

Alcatel·Lucent



9500 MPR

Indoor: MSS-8/MSS-4 + Outdoor: ODU300 / MPT-HC / MPT-HC V2 / MPT-MC

Rel. 3.1

User Manual

3DB18809AAAA

Issue 1

May 2011

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3DB18809AAAA
Issue 1
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PREFACE

Preliminary Information

WARRANTY

Any warranty must be referred exclusively to the terms of the contract of sale of the equipment to which this handbook refers to.

Alcatel-Lucent makes no warranty of any kind with regards to this manual, and specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Alcatel-Lucent will not be liable for errors contained herein or for damages, whether direct, indirect, consequential, incidental, or special, in connection with the furnishing, performance, or use of this material.

INFORMATION

The product specification and/or performance levels contained in this document are for information purposes only and are subject to change without notice. They do not represent any obligation on the part of Alcatel-Lucent.

COPYRIGHT NOTIFICATION

The technical information of this manual is the property of Alcatel-Lucent and must not be copied, reproduced or disclosed to a third party without written consent.

SAFETY RECOMMENDATIONS

The safety recommendations here below must be considered to avoid injuries on persons and/or damage to the equipment:

- 1) **Service Personnel**
Installation and service must be carried out by authorized persons having appropriate technical training and experience necessary to be aware of hazardous operations during installation and service, so as to prevent any personal injury or danger to other persons, as well as prevent-damaging the equipment.
- 2) **Access to the Equipment**
Access to the Equipment in use must be restricted to Service Personnel only.
- 3) **Safety Rules**
Recommended safety rules are indicated in Chapter 1 from page 31.

Local safety regulations must be used if mandatory. Safety instructions in this handbook should be used in addition to the local safety regulations. In case of conflict between safety instructions stated in this manual and those indicated in local regulations, mandatory local norms will prevail. Should not local regulations be mandatory, then safety rules stated in this manual will prevail.

SERVICE PERSONNEL SKILL

Service Personnel must have an adequate technical background on telecommunications and in particular on the equipment subject of this handbook.

An adequate background is required to properly install, operate and maintain equipment. The fact of merely reading this handbook is considered as not enough.

Applicability

This handbook applies to the following product-release:

PRODUCT	
9500 MPR	
PRODUCT	RELEASE
MSS-8/MSS-4 + ODU300/MPT-HC/MPT-HC V2/MPT-MC	3.1.0

Scope

This document aims to describe the hardware and software functionalities of the 9500 MPR-E.

This document is intended to the technicians involved in Planning, in Operation and Maintenance and in Commissioning of the 9500 MPR-E.

History

ISSUE	DATE	DESCRIPTIONS
01	May 2011	

Change notes

Handbook Structure

This handbook has been edited according to the Alcatel-Lucent standardized "drawing-up guides" complying with such suggestion.

This handbook is divided into the main topics described in the table of contents:

PREFACE	It contains general information as preliminary information, handbook scope, history. Furthermore, it describes the handbook structure and the customer documentation.
SAFETY	This section includes all the safety instructions.
PRODUCT INFORMATION AND PLANNING	This section provides the equipment description (at system, MSS and ODU levels), introduces the basic information regarding the HW architecture, and gives its technical characteristics.
NE MANAGEMENT BY SOFTWARE APPLICATIONS	This section gives the description and use of the SW tools available for the NE management.
INSTALLATION	<p>This section provides whole information regarding Equipment hardware installation.</p> <p>Moreover, it contains the whole operative information on:</p> <ul style="list-style-type: none"> – provisioning of equipment items (P/Ns, equipping rules) – their physical position in the system – unit assembly and front panel drawings, with the description on the access point usage (connectors, visual indicators, buttons). <p>This section provides also the whole operative instructions for the preparation of the WebEML for the Line-Up and Commissioning of the two NEs making up the radio link.</p>
PROVISIONING	This section gives all the instructions to provision (to configure) the NE.
MAINTENANCE AND TROUBLE-CLEARING	This section contains the whole logical and operative information for the equipment maintenance and system upgrade.
LINE-UP AND COMMISSIONING	This section provides all the instructions for the line-up and commissioning of the NE.
ABBREVIATIONS	The abbreviation list is supplied.
CUSTOMER DOCUMENTATION FEEDBACK	It contains info regarding customer opinions collection about this documentation.

General on Alcatel-Lucent Customer Documentation

This paragraph describes in general the Alcatel-Lucent Customer Documentation system, details the association between the product levels and the associated documentation, and explains Customer Documentation characteristics as well as the policies for its delivery and updating.

Customer-Independent Standard Customer Documentation

a) **Definition**

Standard Customer Documentation, referred to hereafter, must be always meant as plant-independent and is always independent of any Customization.

Plant-dependent and/or Customized documentation, if envisaged by the contract, is subjected to commercial criteria as far as contents, formats and supply conditions are concerned.

