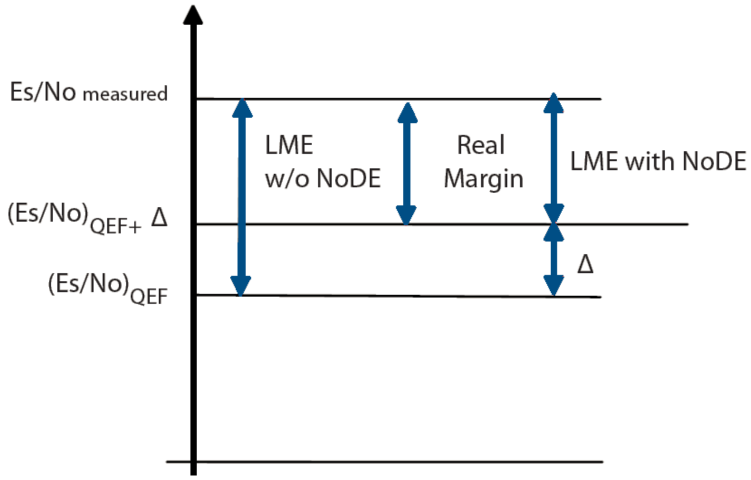


Figure 89 :LME – Non-Linear Environment

When non-linear distortion is present, the real link margin is decreased and is no longer equal to the difference between the measured Es/No value and $(Es/No)_{QEF}$. NoDE calculates the amount of distortion present on the received signal, then corrects the minimum ES/No value to obtain quasi error-free transmission by a delta Δ that takes into account the effect of the distortion. In a non-linear environment, as described in Figure 89, NoDE enables the measurement of an accurate Link Margin Estimation. By providing the operator with an accurate estimation of the Real Link Margin, NoDE prevents the link being operated in a region where the performance is unpredictable and only marginally stable.

By observing the evolution of $(Es/No)_{QEF} + \Delta$ functioning in a variation of the uplink power, NoDE can also help the operator to find the optimal operational point of the transponder without interrupting the transmission.

9.3 Equalink

BER performance degradation due to transmission channel impairments is becoming increasingly important in DVB-S2 systems operating with higher order modulation formats (16APSK, 32APSK), in particular at the higher symbol rates.

The Equalink concept effectively optimizes satellite link performance by counteracting these effects. Newtec DVB-S2 Modulators equipped with the Equalink™ feature contain both linear and non-linear predistortion functions which can be individually enabled/ disabled.

Equalink operating principle:

- Optimum predistortion is computed off-line based on specified distortion characteristics;
- Resulting predistortion table(s) are uploaded to the Modulator and activated.

Link performance can be expressed in terms of Bit or Packet Error Rate (BER or PER) versus Energy-per-symbol to Noise density ratio (Es/No).

For a communication channel over a satellite link, the overall link performance can be severely degraded by channel impairments. Examples of such impairments are interference Adjacent Channel Interference (ACI) and Co-Channel Interference (CCI), Inter-Modulation (IM), Adjacent Satellite Interference (ASI), phase noise, signal distortions etc.

Performance degradation due to these impairments is becoming more important in DVB S2 systems operating with higher order modulation (16APSK, 32APSK), in particular at the higher symbol rates.

The Equalink™ concept effectively optimises satellite link performance by counteracting these effects.

We refer to the Equalink™ User Manual for a full description of this feature.

9.4 Demodulator Statistics

The demodulator statistics shows a number of monitoring parameters of the received carrier for each stream present in that received carrier in case of DVB-S2.

Location: EL470 | Modem | Monitor | Demodulation | ModCodStats | Demodulator S2 statistics

FEC-rate and mod.	Frame type	Pilots	BB frame count	Uncor frame count		Data EsNo est		Channel quality est		C/D est		Link margin est
16APSK-8/9	normal	off	9052 frames	5 frames	*	32.46 dB	>	19.51 dB	*	19.72 dB	*	18.32 frames

Figure 90 – Screenshot of the Demodulator Statistics Overview

9.4.1 FEC-rate and mod

This monitoring parameter displays the detected modulation and FEC used for each of the DVB-S2 streams in the received carrier.

9.4.2 Frame type

This monitoring parameter displays the detected frame type (normal or short frames) that is used for each of the DVB-S2 streams in the received carrier.

9.4.3 Pilots

This monitoring parameter displays whether pilot tones were inserted for each of the DVB-S2 streams in the received carrier.

9.4.4 BB frame count

This monitoring parameter displays the number of baseband frames that are decoded by the demodulator board for each of the DVB-S2 streams in the received carrier.

9.4.5 Uncor frame count

This monitoring parameter displays the number of uncorrected baseband frames by the demodulator board for each of the DVB-S2 streams in the received carrier. It indicates that the link margin is too low or that channel distortions caused by saturation or non-linearity caused the decoder not to be able to correctly decode frames.

9.4.6 Data EsNo clipping info

Data EsNo clipping info indicates a clipped link margin.

When reading saturated values for the Es/No estimation, the clipping info will identify the direction of saturation or return equal if the value is within range.
An asterisk indicates the readout of the Es/No value is about to saturate and may be not very accurate. "<" or ">" indicates when the EsNo is too low or too high to be accurately determined.

9.4.7 Data EsNo est

Data EsNo est: Signal to noise estimation.

9.4.8 Channel quality estimation

The channel quality estimation displays the Es/No of the modulated symbols for each of the DVB-S2 streams in the received carrier. It differs from the total carrier Es/No which only looks at the Physical Layer Headers (which are modulated in a kind of BPSK modulation). Hence in a non-linear channel the total carrier Es/No and Channel Quality Estimation will differ because symbols modulated with higher modulation and coding than the headers will suffer more from the degradation due to non-linearity. It is to be noted that the Es/No indication is derived from the number of corrections the LDPC decoder had to perform. Hence it is most accurate close to the threshold of decoding. For high Es/No values the error becomes larger.

9.4.9 C/D est.

Carrier-to-distortion estimation. This value (in dB) is a measure for the distortion due to linear and non-linear degradation that is present in each of the DVB-S2 streams in the received carrier. It can be used to determine the optimal operating point when optimising a (new) satellite link (for example input back off). The operation point should be selected to have the highest C/D value.

9.4.10 C/D clipping

The C/D clipping will indicate “<” or “>” when the C/D value is too low or too high to be accurately determined. In case it is too low, the link margin might be too low in order for the detector to operate correctly. In case it is too high, there might not be enough distortion (for example in perfectly linear operation) in order for the detector to display a meaningful value.

9.4.11 Link margin est.

Link margin estimation for each of the DVB-S2 streams in the received carrier. This monitoring parameter indicates how much the Es/No is above the decoding threshold. It is a measure for the number of dBs of fading that is possible on the link before the demodulator is not able to decode the received signal anymore.

9.4.12 Link margin clipping

The link margin clipping will indicate “<” or “>” when the link margin value is too low or too high to be accurately determined. In case it is too low, the link margin might be too low in order for the detector to operate correctly. In case it is too high, there might not be enough decoding errors (for example in channel with high link margin) in order for the detector to display a meaningful value.

9.5 Extended VLAN Support

9.5.1 VLAN Tagging

Virtual LAN tagging is a network standard (IEEE 802.1 Q standard) used to share a physical Ethernet network link by multiple independend logical networks. VLAN tagging is performed on layer two of the OSI model.

To set this up an administrator assigns a unique VLAN to each site in the network. The devices are configured to insert the appropriate VLAN tag (site dependend) into the ethernet frames.

Figure 91 represents a standard Ethernet frame format and an Ethernet frame format with a VLAN tag added.

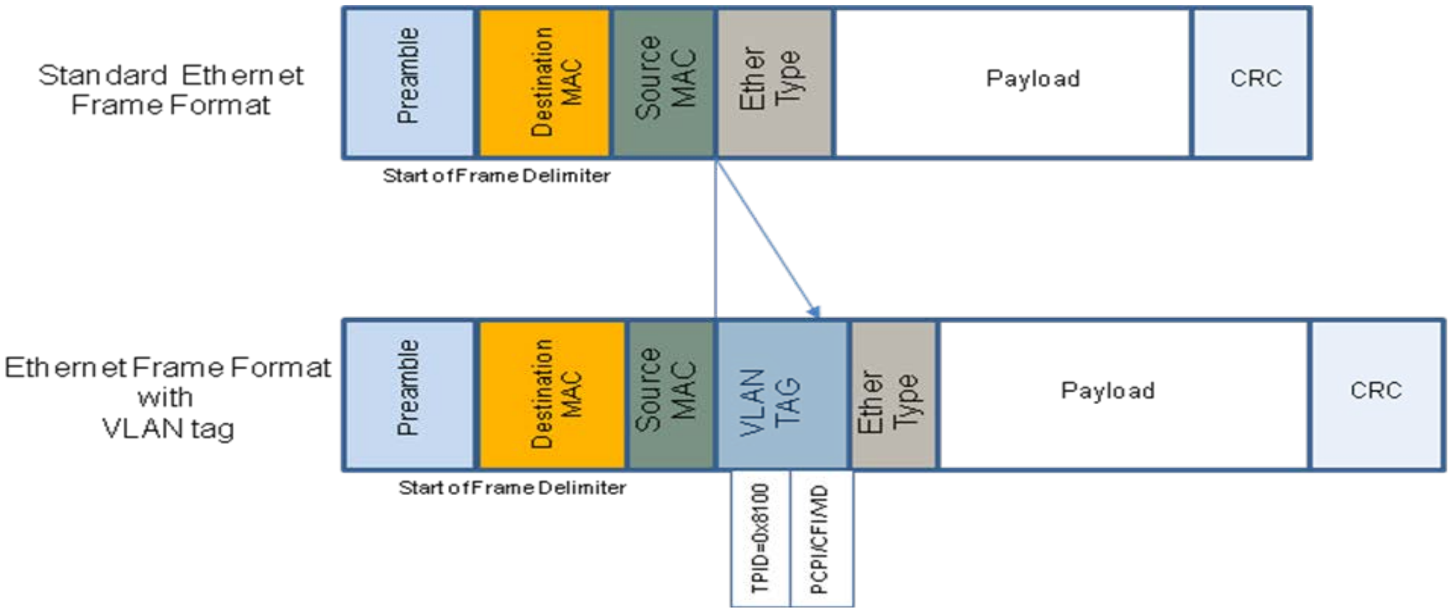


Figure 91 – VLAN Tag

The VLAN tag exits out of the following fields:

16bits	3bits	1bits	12bits
TPID	PCP	CFI	VID

Figure 92 - VLAN Tag Fields

Field	Description
Tag Protocol Identifier	Used to distinguish the tagged frame from untagged frames. This identifier refers to the Ether type field.
Priority Code Point	This indicates the frame priority level. (Voice, video, data).
Canonical Format Indicator	This bit is always set to zero.
VLAN Identifier	Used to specify to which VLAN the frame belongs.

9.5.2 Ether Type Field

The EtherType is a two-octet field in an Ethernet frame. It indicates which protocol is encapsulated in the payload.

The following table shows an overview of the EtherType value for some common protocols.

EtherType	Protocol
0x0800	Internet Protocol, Version 4 (IPv4)
0x0806	Address Resolution Protocol (ARP)
0x8100	VLAN tagged frame (IEEE 802.1Q)
0x86DD	Internet Protocol, Version 6 (IPv6)
0x9100	Q-in-Q
0x88a8	Provider Backbone Bridges (PBB) or IEEE 802.1ah-2008
0x88e7	Provider Backbone Bridges (PBB) or IEEE 802.1ah-2008

This ether type field must be defined in the device. This is done by entering the correct value in the VLAN type id. Refer to section 9.5.4.

9.5.3 QinQ Tagging

When VLAN tagging is repeated it is called QinQ tagging.

QinQ tagging is useful for service providers. It allows the service provider to use VLANs internally and combining traffic from clients that is already VLAN-tagged. This means that a conflict between different “customers or devices” that make use of VLAN tags is exluded. This because multiple VLAN headers are inserted into a single Ethernet frame.

The outer tag (next to the source MAC field) is used to identify the VLAN of the service provider.

The EL470 modem is transparent for QinQ tagging. Only a check is performed on this feature.

QinQ-tagging is shown in Figure 93.

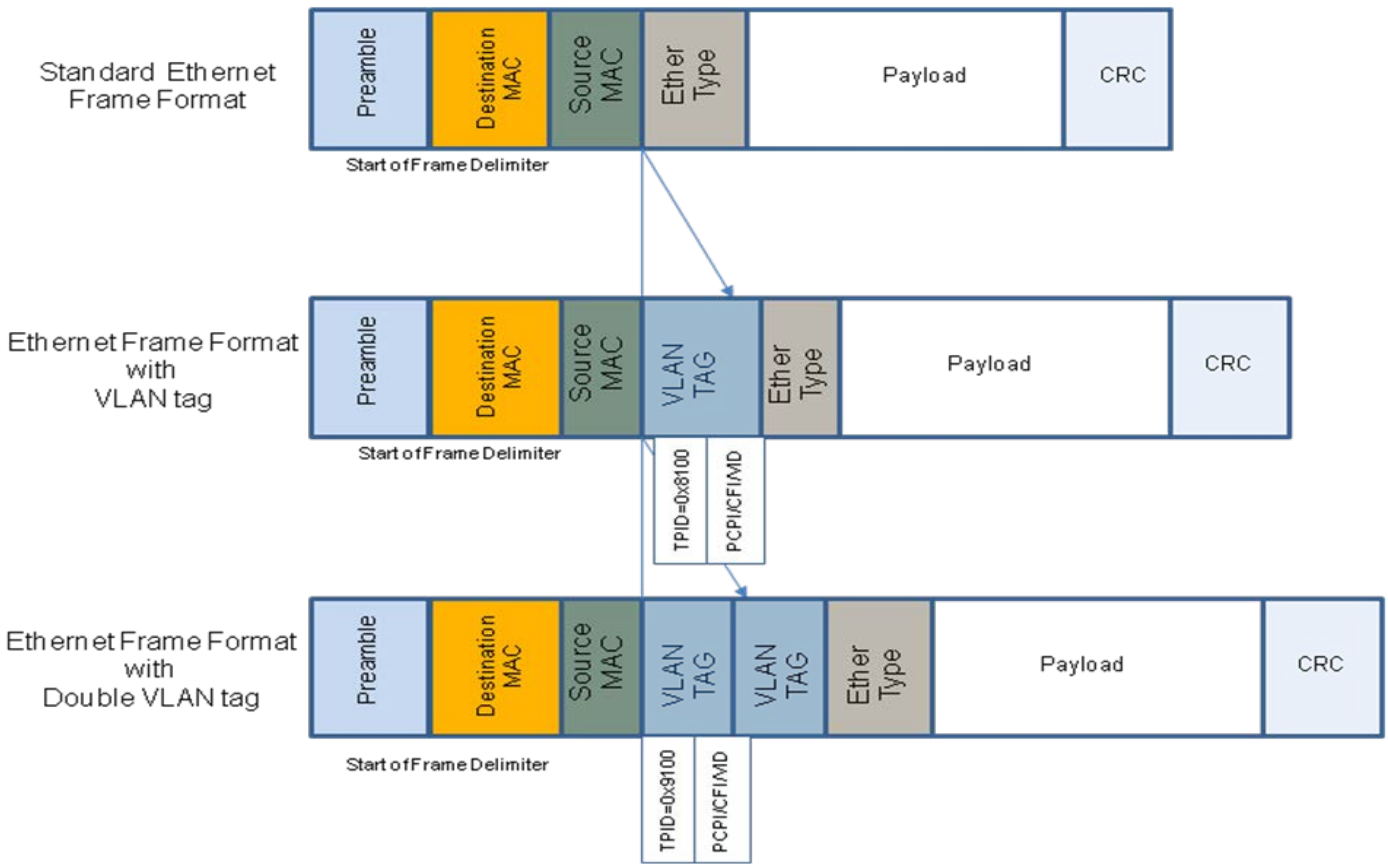


Figure 93 – QinQ Tagging

9.5.4 VLAN Forwarding

The VLAN forwarding setting is used to configure how the VLANs are mapped to the satellite payload.

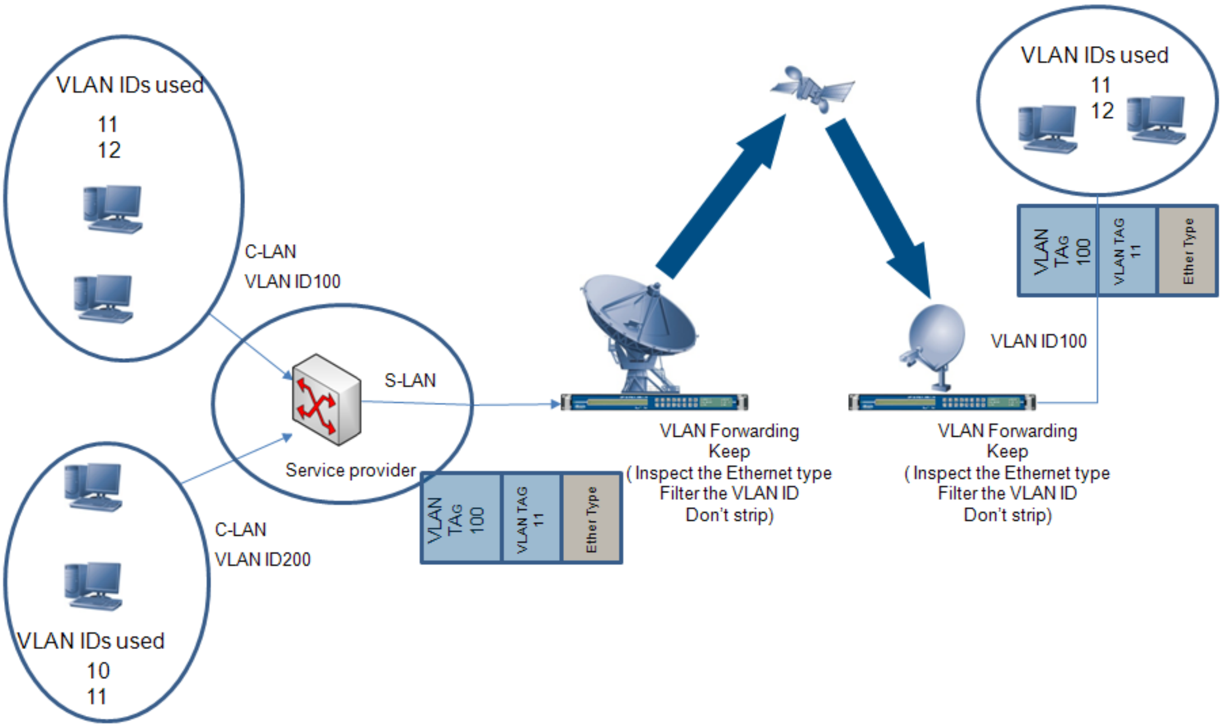


Figure 94 – VLAN Forwarding

The following steps are done in the modem:

1. Inspect: the Ethernet type;
2. Filter: the VLAN Identifier;
3. Strip or don't strip . (Add-drop or Keep) the VLAN

Go to the following menu to configure the device settings:

- EL470 > Control > Interfaces > ipencap

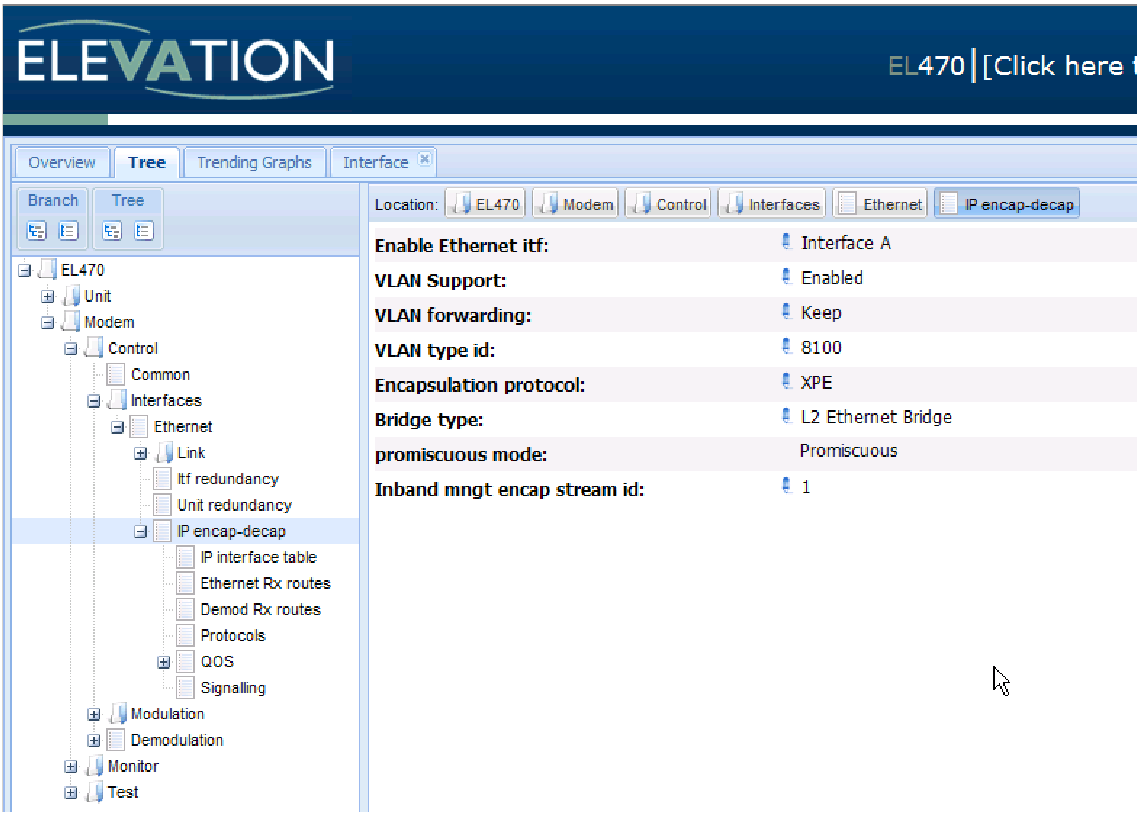


Figure 95 - IP encap-decap Settings

VLAN Forwarding	Description
Add-drop	The VLAN tag is dropped and replaced by PID/ISI/AirMAC addressing.
Keep	The VLAN tag is kept in addition to the PID/ISI/AirMAC addressing.

VLAN type id:	Description
VLAN type id	This is used to filter on the VLAN tag and identify which protocol is used. This is the indication of the Ether type, refer to section 9.5.2. The default value is 8100. Change this setting manually when needed.

9.6 QoS

9.6.1 Introduction

There are two aspects in handling QoS:

- The handling of several QoS classes: different QOS classes exist and are handled with a different priority (e.g. real-time traffic, and non-real-time traffic). Voice traffic for example, is treated as high priority;
- The handling of data flows: when different end-users make use of the same bandwidth pipe, one user may not consume the full bandwidth and fairness must be implemented.

9.6.2 QoS classes

A modulator (or modem) with Ethernet interface can be a congestion point in an IP network, for example when traffic is carried from a 100 Mbit or 1000 Mbit network to a relatively low speed satellite network.

When the satellite link has a low throughput, it becomes very important to differentiate amongst different QOS classes.

When we go from a high-speed network to a low-speed network, we need to implement buffering. This buffering is needed to avoid that the majority of a traffic burst is discarded.

TCP typically requires large buffers. It makes use of a window mechanism defining the maximum of outstanding non-acknowledged data. Moreover, for satellite communication, the window sizes are often raised to a higher value (to overcome the large satellite delay). This large window size causes relatively large bursts. It is recommended to buffer at least 100 Kbytes on a satellite modulator. Suppose that you have a low speed satellite throughput (e.g. 1 Mbps), and you buffer 100 Kbytes on the modulator, then you can buffer up to (100*1024*8 / 1000000) = 819 ms of data!

For voice traffic, typically high priority traffic, we require small buffers: buffering voice packets, causes delay in the conversation. Roundtrip delays higher than 250 ms are noticed by end users (ITU-T G.114 recommends a maximum of a 150 ms one-way delay). For satellite communication, we will experience an even longer delay, because the satellite segment itself causes already a roundtrip delay of about 500 ms.

If we put regular TCP traffic (that requires 819 ms of buffering) and voice traffic (that requires minimal buffering) in the same queue, we won't be able to satisfy TCP users and voice users.

Real-time traffic is stored in a small queue, and forwarded with high priority. Non-real-time traffic (often TCP traffic) must be stored in a large queue, and forwarded with lower priority.

In the Elevation equipment, rules can be implemented, defining which Ethernet packets are directed to which queue.

9.6.3 Data Flows

Real-time traffic and non-real-time traffic are stored in a separate queue as described in previous paragraph. In such a situation, it is still possible that one end-user fills one of these queues completely. This is especially noticed for the large non-real-time queue: if one end user manages to fill this queue, it may take a long time (e.g. 819 ms for our low speed satellite link example of 1Mbps) before other end users can transmit their data.

The problem can only be solved, by the device that knows how narrow the bottleneck is.

A shaper can be put in front of the satellite modulator. The shaper is than configured in such a way, that it forwards the data at exactly the same bit rate as the modulator can transmit. In this case, the shaper can guarantee fairness amongst all end users.

With the recent evolution of dynamic satellite bandwidths (VCM or ACM), it becomes difficult for a shaper to guarantee fairness amongst end users. There are not so many shapers that shape traffic for a dynamically changing satellite bandwidth.

The second, preferred strategy is to perform the shaping in the modulator and is visualized in the next figure.

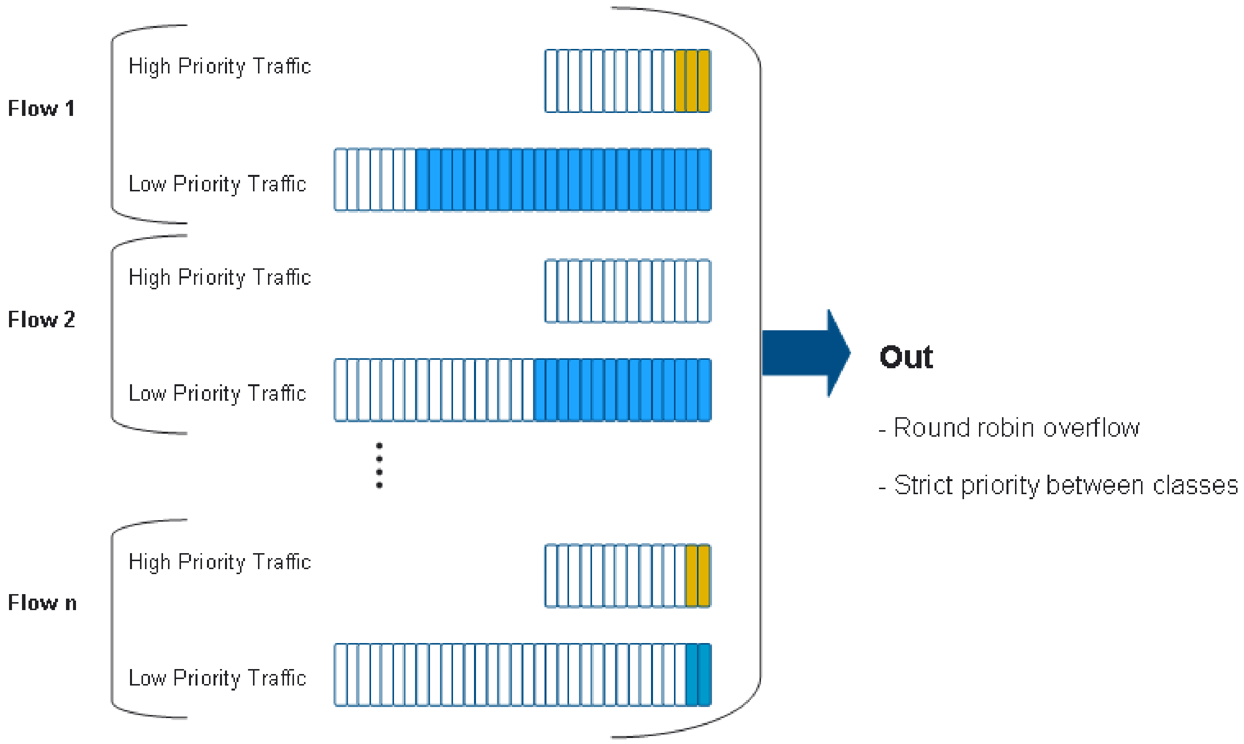


Figure 96 – Example of Quality of Service Implementation

9.6.4 Implementation

Quality of Service is implemented using the following steps:

1. IP traffic is put into queues before transmission. There are four types of queues each with their own transmission priority (lowest, low, high and highest).
   The maximum and guaranteed size of each queue can be set individually.

Location: EL470 | Modem | Control | Interfaces | Ethernet | IP encap-decap | QOS | Eth RX QOS queue table

Priority	Guaranteed size (in mS) per flow	Max size (in mS) per QOS
Lowest	5	3000
Low	5	3000
High	10	1000
Highest	10	100

Figure 97 – QoS Queue Table

2. In order to direct incoming traffic to each queue, a rule can be defined per priority queue as shown in the following figure.

Location: EL470 | Modem | Control | Interfaces | Ethernet | IP encap-decap | QOS | Eth RX QOS rule table

Active	classifier	Priority
Enabled	default	Lowest
Enabled	ip.proto==udp	High
Disabled		Lowest
Disabled		Lowest

Figure 98 – QoS Rule Table

<u>Examples:</u>

ip.proto==udp
ip.proto==17
eth.type==lacp
ip.tos==4-255
ip.tos==8,16
ip.dscp==8-16
ip.dscp==8,16
ip.src==1.2.3.4
ip.dst==1.2.3.4

IP Datagram Format (IPv4)

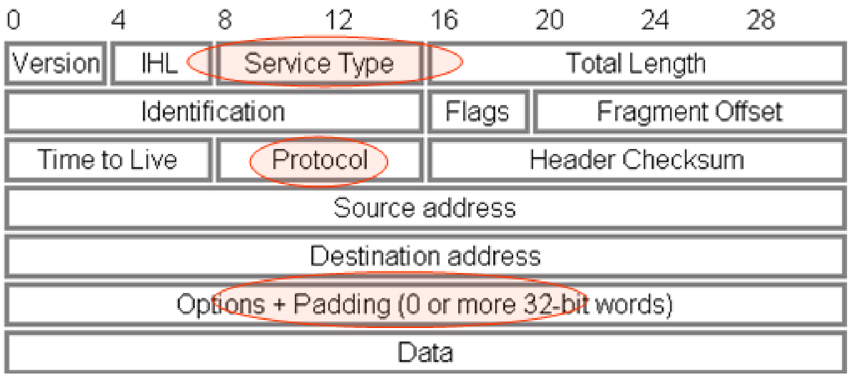


Figure 99 – IP Datagram Format (IPv4)

QoS filtering is done on the following fields:

TOS (Type of Service) or DSCP byte

Protocol (e.g. 6=TCP, 17=UDP)

Source IP address

Destination IP address

Ethernet type (e.g. LACP)

9.7 Loopback management on EL470

With the introduction of Elevation release 8.1 there is a new function added on the EL470 to make the management of the unit easier and independent from the network situation behind the unit. The introduction of loopback management provides the opportunity to locally insert the management port in the data-path.

9.7.1 Cabling Description

The use of the loopback management is easy:

Proceed as follows:

- Make a physical connection between the management port (marked as LAN) and the second data port (marked as port B) on the EL470.

> We assume that the data port for the user data is port A.

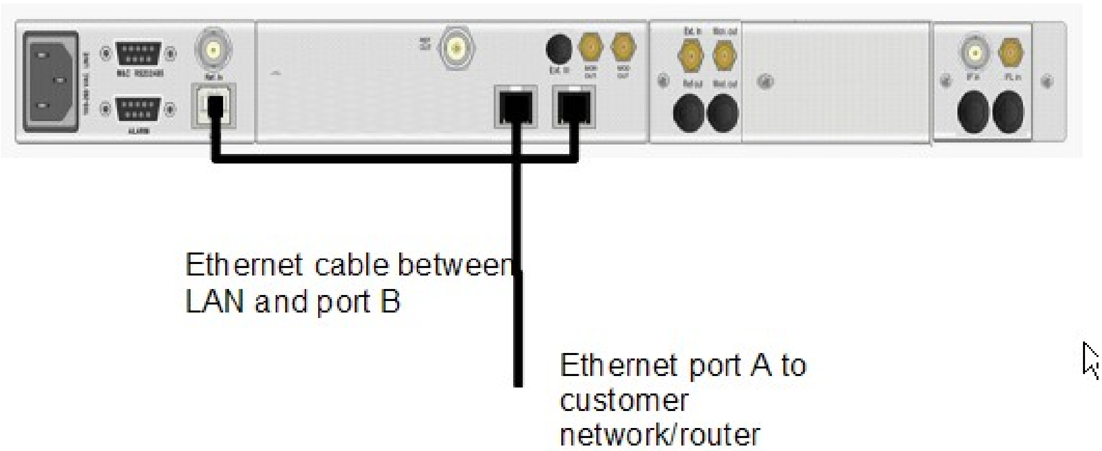


Figure 100 – Loopback Management Physical Connection

Use a straight ethernet cable to make the loopback connection, port B is auto-cross over.

> When this loopback management function is used it is not possible to use the port redundancy function.

9.7.2 Configuration

To getter with this function two new parameters are added to indicate to the EL470 that the loopback mode is active.
The parameters are located under

- EL47X>>Modem>>Control>>Interface>>Ethernet>>IPencap-decap

- Parameter 1: **Management loopback port** , here you can select the port that is used to loopback on.
  Options : Interface A , Interface B

- Parameter 2: **Management VLAN** : This option is only visible when you work in a "VLAN support enabled" mode. Define here the VLAN tag that port A or B should add to the management traffic coming from the LAN (management port) So to state clearly, the LAN port (management port) always sends out untagged traffic it is the loopback port (port B in our example) who adds the VLAN tag to the management traffic.

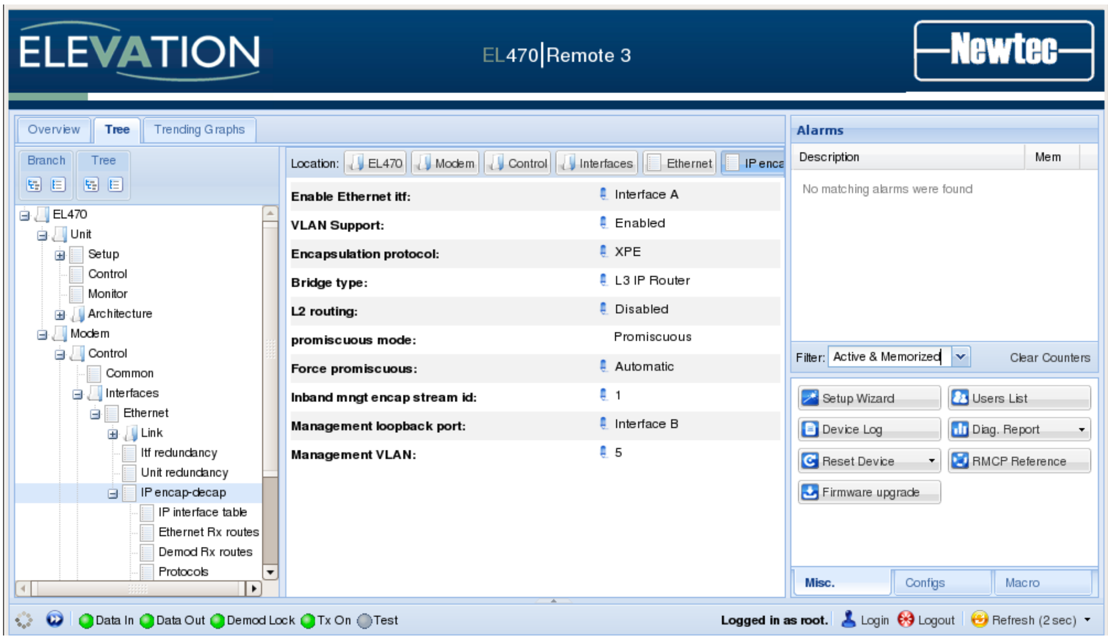


Figure 101 –Management Loopback Port and Management VLAN

For a detailed configuration to the application note: Management Loop-back inserted on the cd you received with this device.

9.8 Redundancy

Ethernet interface redundancy is implemented by interface bonding: Ethernet interface A and Ethernet interface B are bonded as 1 virtual interface. Only 1 of the interfaces is active at a time.

When the modem (or modulator or demodulator) is configured as a layer-3 device (IP router or IP terminating device), it is important that both interfaces share the same virtual IP address (es) and virtual MAC address. This guarantees the fastest switchover time from one interface to the other (the other devices in the same subnet don't need to renew an ARP entry – the only thing that changes, is the location of this MAC address. The principles used to make the network redundant are compatible with HSRP or VRRP principles.

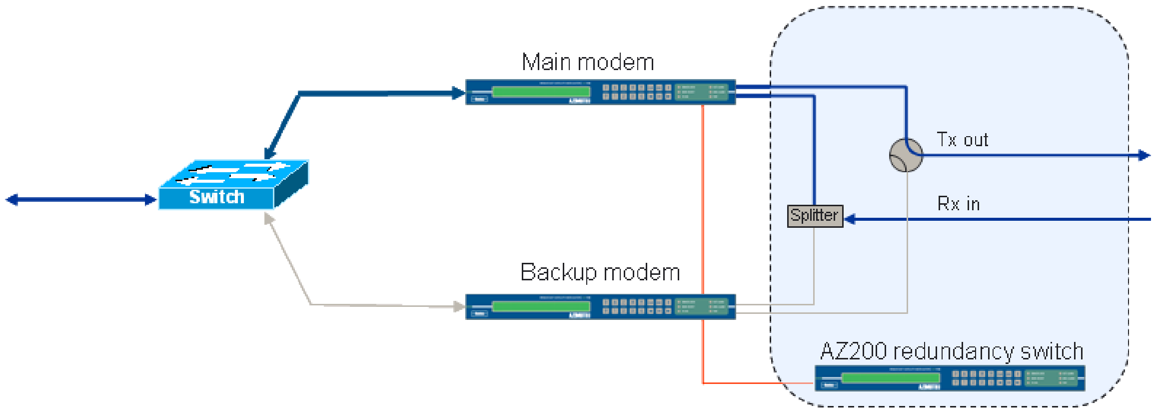


Figure 102 - Example of Equipment Redundancy Configuration

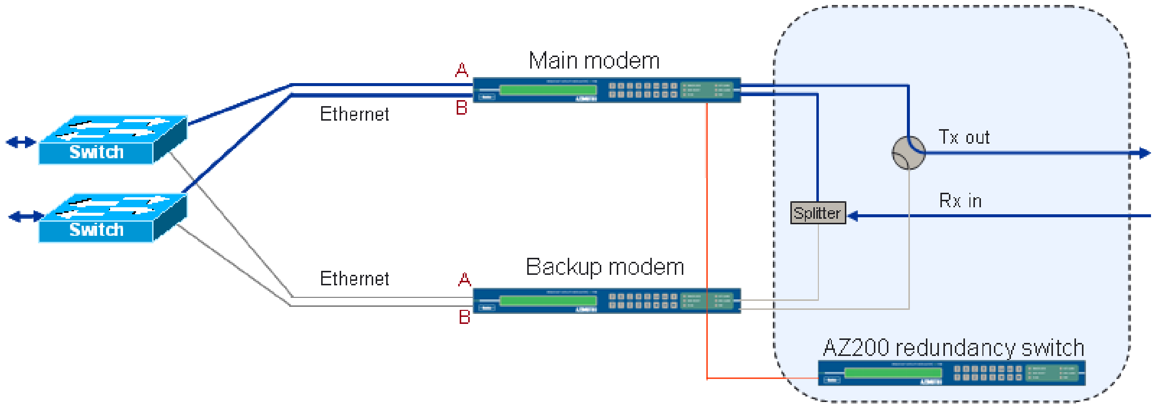


Figure 103 - example of Equipment and Port Redundancy Configuration

9.9 Modulator Constant Power / RIM

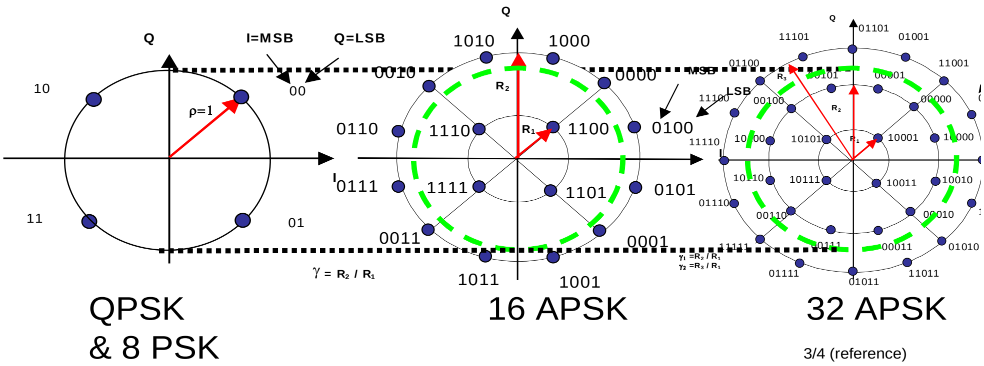
The Modem features two Output Level Plans:

- **Constant Power**: in this plan, output power is kept equal for the different ModCods. This is the default mode of operation;
- **Constant Rim**: in this plan, the outer ring of the symbol constellation is kept equal for the different ModCods. As a consequence, different ModCods are transmitted with different output power. This mode is intended to operate with a saturated transponder. It avoids excessive input back-off for QPSK, 8PSK 16APSK ModCods during VCM/ACM operation. The lower ModCods can indeed be operated closer to saturation. Due to the dynamic level changes this mode is only possible with "Manual Gain Control". As such, the ALC on the transponder should be disabled. Since the highest outer ring level occurs for a ModCod of 32APSK-3/4, this ModCod is used as the reference for the output power level setting. The other ModCods are transmitted with higher power:

  - 16APSK : +1 dB
  - QPSK and 8PSK : +2 dB

> When operating in constant RIM mode:
> - Equalink should be disabled;
> - Transponder ALC should be disabled.

Constant power



Dashed circles = Average power

Figure 104 - Constant Power Visualisation

Constant RIM

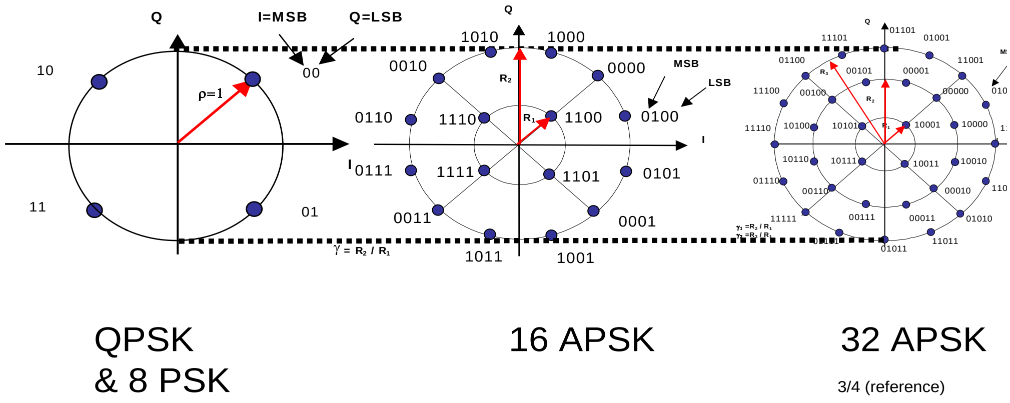


Figure 105 - Constant RIM Visualisation

9.10 Packet Generator and Monitor

The Ethernet interface board has a built-in UDP packet generator compatible with the bandwidth measurement tool iPerf.

> iPerf is freeware, (available from http://dast.nlanr.net/Projects/Iperf/) in UDP mode.

In addition, it has packet monitor to perform Ethernet frame or IP packet sniffing or to terminate a selected traffic stream generated by either the UDP packet generator or iPerf and provide statistics for that stream.

Typical use cases for the traffic generator/monitor are:

- Generate traffic on a modulator/modem and monitor this traffic on a demodulator/modem;
- Generate traffic from an iPerf client on a PC, and monitor this traffic on a modulator, modem or demodulator/modem (via modulator);
- Generate traffic on a modulator/modem and monitor this traffic on an iPerf server on a PC (via demodulator).

Packet Generator

The procedure to activate the UDP packet generator is as follows:

- Go to the EL470 >> Modem >> Monitor >> Interfaces >> Ethernet >> Packet Gen menu;
- Fill out the **Packet format;**

  The packet generator format is defined by a space-separated sequence of the following expressions

  - **`vlan==5`** (VLAN)
  - **`eth.dst==00:11:22:33:44:55`** (destination MAC address hex)
  - **`eth.src==00:11:22:33:44:55`** (source MAC address hex)
  - **`ip.dst==1.2.3.4`** (destination IP address)
  - **`ip.src==1.2.3.4`** (source IP address)
  - **`ip.len==1200`** (length of UDP datagram, default
  - 1470)
  - (does not include length of ip or udp
  - header)
  - **`udp.dst==5001`** (or 0x1389)
  - (UDP destination port, default 5001)
  - **`raw[12]==ab`** (payload of UDP datagrams, hex)
  -
  - In the most common case only the destination ip address is filled out
  - (and a VLAN, if VLANs are used):

  `ip.dst==10.100.0.3`

  `ip.dst==10.100.0.3 vlan==5`

- For **Probe** select Eth RX interface;
- Fill out the **Bit rate** in bps;
- Fill out the **Bytes to transmit.**

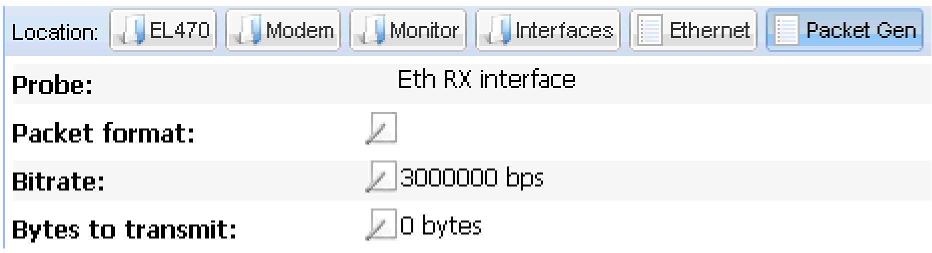


Figure 106- Packet Generator

The traffic generator starts transmitting if this counter is filled out with a positive number and the counter counts down according to the number of bytes that are sent. The generator stops if the counter has reached the value 0.
If you enter the value 4294967295 the traffic generator transmits packets continuously (until this value I set to 0)

Packet Monitor

If the packet monitor is activated, then the selected traffic is removed from the data path and sent to the packet monitor. The selection of traffic is done by means of a packet log filter. Only packets that match this filter are logged.

The procedure to activate the packet monitor is as follows:

➢ Go to the:

EL470 >> Modem >> Monitor >> Interfaces >> Ethernet >> Packet Mon menu

➢ Select an **Action;**

This configures the action taken when a packet is logged.

The options are:

- **`log binary`**	(default)
- **`log decoded`**	in a more readable format, showing IP
-	addresses etc...
- **`count`**	packet counter + bit rate
- **`rx to packet monitor`**	this option extracts the traffic to the packet monitor

➢ Select a **Filter;**

The filter consists of a space-separated sequence of expressions, which are combined as a logical AND.

Possible criteria are:

- **`eth.dst==00:11:22:33:44:55`**	(destination MAC address in hex)
- **`eth.src==00:11:22:33:44:55`**	(source MAC address in hex)
- **`ip.dst==1.2.3.4`**	(destination IP address)
- **`ip.src==1.2.3.4`**	(source IP address)
- **`udp.dst==5001`**	(or 0x1389)
-	(UDP destination port, default 5001)
- **`raw[12]==ab`**	(payload of UDP datagrams, hex)

To remove the packet filter, you can enter a dummy string of 1 character (e.g. "-").

➢ Select a **Probe:**

to configure which packets are logged to the packet log buffer:

- **`All errors`**
- **`No logging`** (default – packet monitor inactive)
- **`All Eth packets`**
- **`All EthRx packets`**
- **`All EthTx packets`** (for terminating traffic from the traffic generator or from iPerf)
- **`All EthRx errors`**
- **`All EthTx errors`**
- **`ARP Rx packets`**
- **`ARP Tx packets`**

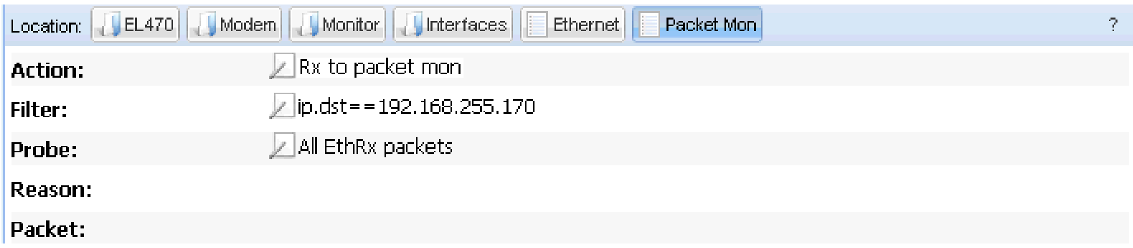


Figure 107- Packet Monitor

The result of the packet monitor is displayed in the following fields:

- **Reason** - the reason for which the packet is logged. If **`All errors`**, **`All EthRx errors`** or **`All EthTx errors`** is selected this gives the error cause;
- **Packet** - displays the header of a logged packet. In order to freeze this output, the value for Probe is immediately changed in No logging.

The following counters are only displayed if Action is **count** or **`rx to packet monitor`**.

- **Counter** – the number of packets that is captured by the packet monitor;
- **Bit rate** – the measured bit rate of the captured traffic stream;
- **Sequence errors** – the number of missing or error packets coming in case the traffic stream is generated by the traffic generator or iPerf.

9.11 DVB-S / DVB-S2 Test Generator

There is a test generator independent from the interfaces. This internal data generator on the modulator can be used as a transmit data source for testing, installation and link evaluation. The data source generates baseband frames in one or a series of ModCods.

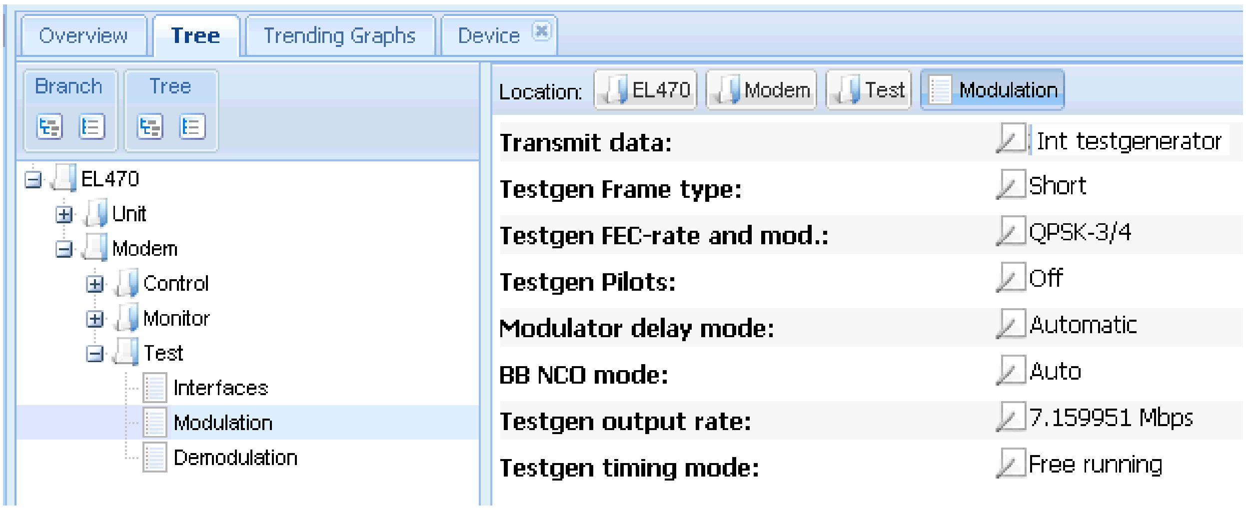


Figure 108- Modulator Test Generator

9.12 Backup Carrier Settings

These settings are implemented to have a backup carrier during carrier changes in the network.
Configure these settings on the demodulator/modem of the remote sites when the modulator/modem on the hub site has to change to a new carrier.
When this new carrier becomes active the complete network is switched to this second carrier configuration.

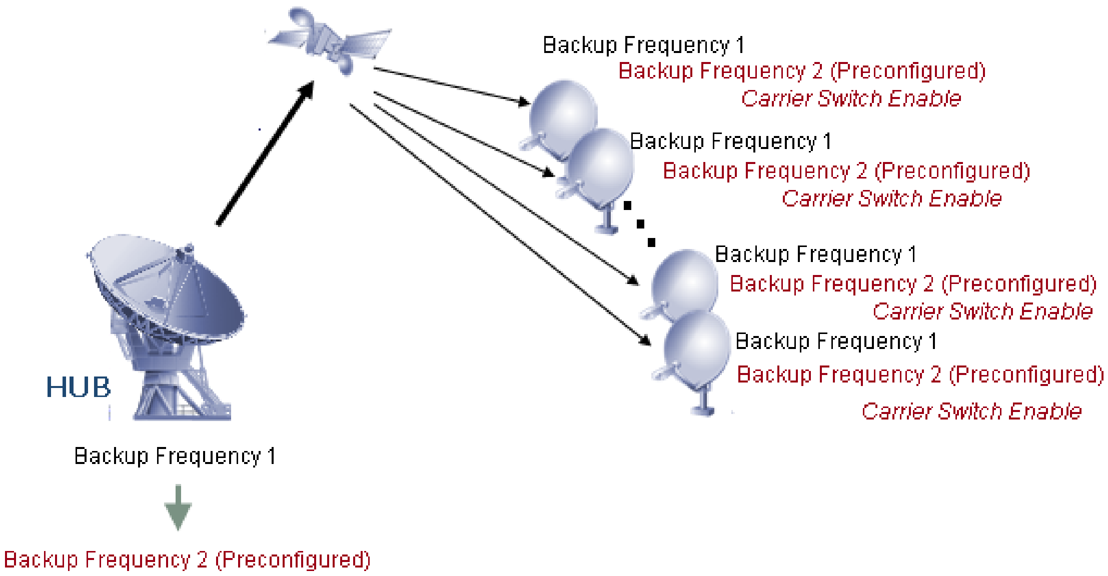


Figure 109 - Backup Carrier in the Network

The following procedure is performed in the network.

Time	Hub	Remote site(s)
Start	The hub transmits on: frequency 1, symbol rate 1.	The remote site is locked on frequency 1, symbol rate 1.
Preconfiguration	The hub transmits on frequency 1, symbol rate 1.	The remote site is locked on frequency 1, symbol rate 1. Preconfigure the remote site as follows: • **Backup receive frequency 1**: Frequency 2, symbol rate 2; • **Backup receive frequency 2**: Frequency 1, symbol rate 1. • Enable the setting **carrier switching Enable**.
Carrier switch	The hub transmits on: frequency 2, symbol rate 2.	1. The remote site looses lock; 2. The remote site tries to connect with **Backup receive frequency 1** (Frequency2, symbol rate 2). The remote site is locked on frequency 2, symbol rate2.
The network is stable.	The hub transmits on: frequency 2, symbol rate 2.	1. The remote site is locked on frequency 2, symbol rate2. 2. Disable the setting **carrier switching Enable.** 3. Save the configuration.

Go to the following menu to configure the different settings on the remote site:

- EL470 >> Modem >> Control >> Demodulation >> Backup carrier

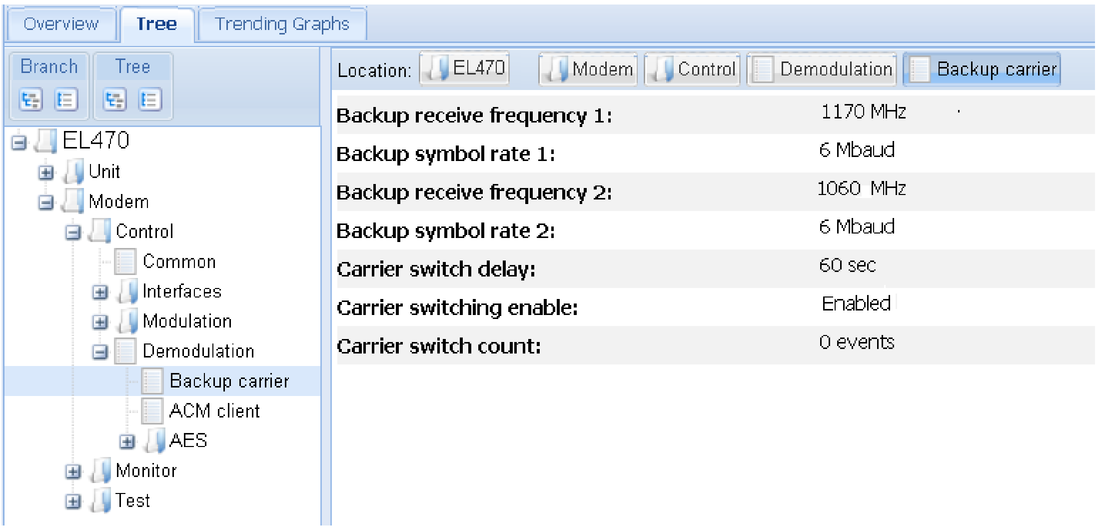


Figure 110 - Backup Carrier

Setting	Description
Backup receive frequency 1/2	This is the RF input frequency for the backup carrier configuration.
Backup Symbol rate 1/2	This is the backup nominal symbol rate, used when we fail to lock on the primary demodulator parameters.
Carrier switch delay	This is the time interval (in seconds) between consecutive demodulator carrier switch operations. When this time is to short the device is unable to connect to the other frequency and can result in permanent loss of satellite link connection. By default this is 60 seconds.
Carrier switching enable	Use this variable to enable or disable the switching between the two demodulation carriers.
Carrier switch count	The number of times we have dynamically switched to another carrier (with or without success).

The next sequence is followed on the remote site. (refer to Figure 111)

When the demodulator/modem on the remote site looses connection (unlock) with the current frequency a switch is performed to the other frequency . When the demod is not locked within the **switch delay time** the second frequency is tried. This sequence continues until the demod is locked.

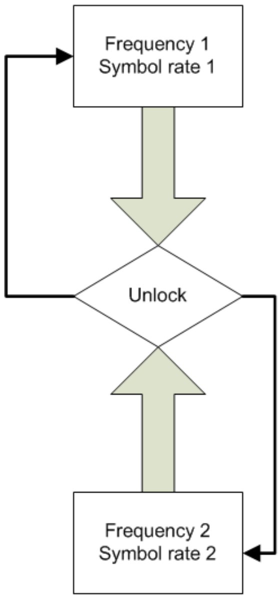


Figure 111 - Flow

When the demod is locked on the new carrier it is important that:

1. The setting **carrier switching** is set to disable;
2. The configuration is saved in config (0). (Refer to boot configuration on page 177)

During the switchover alarms will occur. This provides the real state of the device.

9.13 AES Content Protection

AES content protection is a solution to protect content during the satellite transmission. The protection is implemented at DVB-S2 baseband frame level. The modulator will encrypt the content before transmission. To receive the content, the demodulator must be able to decrypt the received signal. The encryption and decryption process is based on content keys. The decryptor is only authorised to receive the content when the correct content key is loaded on the demodulator.

Furthermore, AES content protection is a fully transparent security solution that guarantees the transport stream at the output of the decryptor to be bit-per-bit identical to the one at the input of the encryptor. This guarantees to use the content in a single frequency network after satellite transmission.

AES protects transport streams or IP data, independently of the encapsulation used.

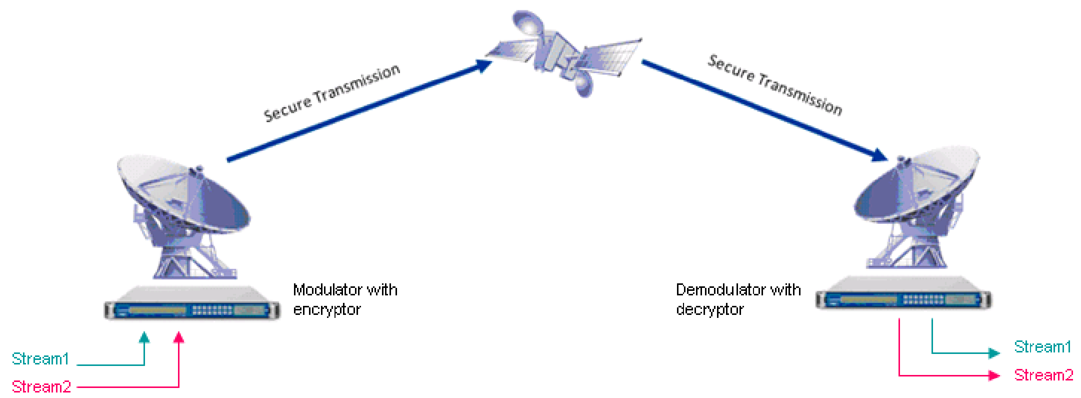


Figure 112 - Secure Transmission over Satellite

The security mechanism implemented is however NOT suited for applications requiring very strong security, such as banking data exchanges, military secrets, highly sensitive information, video feeds that needs to be kept confidential for a long time.

9.13.1 Content Protection

Content is protected by encrypting the baseband frames of a DVB-S2 transmission.

Encryption is applied on the data field of the baseband frame, using the AES algorithm to encrypt it. Different baseband frames are encrypted independently.

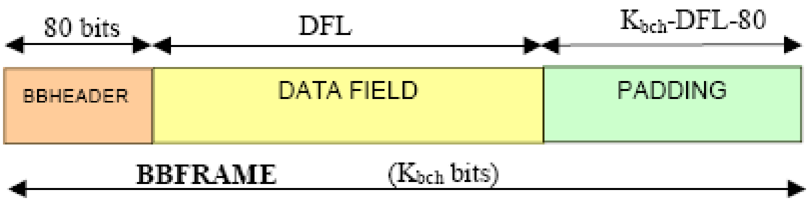


Figure 113 - Baseband Frame Structure (Source: EN-302307)

The encryption-decryption process makes sure that at the output of the decryptor, the baseband frame is identical to the one at the input of the encryptor.

The signalling used for the encryption is proprietary. Unencrypted streams can be received by any DVB-S2-compliant receiver. Encrypted signals can only be received by devices that have the Newtec AES decryption mechanism implemented.

9.13.2 Key Management

9.13.2.1 Overview

The key management defines the ways encryption/decryption keys are sent to and used by the encryptor and decryptor engines.

The key management system is designed to be straightforward, enabling effective manual or automated operations.

Keys are sent to the devices through the monitoring and control channel.

The encryption keys must be entered on the modulator by a human operator or an automated management system. The content key can be entered in non-encrypted or in encrypted format.

The non-encrypted format is used in any deployment where the channel (human operator or computer network) used to send the content key to the device is secure enough.

The encrypted format is used when the communication channel used to distribute the keys to the device is not secure. In that case, the system uses a secret group key stored in the device to guarantee that the encrypted content key can only be used on that device (or devices with the same group key).

Each device can support two keys for each stream: the odd key or the even key. One key is the active key, while the other one is the next key to use. This allows to distribute keys to all devices, then to switch to the new key on all devices at the same time.

9.13.2.2 Key Management System Structure

The following picture details the structure of the AES key management system that is implemented on all devices.

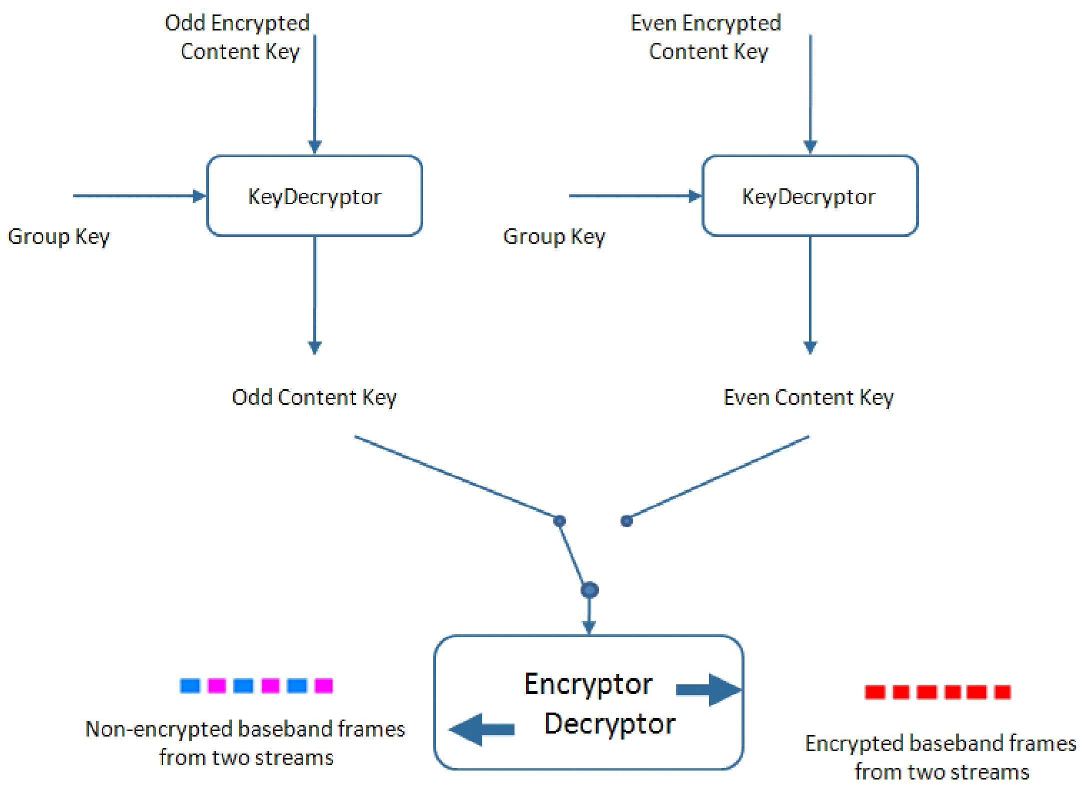


Figure 114 - AES Key Management System

- **Group key**: This key is entered by the user through any interface and stored in the device. Group keys are used to decrypt the encrypted content keys. Group keys cannot be read back on any interface.

EL170/470/970 >> Unit >> Control >> AES

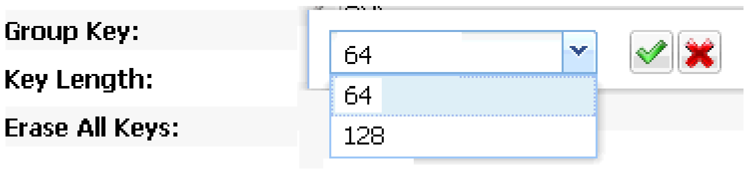


Figure 115 - Group Key Field

- **Encrypted content key**: There are two encrypted content keys per stream - the odd encrypted content key and the even encrypted content key. These keys are entered by the user through any interface and used to compute the corresponding content key which is stored in the device. Encrypted content keys cannot be read back on any interface.
- **Content key**: There are two content keys per stream - the odd content key and the even content key. The content keys are entered by the user through any interface or these keys are computed from the corresponding encrypted content key. Content keys cannot be read back on any interface.
- **Key decryptor**: The key decryptor is an AES decryption engine used to compute the content key based on the encrypted content key and using the group key as the AES key. The previous statement is only valid for 128-bit keys. In case of 64-bit keys, a DES decryption engine is used instead of AES.
- **Odd/Even key**: The operator on the modulator selects which key to use. The demodulators automatically detect which key is used (odd or even) and selects the key of the same type (odd or even) to performing the decryption.

9.13.2.3 Key Sizes

The key management layer for AES is defined to work with two key sizes: 128 bits for maximum security and 64 bits for meeting exportation restrictions in some countries - the 64 bit keys have a randomness of 56 bits to fully meet exportation restrictions. The last byte of the key is not used.

It is possible that the security mode on your modulator is restricted in the factory to use 64-bit keys only. In that case, you cannot switch to 128-bit key mode.

EL170/470/970 >> Unit >> Control >> AES

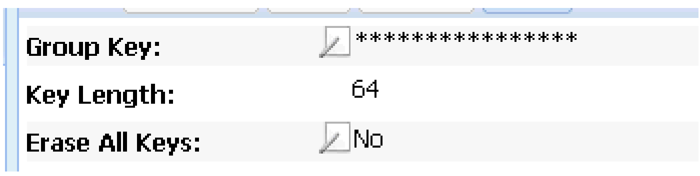


Figure 116 - Group Key Field

Switching from one key size to another erases all keys in use.

9.13.2.4 Use of Group Key

The group key can be used in two ways:

- A unique group key is defined for each device. In that case, a different encrypted content key needs to be sent to each device. This key is unique and the operator is guaranteed that if the key is intercepted, it cannot be used on another device (unless the group key is known).
- A group key is defined for a group of devices. Devices from region A share the same group key, while devices from region B share another group key. In this case, the same encrypted content key (let's say protected with the group key of region A) can be broadcasted to all devices. Only devices of region A will be able to receive the content. The same procedure can be used to separate receivers from two different sub-networks and it can also be used to separate receivers dedicated to different purposes.

For 64-bits keys, some restriction applies. As the DES encryption is used to protect the encrypted content key, it is not possible to use a weak DES key as a group key. Weak DES keys are listed in Appendix E at the back of this manual.

9.13.2.5 Seamless Key Change

The AES key management system is designed to allow the change of an encryption key during a transmission without interrupting the stream, if the demodulator stores the same content keys than the modulator.

Demodulators can detect which key (odd or even key) is currently in use. When the modulator switches from one key to another, the demodulator automatically detects the change and switches to the other key in a frame-synchronous way. This way, the demodulator always uses the proper key to decrypt the baseband frames. No interruption or glitch appears at the output of the demodulator.

By changing the unused key on the modulator and demodulators, it is possible to switch again the key in the network.

9.13.2.6 Global Protection or Protection per Stream

DVB-S2 allows the transmission of several streams over satellite at the same time. The different streams are all encapsulated in baseband frames and each stream is linked to a different input stream identifier or ISI. The ISI-values are used to separate all streams again at the reception site.

EL170/470/970 >> Modulator >> Control>> Modulation >> AES

Figure 117 - Global Encryption mode

The AES encryption mechanism can work in two different modes:

- The first mode is called the **global protection** mode. In this mode, all different DVB-S2 streams are encrypted with the same content key. One pair of odd and even content keys or one pair of odd and even encrypted content keys can be entered in the modulator.

> EL170/470/970 >> Modulator >> Control>> Modulation >> AES >> Global

Encryption Global:	Off
Global Key Parity:	Odd
Global Encypted Even Key:	****************
Global Encypted Odd Key:	****************
Global Even Key:	****************
Global Odd Key:	****************

Figure 118 - Global Content Keys

His second mode is called **protection per stream**. In this mode, all different DVB-S2 streams are encrypted with a different content key. This means that different sets of content keys must be entered in the modulator for each different stream that needs to be encrypted. On most Newtec devices, a total of four pairs of odd and even content keys or pairs of odd and even encrypted content keys can be linked to the ISI-values of the streams that need to be encrypted. On the AZ810 Stream Aggregator, specifically designed for 6 streams, up to 6 key pairs can be used, one for each possible stream.

- EL170/470/970 >> Modulator >> Control >> Modulation >> AES >> Keys 1..4

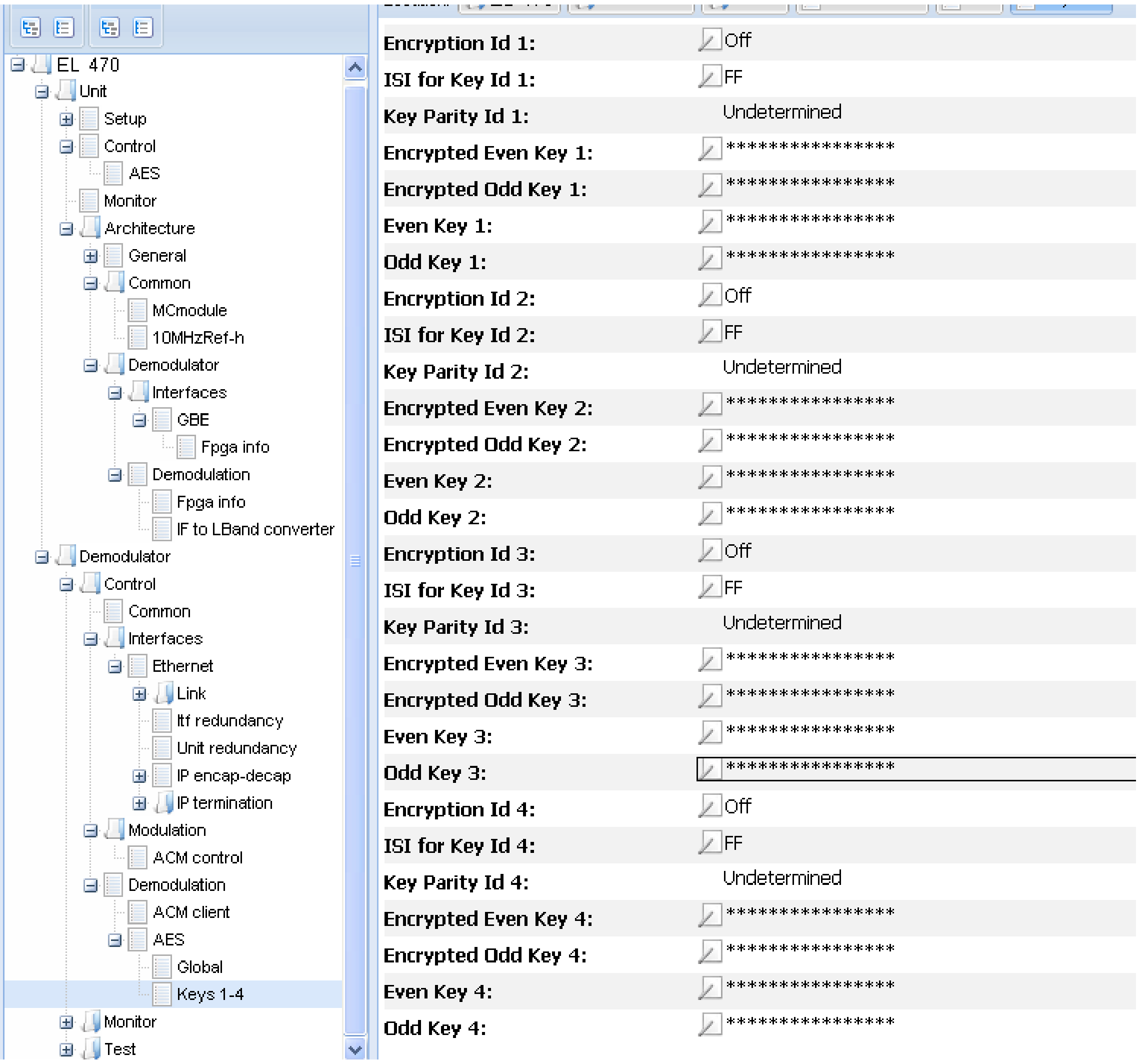


Figure 119 - Content Keys per ISI

When changing the encryption mode on the encryptor between “global” and “per ISI”, the encryption is turned off for all ISI so that such change does not interrupt the transmission.

9.13.3 Operation of AES

9.13.3.1 Setting a Key for the Transmission

Starting point: The encryptor sends clear data to the decryptor. Both have their encryption mode set to “Off” or no encryption.

Steps:

1. The odd content key is entered in the decryptor;
2. The decryptor encryption mode is set to “On”;
3. The odd content key is entered in the encryptor.;The encryptor encryption mode is set to “On”.

9.13.3.2 Changing Keys Seamlessly

Starting point: The encryptor sends encrypted data to the decryptor. The odd key is active. Both have their encryption mode set to “On”.

Steps:

1. The even content key is entered in the decryptor;
2. The even content key is entered in the encryptor;
3. The encryptor is toggled to use the even key.

An alternative is to turn the encryptor off, change the keys on encryptor and decryptor and turn the encryptor back on. The drawback is that the content is in clear for the time needed to change all the keys.

9.13.3.3 Adding a Receiver to the Network

Starting point: The encryptor sends encrypted data to several descriptors all using the same content key.

Steps:

1. Simply send the correct content key to that new receiver;
2. Turn on the decryptor of the new receiver.

9.13.3.4 Removing a Receiver from the Network

Starting point: The encryptor sends encrypted data to the descriptors. The odd key is active. All have their encryption mode set to “On”.

Steps:

1. Define a new even content key;
2. The new content key is entered in all decryptors, except the one receiver to be removed from the network;
3. The new content key is entered in the encryptor;
4. The encryptor is switched to the even key.

9.13.3.5 Sending Protected Content Keys

Starting point: An encryptor and a set of decryptors are running in a secured facility (or in secured facilities).

Steps:

1. Define a group key;
2. Insert the group key in all units by a trusted person/system in expert mode;
3. Deploy the devices;
4. Set the key for a transmission, sending encrypted content keys rather than content keys.

9.13.3.6 Creating Groups of Receivers

Groups of receivers, mutually exclusive, are created by inserting different group keys in those receivers and in the related sender. This way, keys sent to a group of receivers cannot be used by another group of receivers.

9.13.3.7 Changing Group Keys

Group keys need to be changed by a trusted person or entity. The devices are set in expert mode and the group key is changed. The security of this operation relays on the security level of the entity modifying the group key.

For remote group key update, use a secure connection up to the device or at least up to the machine controlling the device.

9.13.3.8 Multi-stream Transmissions to Different Groups of Receivers

If receivers are only part of one group and all receivers of the same group receive the same content, the group key is well adapted to this case.

It can also happen that the group of receivers shall differ for each stream. But as one receiver can receive several streams, groups must be defined per stream. In this case two options are possible:

- Send the (encrypted) keys of each stream only to the relevant receivers. The sending should be unit-casted as other receivers with the same group key could decrypt the stream key too;
- Define one group key per receiver and to send the encrypted content keys to those receivers only. This solution has the advantage that a message intercepted cannot be used on another receiver (unless group keys are known publicly).

9.13.3.9 Deleting Keys

EL170/470/970 >> Unit >> Control >> AES

A command “Erase All Keys” is implemented to erase all AES-related keys on that device. This command erases (i.e. writes a 0xFFF…FF value):

- The group key;
- The content keys that are in use.

The content keys stored in device configurations are NOT erased. A factory reset will erase all keys stored in the device.

9.13.4 Generating Encrypted Content Keys

Newtec distributes a simple web-based java script to compute encrypted keys for a specific device.
Use the Newtec Service Desk tool to receive a copy:
> Browse to http://customersupport.newtec.eu .
> Fill in your Username and Password
> Create a ticket
As response of your request you will receive the script from our support team.
In case you don't have a Username and Password yet for the Newtec Service Desk tool: request a login to customersupport@newtec.eu.

In the section below, all keys or data are represented in hexadecimal. For the algorithms, they are represented with the most significant byte (bit) first.

9.13.4.1 128-bit Keys

The computation of the encrypted content key from a given content key is depicted in the following figure.

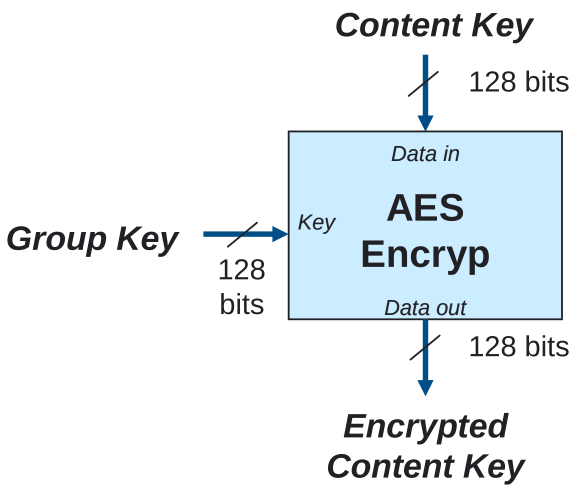


Figure 120 - Process to Encrypt a Content Key with a Specific Group Key in 128-bit Mode

The following lines provide a few examples of key computations for reference:

Example 1:

Content Key: e81816b87e5cf9c4e81816b87e5cf9c4

Group Key: d9d47fae81fad3154384d79cf1278306

Encrypted Content Key: be9c253b8e707ee851ba5ce6dd388753

Example 2:

Content Key: 1234567890abcdef1234567890abcdef

Group Key: d9d47fae81fad3154384d79cf1278306

Encrypted Content Key: d52e1da09a29691f85f9d5da74e07bed

Example 3:

Content Key: 1234567890abcdef1234567890abcdef

Group Key: 06450f0aaa9b9655ee9c4073097c7b08

Encrypted Content Key: 9df1586017ee2b0417eebf86ac6d4627

9.13.4.2 64-bit Keys

A similar process is used for the computation of encrypted content keys in the 64-bit mode. The computation of the encrypted content key from a given content key is depicted in the following figure.

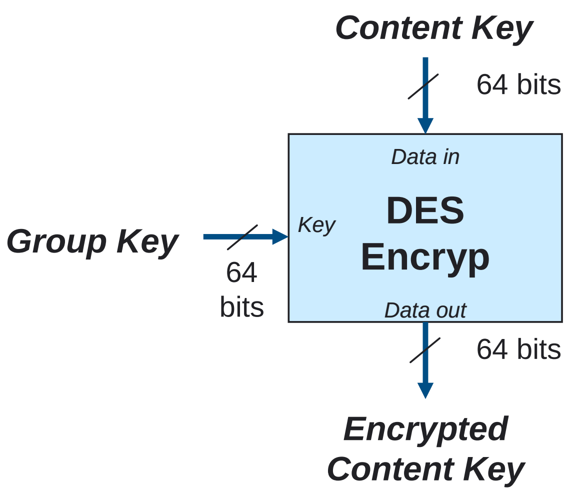


Figure 121 - Process to Encrypt a Content Key with a Specific Group Key in 64-bit Mode

The DES algorithm used is the one described in the FIPS-46-3 standard from the NIST.

The following lines provide a few examples of key computations for reference:

Example 1:

Content Key: 278da56a0f06aa1f

Group Key: fb5f9c585dd359aa

Encrypted Content Key: bf561dd5e15890b7

Example 2:

Content Key: 1234567890abcdef

Group Key: fb5f9c585dd359aa

Encrypted Content Key: d46f63e2cc998eec

Example 3:

Content Key: 1234567890abcdef

Group Key: 7fae81fad3154384

Encrypted Content Key: be407096c6104b1e

APPENDIX A – USER DEFINED MENU

You can configure the user menu according to your needs. In this way, you can create a quick access to those control, monitor and testing parameters that you need to change or monitor regularly. In addition, you can also change the order in which the menu items are presented to meet your specific demands. This is very useful in, for example, the DSNG applications. Here you can pre-configure the general parameters and store them in the default boot-configuration. You can then make all relevant parameters that need a quick change during link setup available as a group in the user menu. When you have done this, you can operate the IP Satellite Modulator without having to go through all the different menus. A typical example would be to group the parameters **output frequency**, **output level** and **transmit** while leaving all other parameters untouched.

The following is an example for the EL170 modulator. The same procedure can be used for the other devices.

Defined user menu

- Choose **EL170** >**unit**>**setup**> **User menu** and click **OK**

```
EL170/Unit/setup
User menu: <press OK, ESC when done>
```

- Choose **EL170** > **Unit** > **Setup** > **User** menu and click **OK**. This brings up the first item from the **EL170** > **Control** menu:

```
EL170/Control                   not present
<example parameter>             <OK> to add
```

- Click **OK** to add this menu to the list of menu items that is visible in the user menu or press the 'right arrow' key to move to the next menu item in the control, monitor and test menu. The available list contains all the menu items when the device is in "expert mode".
- Click **OK** to change the display to:

```
EL170/Control                   present
<example parameter>             <OK> to remove
```

The above indicates that this menu item is present in the user menu. To remove it, click **OK** again.

After a "reset to factory defaults" the user menu contents are lost.

APPENDIX B – SETUP WIZARD EXAMPLE

The following is an example of a configuration using the Setup Wizard.

- Click **Misc**. in the Function controls window.

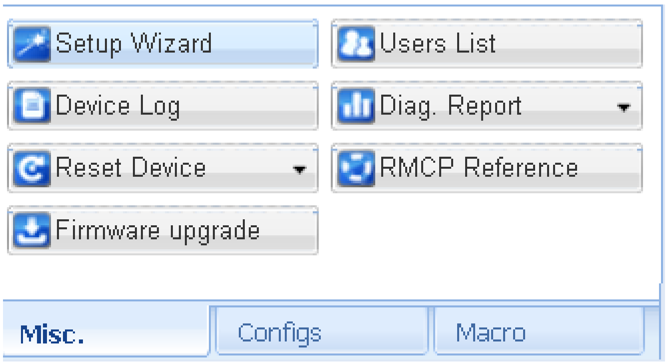


Figure 122 - Function Controls Window

- Click **Setup Wizard**

Figure 123 - Intializing Setup Wizard

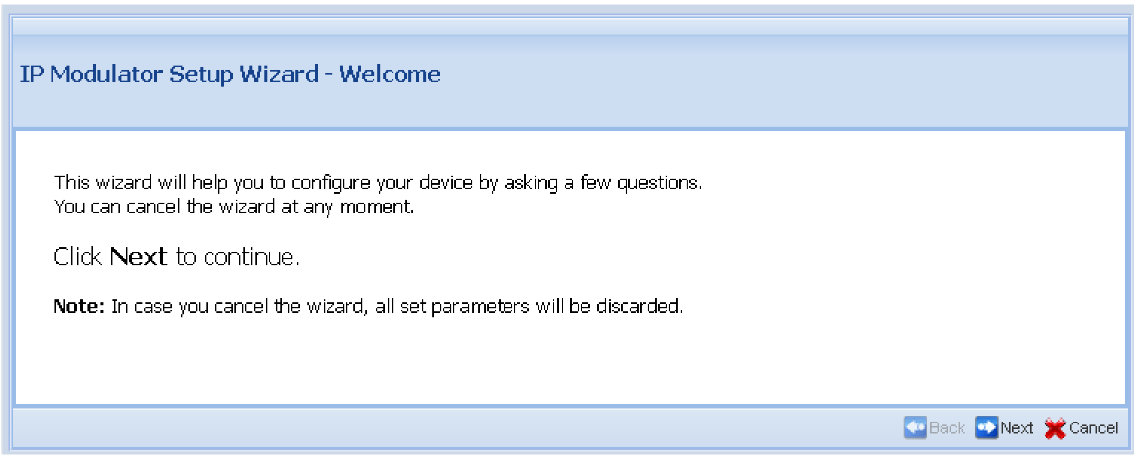


Figure 124 - Wizard Welcome Screen

➢ Click **Next**

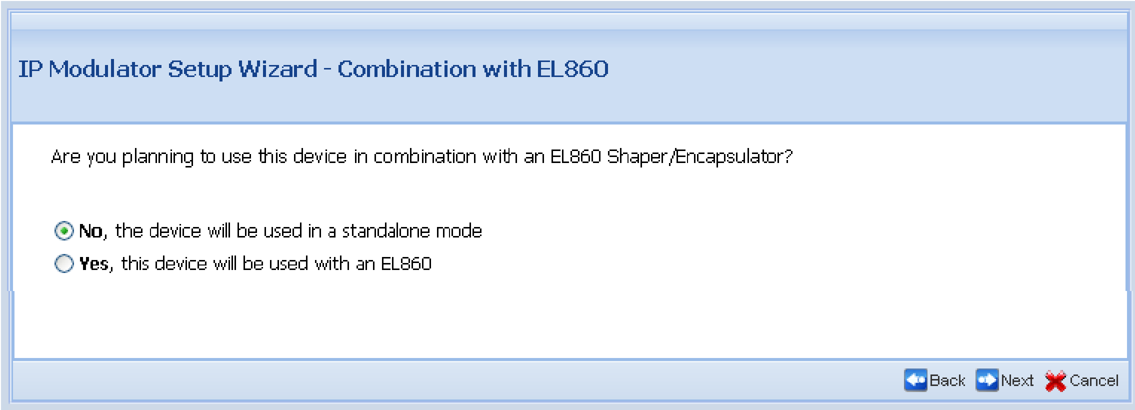


Figure 125 - Combination with EL860

➢ Click **Next**

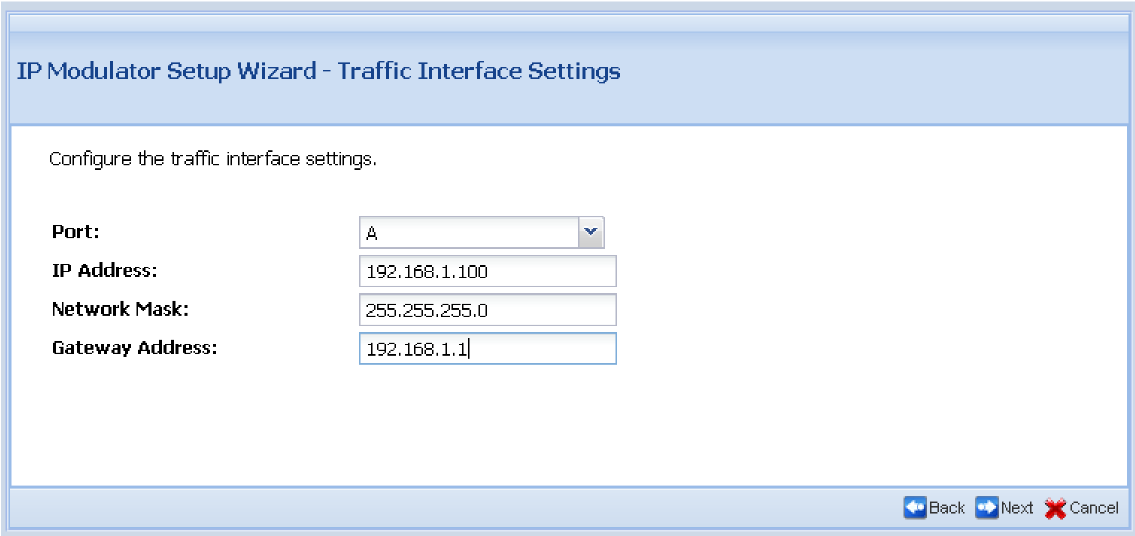


Figure 126 - Traffic Interface Settings

➤ Click **Next**

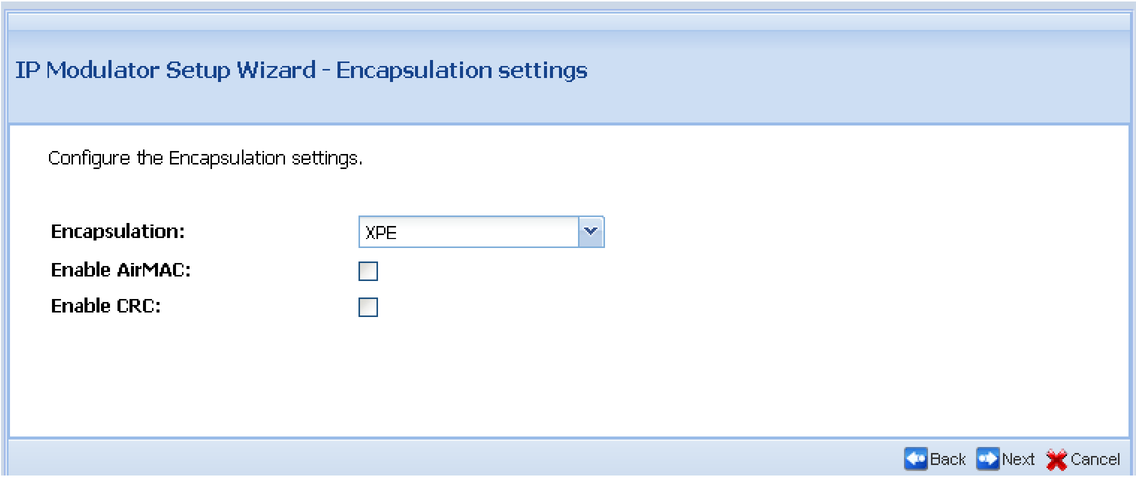


Figure 127 - Encapsulation Settings

➤ Click **Next**

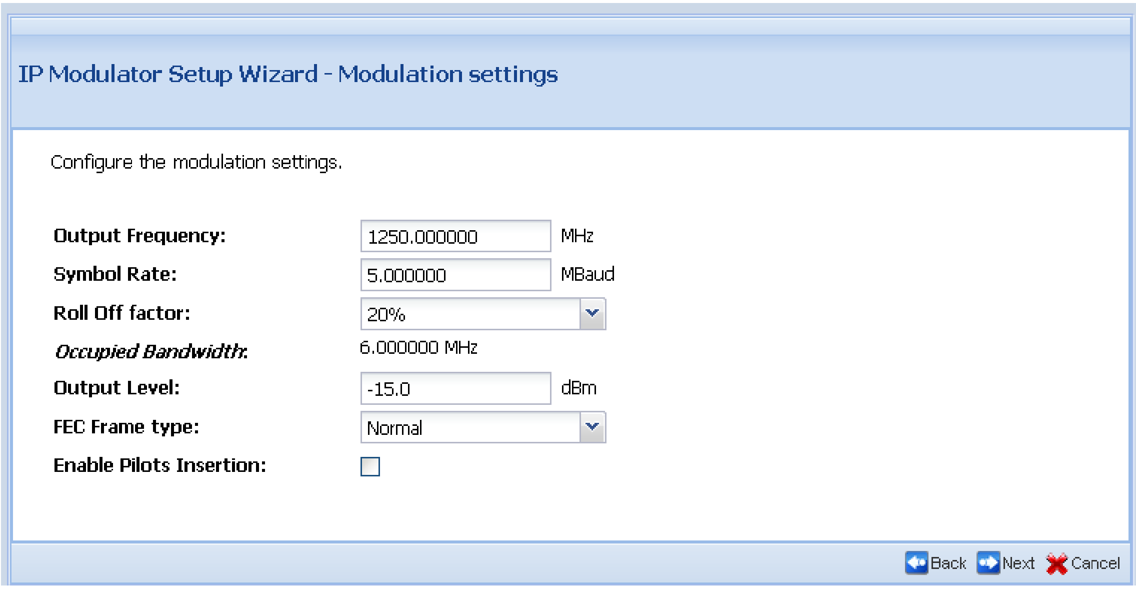


Figure 128 - Modulation Settings

➢ Click **Next**

Figure 129 - Routing Table

➢ Click **Next**

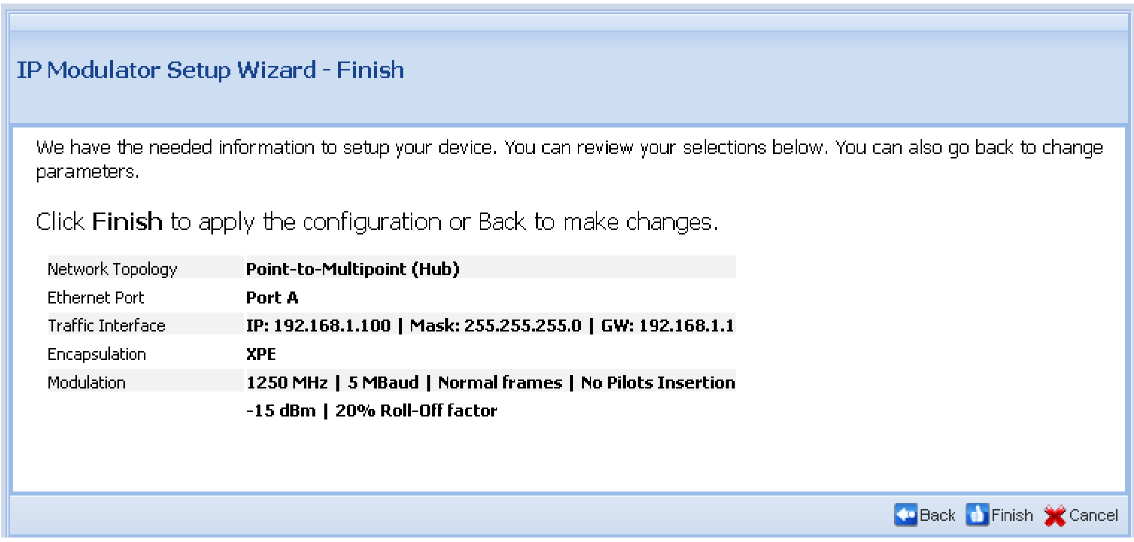


Figure 130 – Finish

➢ click finish to complete the confiugration.

The configuration are apllied immediately.

APPENDIX C – TECHNICAL SPECIFICATIONS

EL170 IP Satellite Modulator

Input Interface

- Auto switching 10/100/1000 Base-T Ethernet interface;
- Maximum rate: 133 Mbit/s or 67,000 packets per second;
- Layer 2 bridge mode: Ethernet frames over satellite;
- Layer 3 bridge or router mode: IP packets over satellite;
- Proxy ARP support;
- Base Band Frame input (optional);
- Supported encapsulation modes:
    - Data piping;
    - Ultra Lightweight Encapsulation (ULE);
    - Multi Protocol Encapsulation (MPE) Extended Performance Encapsulation (XPE) - Newtec's highly efficient encapsulation protocol for the encapsulation of Ethernet/IP frames in DVB-S2 Base-Band frames.
- Filtering and routing capabilities:
    - Up to 32 VLAN filters;
    - Up to 255 MAC filters;
    - Up to 255 IP routes/air-MAC addresses;
    - Up to 255 PIDs;
    - Up to 16 DVB-S2 Streams.

Modulation

Supported modulation schemes and FEC

- DVB-S/DSNG:
  Outer/Inner FEC: Reed Solomon /Viterbi
  ModCods:
    - QPSK: 1/2, 2/3, 3/4, 5/6, 7/8
    - 8PSK: 2/3, 5/6, 8/9
    - 16QAM: 3/4, 7/8
- DVB-S2:
  Outer/Inner FEC: BCH/ LDPC
  ModCods:
    - QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
    - 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10
    - 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
    - 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10

- VCM support (optional);
- Embedded point-to-point FlexACM controller (optional).

Baud rate Range

- DVB-S2;
  - QPSK/8PSK 0,05 – 45 Mbaud
  - 16APSK/32APSK 0,05 – 33 Mbaud

  (for higher baud rates see EL178)
- DVB-S/DSNG;
  - QPSK/8PSK/16QAM 0.05-45 Mbaud

Frame Length

- DVB-S/DSNG 188 bytes;
- DVB-S2 Short Frames 16200 bits;
- DVB-S2 Normal Frames 64800.

Roll-of factor

- 20 % - 25 % - 35 %.

Output interfaces

L-band output (default):

- Connector SMA (F), 50 ohms;
- Return loss > 14 dB;
- Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 1750 MHz (50 Hz steps).

Extended L-band output (optional)

- Connector SMA (F), 50 ohms;
- Return loss > 14 dB;
- Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 2150 MHz (50 Hz steps).

IF-band (optional):

- Connector:
  - BNC (F) - 75 ohms (intermateable with 50 ohms);
- Return loss:
  - 50 ohms : > 14 dB;
  - 75 ohms : > 20 dB.

- Level -30/+5 dBm (± 3 dB);
- Frequency 50 - 180 MHz (50 Hz steps).

L-band+IF (optional)

- L-band: same as above;
- IF: fixed 70 or 140 MHz frequency;
  - 34/+1 dBm (+/- 3 dB) output level.

L-band monitoring output (default)

- Connector SMA (F), 50 ohms;
- Return loss > 7 dB;
- Level -45 dBm;
- Frequency default: identical to L-band output. with options AA-02 / AA-06: 1080 MHz

BUC power and reference frequency (optional)

- Max. current 1,5 A;
- Voltage 24V, 48V;
- Frequency 10MHz;
- Stability ±5x10-8 over 0°C to 65°C.

With this option installed, the L-band output connectors become N(F), 50 ohms.

Spurious performance

- Better than -65 dBc/4 kHz @ +5 dBm level and > 200 kbaud.

10 MHz reference input / output (optional)

- Connector BNC (F) – 50 ohms;
- Input level -3dbm up to 7dBm;
- Output level +7dBm.

Internal Reference frequency

High Stability (optional)

- Stability ±5x10 over 0°C to 70°C;
- Ageing: ± 15 ppb/day ± 300 ppb/year.

Very High Stability (optional)

- Stability: ±2x10 over 0°C to 65°C;
- Ageing: ± 0.5 ppb/day ± 500 ppb/10 year.

Generic

Monitor and control interfaces

- Web based GUI;
- Diagnostics report, alarm log;
- RMCP over TCP-IP/UDP and RS232/RS485;
- SNMP v2c.

Alarm interface

- Electrical dual contact closure alarm contacts;
- Connector 9-pin sub-D (F);
- Logical interface and general device alarm.

Physical

- 1RU, width: 19”, depth 51 cm, 6 kg;
- Power supply:
    - 90-130 & 180-260 Vac, 105 VA, 47-63 Hz;
    - Temperature;
    - Operational: 0°C to 40°C;
    - Storage: -40 to +70°C;
- Humidity: 5% to 85% non-condensing;
- CE label.

EL970 IP Satellite Demodulator

Input interface

***Dual* L-band input (default)**

- Connector 2 x F-type (F), 75 ohms;
- Return loss > 7 dB;
- Level -65/-25dBm;
- Frequency 950 - 2150 MHz;
- Adjacent signal < (Co+7) dBm/Hz where Co = signal level density.

IF-band input (optional, replaces one L-band input)

- Connector BNC (F) - 75 ohms;
- Return loss > 15 dB;
- Level -55 to -15 dBm;
- Frequency 50 - 180 MHz;
- Adjacent signal < (Co+7) dBm/Hz where Co = signal level density.

***LNB* power and control**

- max. current 350 mA (on selected IFL input);
- voltage
  - 11,5 -14 V (Vertical polarization);
  - 16 -19 V (Horizontal polarization) & additional 22kHz +/- 4KHz (band selection according to universal LNB for Astra satellites & DiSEqC command transmission);
- 10 MHz reference.

Demodulation

Supported modulation schemes and FEC

- DVB-S/DSNG:
  Outer/Inner FEC: Reed Solomon /Viterbi
  ModCods:
  - QPSK: 1/2, 2/3, 3/4, 5/6, 7/8
  - 8PSK: 2/3, 5/6, 8/9
  - 16QAM: 3/4, 7/8
- DVB-S2:
  Outer/Inner FEC: BCH/ LDPC
  ModCods:
  - QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
  - 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10
  - 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
  - 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10

- CCM + VCM support;
- ACM client (optional).

Baud rate range

- DVB-S2
  - QPSK/8PSK 0,256 – 45 Mbaud
  - 16APSK 0,256 – 33 Mbaud
  - 32APSK 1 - 33 Mbaud
- DVB-S/DSNG
  - QPSK/8PSK/16QAM 1-45 Mbaud

Frame length

- DVB-S/DSNG 188 bytes;
- DVB-S2 Short Frames 16 200 bit;
- DVB-S2 Normal Frames 64 800 bit.

Roll-off factor

- 20 % - 25 % - 35 %.

DVB-S2 performances at PER 1E-S

	Short Frames	Normal Frames
	< 15 Mbaud	< 45 Mbaud
Config	Es/No	Es/No
QPSK- 1/3 -	-0.6	-0.7
QPSK- 2/5	0.4	0.2
QPSK- 1/2	1	1.4
QPSK- 3/5	3.1	2.8
QPSK- 2/3	3.8	3.6
QPSK- 3/4	4.5	4.3
QPSK- 4/5	5.1	5.1
QPSK- 5/6	5.8	5.5
QPSK- 8/9	6.7	6.6
QPSK- 9/10	-	6.7
8PSK- 3/5	6.5	6.3
8PSK- 2/3	7.4	7.1
8PSK- 3/4	8.6	8.4
8PSK- 5/6	10.2	9.7
8PSK- 8/9	11.4	11.1
8PSK- 9/10	-	11.3
16APSK- 2/3	9.9	9.6
16APSK- 3/4	10.9	10.5
16APSK- 4/5	11.6	11.5
16APSK- 5/6	12.4	12.1
16APSK- 8/9	13.6	13.3
16APSK- 9/10	-	13.6
32APSK-3/4	-	13.6
32APSK-4/5	-	14.5
32APSK-5/6	-	14.9
32APSK-8/9	-	16.1
32APSK-9/10	-	16.5

Table 13 DVB-S2 Performances at PER 1E-S

DVB DSNG/S performances at BER 1E-7 after RS

	Short Frames	**Normal Frames**
	< 20 Mbaud	< 20 Mbaud
Config	Es/No	Es/No
QPSK- 1/2 -	3.9	3.9
QPSK- 2/3	4.4	4.5
QPSK- 3/4	4.9	5.1
QPSK- 5/6	5.4	5.8
QPSK- 7/8	5.8	6.4
8PSK- 2/3	6.3	6.5
8PSK- 5/6	8.3	8.8
8PSK- 5/6	8.8	9.8
16QAM- 3/4	8.4	8.6
16 QAM 7/8	10.1	11.1

Output interface

- Auto switching 10/100/1000 Base-T Ethernet interface;
- Maximum rate: 133 Mbit/s or 67,000 packets per second;
- Layer 2 bridge mode: Ethernet frames over satellite;
- Layer 3 bridge or router mode: IP packets over satellite;
- Supported encapsulation modes:
  - Data piping:
  - Ultra Lightweight Encapsulation (ULE)
  - Multi Protocol Encapsulation (MPE):
  - Extended Performance Encapsulation (XPE), Newtec's highly efficient encapsulation protocol for the encapsulation of Ethernet/IP frames in DVB-S2 Base-Band frames (optional).
- Data filtering:
  - Up to 32 streams in DVB-S2 multi-stream;
  - Up to 256 configurable PID filters;
  - One air MAC address filter per PID or stream.

Internal Reference frequency

High Stability (optional)

- Stability ±5x10 over 0°C to 70°C;
- Ageing: ± 15 ppb/day ± 300 ppb/year.

Very High Stability (optional)

- Stability: ±2x10 over 0°C to 65°C;
- Ageing: ± 0.5 ppb/day ± 500 ppb/10 year.

Generic

10 MHz reference input / output (optional)

- Connector BNC (F) – 50 ohms;
- Input level -3dbm up to 7dBm;
- Output level +7dBm.

LNB reference frequency output (optional, only available with L-band)

- Frequency 10 MHz;
- Stability +/- 5x10-8 over 0°C to 65°C;
- Warm up time 5 min (+/-100ppb);
- Ageing
  - +/- 15 ppb/day;
  - +/- 300 ppb/year.

Monitor and control interfaces

- Web based GUI;
- Diagnostics report, alarm log;
- RMCP over TCP-IP/UDP and RS232/RS485;
- SNMP v2c.

Alarm interface

- Electrical dual contact closure alarm contacts;
- Connector 9-pin sub-D (F);
- Logical interface and general device alarm.

LNB reference frequency output (optional, only available with L-band)

- Frequency 10 MHz;
- Stability +/- 5x10-8 over 0°C to 65°C;
- Warm up time 5 min (+/-100ppb);
  - ageing +/- 15 ppb/day;
  - +/- 300 ppb/year.

Monitor and control interfaces

- Web based GUI;
- Diagnostics report, alarm log;
- RMCP over TCP-IP/UDP and RS232/RS485;
- SNMP v2c.

Alarm interface

- Electrical dual contact closure alarm contacts;
- Connector 9-pin sub-D (F);
- Logical interface and general device alarm.

Physical

- 1RU, width: 19", depth 51 cm, 6 kg;
- Power supply: 90-130 & 180-260 Vac, 105 VA,47-63 Hz;
- Temperature:
    - Operational: 0°C to 40°C;
    - Storage: -40 to +70°C;
- Humidity: 5% to 85% non-condensing;
- CE label.

EL470 IP Satellite Modem

Input Interface

- Auto switching 10/100/1000 Base-T Ethernet interface;
- Maximum rate: 133 Mbit/s in each direction, or 200Mbit/s Tx+Rx or 67,000 packets per second Tx + Rx;
- Layer 2 bridge mode: Ethernet frames over satellite;
- Layer 3 bridge or router mode: IP packets over satellite;
- Proxy ARP support;
- Base Band Frame input (optional);
- Supported encapsulation modes:
    - Data piping;
    - Ultra Lightweight Encapsulation (ULE);
    - Multi Protocol Encapsulation (MPE) Extended Performance Encapsulation (XPE) - Newtec's highly efficient encapsulation protocol for the encapsulation of Ethernet/IP frames in DVB-S2 Base-Band frames.
- Filtering and routing capabilities:
    - Up to 32 VLAN filters;
    - Up to 255 MAC filters;
    - Up to 255 IP routes/air-MAC addresses;
    - Up to 256 PIDs;
    - Up to 16 DVB-S2 Streams.

Modulation and Demodulation

Supported modulation schemes and FEC

- DVB-S/DSNG:
  Outer/Inner FEC: Reed Solomon /Viterbi
  ModCods:
    - QPSK: 1/2, 2/3, 3/4, 5/6, 7/8
    - 8PSK: 2/3, 5/6, 8/9
    - 16QAM: 3/4, 7/8
- DVB-S2:
  Outer/Inner FEC: BCH/ LDPC
  ModCods:
    - QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
    - 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10
    - 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
    - 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10
- Embedded point-to-point FlexACM controller (optional);
- Support DVB-S2 VCM mode (demod);
- Flex ACM client (optional).

Baud rate range

- DVB-S2:
    - QPSK/8PSK 0,256 – 45 Mbaud;
    - 16APSK 0,256 – 33 Mbaud.
- DVB-S/DSNG:
    - QPSK/8PSK/16QAM 1-45 Mbaud.

Frame length

- DVB-S2 Short Frames 16 200 bit;
- DVB-S2 Normal Frames 64 800 bit;
- DVB-S/DSNG 188 bytes.

Roll-off factor

- 20 % - 25 % - 35 %.

Modulator Interface

L-band output (default):

- Connector SMA (F), 50 ohms;
- Return loss > 14 dB • Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 1750 MHz (50 Hz steps;
- Extended L-band output (optional);
- Connector SMA (F), 50 ohms;
- Return loss > 14 dB;
- Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 2150 MHz (50 Hz steps).

IF-band (optional):

- Connector BNC (F) - 75 ohms (intermateable with 50 ohms);
- Return loss:
  - 50 ohms : > 14 dB;
  - 75 ohms : > 20 dB;
- Level -30/+5 dBm (± 3 dB);
- Frequency 50 - 180 MHz (50 Hz steps).

Roll-off factor

- 20 % - 25 % - 35 %.

Modulator Interface

L-band output (default):

- Connector SMA (F), 50 ohms;
- Return loss > 14 dB • Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 1750 MHz (50 Hz steps.

Extended L-band output (optional)

- Connector SMA (F), 50 ohms;
- Return loss > 14 dB;
- Level -35/+5 dBm (+/- 2dB);
- Frequency 950 - 2150 MHz (50 Hz steps).

IF-band (optional):

- Connector BNC (F) - 75 ohms (intermateable with 50 ohms);
- Return loss
  - 50 ohms : > 14 dB;
  - 75 ohms : > 20 dB;
- Level -30/+5 dBm (± 3 dB);
- Frequency 50 - 180 MHz (50 Hz steps).

L-band monitoring output (default):

- Connector SMA (F), 50 ohms;
- Return loss > 7 dB;
- Level -45 dBm;
- Frequency default: identical to L-band output. with options AA-02 / AA-06: 1080 MHz.

BUC power and reference frequency (optional)

- Max. current 1,5 A;
- Voltage 24V, 48V;
- Frequency 10MHz;
- Stability ±5x10-8 over 0°C to 65°C.

With this option installed, the L-band output connectors become N (F), 50 ohms.

10 MHz reference input / output (optional)

- Connector BNC (F) – 50 ohms;
- Input level -3dbm up to 7dBm;
- Output level +7dBm.

Demodulator Interface

Dual L-band input (default)

- Connector 2 x F-type (F), 75 ohms;
- Return loss > 7 dB;
- Level -65/-25dBm;
- Frequency 950 - 2150 MHz;
- Adjacent signal < (Co+7) dBm/Hz where Co = signal level density.

IF-band input (optional, replaces one L-band input)

- Connector BNC (F) - 75 ohms;
- Return loss > 15 dB;
- Level -55 to -15 dBm;
- Frequency 50 - 180 MHz;
- Adjacent signal < (Co+7) dBm/Hz where Co = signal level density.

***LNB* power and control**

- Max. current 350 mA (on selected IFL input);
- Voltage:
  - 11,5 -14 V (Vertical polarization)
- 16 -19 V (Horizontal polarization) & additional 22kHz +/- 4KHz (band selection according to universal LNB for Astra satellites & DiSEqC command transmission)10 MHz reference.

DVB-S2 performances at PER 1E-S

	Short Frames	Normal Frames
	< 15 Mbaud	< 45 Mbaud
Config	Es/No	Es/No
QPSK- 1/3 -	-0.6	-0.7
QPSK- 2/5	0.4	0.2
QPSK- 1/2	1	1.4
QPSK- 3/5	3.1	2.8
QPSK- 2/3	3.8	3.6
QPSK- 3/4	4.5	4.3
QPSK- 4/5	5.1	5.1
QPSK- 5/6	5.8	5.5
QPSK- 8/9	6.7	6.6
QPSK- 9/10	-	6.7
8PSK- 3/5	6.5	6.3
8PSK- 2/3	7.4	7.1
8PSK- 3/4	8.6	8.4
8PSK- 5/6	10.2	9.7
8PSK- 8/9	11.4	11.1
8PSK- 9/10	-	11.3
16APSK- 2/3	9.9	9.6
16APSK- 3/4	10.9	10.5
16APSK- 4/5	11.6	11.5
16APSK- 5/6	12.4	12.1
16APSK- 8/9	13.6	13.3
16APSK- 9/10	-	13.6
32APSK-3/4	-	13.6
32APSK-4/5	-	14.5
32APSK-5/6	-	14.9
32APSK-8/9	-	16.1
32APSK-9/10	-	16.5

Table 14 - DVB S2 Performances at PER 1E-S

DVB DSNG/S performances at BER 1E-7 after RS

	Short Frames	**Normal Frames**
	< 20 Mbaud	< 20 Mbaud
Config	Es/No	Es/No
QPSK- 1/2 -	3.9	3.9
QPSK- 2/3	4.4	4.5
QPSK- 3/4	4.9	5.1
QPSK- 5/6	5.4	5.8
QPSK- 7/8	5.8	6.4
8PSK- 2/3	6.3	6.5
8PSK- 5/6	8.3	8.8
8PSK- 5/6	8.8	9.8
16QAM- 3/4	8.4	8.6
16 QAM 7/8	10.1	11.1

Table 15 - DVB DSNG/S Performances at BER 1E-7 after RS

Generic

Monitor and control interfaces

- Web based GUI;
- Diagnostics report, alarm log;
- RMCP over TCP-IP/UDP and RS232/RS485;
- SNMP v2c.

Alarm interface

- Electrical dual contact closure alarm contacts;
- Connector 9-pin sub-D (F);
- Logical interface and general device alarm.

Physical

- 1RU, width: 19”, depth 51 cm, 6 kg;
- Power supply: 90-130 & 180-260 Vac, 105 VA,47-63 Hz;
- Temperature
  - Operational: 0°C to 40°C;
  - Storage: -40 to +70°C.
- Humidity: 5% to 85% non-condensing;
- CE label.

APPENDIX D – NORMAL AND SHORT FRAMES AND MIXING FRAMES

Introduction

This section gives some more information on the limitations when using normal, short frames and mixing these frames.

Mixing Frames

The LDPC/BCH decoder processes a frame while receiving the next frame. This processing takes a minimum time and the minimal time is about 4 times longer for a normal frame as for a short frame. As a normal frame is 4 times longer then a short one, this is normal behaviour.

Now an issue can arise when mixing short and normal frames. When a short frame is received, the decoder might be processing a normal frame. So it is clear that the short frame needs to be long enough so that the decoder has the needed time to process the normal frame.

Short frames need about 0.3 dB more margin for the same spectral efficiency. But they are 4 times shorter, so have less latency, which is most visible at low symbol rates.

Rules for Correct Functioning

This following table gives an overview of the maximum baud rates that can be used in the use of short and normal frames and mixing normal and short frames. This with different available ModCods.

- The 32APSK ModCod can never be used for short frames.
- When the maximum symbol rate is higher then 30Mbaud the following ModCods are not possible in ACM:
  - QPSK ¼
  - QPSK 1/3
  - QPSK 2/5

Max Symbol Rate (Mbaud)	Normal Frames	Short Frames	Mix Normal Frames with
< 10	No limitations	No limitations	No limitations
< 15	No limitations	No limitations	QPSK or 8PSK short frames
< 20	No limitations	No limitations	QPSK short frames
< 33	No limitations	No Limitations	Not possible
< 45	32APSK is not possible!	32APSK is not possible!	Not possible

Conclusion

As a general rule, we can say that it is recommended to use normal frames. Short frames however are useful when working with low symbol rates or with latency sensitive applications.

Mixing normal frames and short frames is an exception on the two general rules, so it is not recommended to be used.

APPENDIX E – LIST OF WEAK 64-BIT GROUP KEYS

Some group keys of 64-bit length are refused when you try to use them. Those are:

```
0000000000000000
00001e1e00000e0e
0000e0e00000f0f0
0000fefe0000fefe
001e001e000e000e
001e1e00000e0e00
001ee0fe000ef0fe
001efee0000efef0
00e000e000f000f0
00e01efe00f00efe
00e0e00000f0f000
00e0fe1e00f0fe0e
00fe00fe00fe00fe
00fe1ee000fe0ef0
00fee01e00fef00e
00fefe0000fefe00
1e00001e0e00000e
1e001e000e000e00
1e00e0fe0e00f0fe
1e00fee00e00fef0
1e1e00000e0e0000
1e1e1e1e0e0e0e0e
1e1ee0e00e0ef0f0
1e1efefe0e0efefe
1ee000fe0ef000fe
1ee01ee00ef00ef0
1ee0e01e0ef0f00e
1ee0fe000ef0fe00
1efe00e00efe00f0
1efe1efe0efe0efe
1efee0000efef000
1efefe1e0efefe0e
e00000e0f00000f0
e0001efef0000efe
e000e000f000f000
e000fe1ef000fe0e
e01e00fef00e00fe
e01e1ee0f00e0ef0
e01ee01ef00ef00e
e01efe00f00efe00
e0e00000f0f00000
e0e01e1ef0f00e0e
e0e0e0e0f0f0f0f0
e0e0fefef0f0fefe
e0fe001ef0fe000e
e0fe1e00f0fe0e00
e0fee0fef0fef0fe
e0fefee0f0fefef0
fe0000fefe0000fe
fe001ee0fe000ef0
fe00e01efe00f00e
fe00fe00fe00fe00
fe1e00e0fe0e00f0
fe1e1efefe0e0efe
fe1ee000fe0ef000
fe1efe1efe0efe0e
fee0001efef0000e
fee01e00fef00e00
fee0e0fefef0f0fe
fee0fee0fef0fef0
fefe0000fefe0000
fefe1e1efefe0e0e
fefee0e0fefef0f0
fefefefefefefefe
FFFFFFFFFFFFFFFF
```

APPENDIX F – ABBREVIATIONS

Acronym	Definition
AC	Alternating Current
ACI	Adjacent Channel Interference
ACM	Adaptive Coding Modulation
AES	Advanced Encryption Standard
ALC	Automatic Level Control
APSK	Amplitude and Phase Shift Keying
ARP	Address Resolution Protocol (TCP/IP)
ASI	Asynchronous Serial Interface
BB	Base Band
BBF	Base Band Frame
BCH	Boise Chaudhuri and Hocquengham
BER	Bit Error Rate/Ratio
BNC	Bayonet (Neill Concelman) Connector (for coaxial cable)
BP	Back Panel
BPSK	Binary Phase Shift Keying
BUC	Block Up Converter
CCI	Co-Channel Interference
CCM	Constant Coding and Modulation
CTS	Clear To Send
DC	Direct Current Data Count (in digital data stream)
DES	Data Encryption Standard
DSCP	Differentiated Services Code Point
DSNG	Digital Satellite News Gathering
DTR	Data Terminal Ready
DVB	Digital Video Broadcasting
DVB-S	Digital Video Broadcasting-Satellite
EMC	ElectroMagnetic Compatibility

Acronym	Definition
FCC	Federal Communications Commission
FEC	Forward Error Correction (in data transmission systems)
FTP	File Transfer Protocol (computer networks & systems)
GND	Ground (connection in equipment or circuits)
GSE	Generic Stream Encapsulation
GUI	Graphical User Interface
HSRP	Hot Standby Router Protocol
HTML	HyperText Mark-up Language (used by World-Wide Web Docs)
ID	Identifier
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IGMP	Internet Group Management Protocol
IP	Internet Protocol
ISI	Input Stream Identifier
ITU-T	ITU Telecommunications Standardization Sector
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LME	Link Margin Estimator
LNB	Low noise block downconverter
LO	Local Oscillator
LSB	Least Significant Bit (in digital coding)
M&C	Monitoring and Control
MAC	Medium Access Control
MCPC	Multiple Channel Per Carrier
MIB	Management Information Base
MOD	Modulator
ModCod	Modulation and coding combination
MPE	Multi Protocol Encapsulation
MPEG	Motion Picture Experts Group
NEC	National Electrical Code
NMS	Network Management System

Acronym	Definition
PC	Personal Computer
PER	Packet Error Rate
PHY	Physical Layer
PID	Packet Identifier
PSU	Power Supply Unit
QEF	Quasi Error Free
QOS	Quality Of Service
QPSK	Quadrature Phase Shift Keying
RMCP	Remote Monitor and Control Protocol
ROHS	Restriction Of Hazardous Substances
RS	Reed Solomon
RX	Receive
SNMP	Simple Network Management Protocol
SNDU	SubNetwork Data Unit
SVHC	Substances of Very High Concern
SCPC	Single Channel Per Carrier
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
VA	Volt-ampere
VCM	Variable Coding and Modulation
VLAN	Virtual Local Area Network
VRRP	Virtual Router Redundancy Protocol
WI	Web Interface
XPE	Extended Performance Encapsulation