N.B. Plant-dependent and Customized documentation is not described here.

b) **Aims of standard Customer Documentation**

Standard system, hardware and software documentation is meant to give the Customer personnel the possibility and the information necessary for installing, commissioning, operating, and maintaining the equipment according to Alcatel-Lucent Laboratory design and Installation Dept. choices. In particular:

- the contents of the chapters associated to the software applications focus on the explanation of the man-machine interface and of the operating procedures allowed by it;
- maintenance is described down to faulty PCB location and replacement.

N.B. No supply to Customers of design documentation (like PCB hardware design and production documents and files, software source programs, programming tools, etc.) is envisaged.

Product levels and associated Customer Documentation

a) **Products**

A "product" is defined by the network hierarchical level where it can be inserted and by the whole of performances and services that it is meant for.

E.g. 9500 MPR-E is a product.

b) **Product-releases**

A "product" evolves through successive "**product-releases**", which are the real products marketed for their delivery at a certain "product-release" availability date. A certain "product-release" performs more functionalities than the previous one.

E.g. Rel.1.0 and Rel.2.0 are two successive "product-releases" of the same "product".

A "product-release" comprehends a set of hardware components and at least one "**Software Package**" (**SWP**); as a whole, they identify the possible network applications and the equipment performances that the specific "product-release" has been designed, engineered, and marketed for.

c) **Configurations and Network Elements**

In some cases, a "product-release" includes different possible "**configurations**" which are distinguished from one another by different "**Network Element**" (NE) types and, from the management point of view, by different SWPs.

d) **SWP releases, versions, and CD-ROMs**

- Each SWP is distributed by means of a specific SWP CD-ROM.
- A SWP is identified by its "Denomination", "P/N" (Part Number) and "CS" (Change Status), that are printed on the CD-ROM's label:
 - the first and second digits of the "Denomination" (e.g. 2.0) correspond to the "HW product-release" number;
 - the third digit of the of the "Denomination" (e.g. 2.0.2) identifies the Version Level of the SWP.

- A SWP with new Version Level, providing main features in addition to those of the previous Version Level SWP, is distributed by means of a SWP CD-ROM having new "Denomination", "P/N" (Part Number), and "CS" restarting from 01
- A SWP patch version, if any, is created to correct SW bugs, and/or to add minor features, and is distributed by means of a SWP CD-ROM, that can be identified:
 - by the same "P/N" of the former CD-ROM, but with an incremented "CS" number (e.g. CS=02 instead of previous CS=01)
 - or by a new "P/N", and "CS" restarting from 01.

Handbook Updating

The handbooks associated to the "product-release" are listed in "History" on page 24.

Each handbook is identified by:

- the name of the "product-release" (and "version" when the handbook is applicable to the versions starting from it, but not to the previous ones),
- the handbook name,
- the handbook Part Number,
- the handbook edition (usually first edition=01),
- the handbook issue date. The date on the handbook does not refer to the date of print but to the date on which the handbook source file has been completed and released for the production.

Changes introduced in the same product-release (same handbook P/N)

The edition and date of issue might change on future handbook versions for the following reasons:

- only the date changes (pointed out in the Table of Contents) when modifications are made to the editorial system not changing the technical contents of the handbook.
- the edition, hence the date, is changed because modifications made concern technical contents. In this case:
 - the changes with respect to the previous edition are listed in "History" on page 24;
 - in affected chapters, revision bars on the left of the page indicate modifications in text and drawings.

Changes concerning the technical contents of the handbook cause the edition number increase (e.g. from Ed.01 to Ed.02). Slight changes (e.g. for corrections) maintain the same edition but with the addition of a version character (e.g. from Ed.02 to Ed.02A). Version character can be used for draft or proposal editions.



NOTES FOR HANDBOOKS RELEVANT TO SOFTWARE APPLICATIONS

Handbooks relevant to software applications (typically the Operator's Handbooks) are not modified unless the new software "version" distributed to Customers implies man-machine interface changes or in case of slight modifications not affecting the understanding of the explained procedures.

Moreover, should the screen prints included in the handbook contain the product-release's "version" marking, they are not replaced in the handbooks related to a subsequent version, if the screen contents are unchanged.

Supplying updated handbooks to Customers

Supplying updated handbooks to Customers who have already received previous issues is submitted to commercial criteria.

By updated handbook delivery it is meant the supply of a complete copy of the handbook new issue (supplying errata-corrige sheets is not envisaged).

Changes due to new product version

A new product version changes the handbook P/N and the edition starts from 01.
In this case the modified parts of the handbook are not listed.

Customer documentation on CD-ROM

In the following by 'CD-ROM' it is meant 'Customer Documentation on CD-ROM'

Contents, creation and production of a CD-ROM

In most cases, a CD-ROM contains in read-only electronic format the documentation of one product-release(-version) and for a certain language.

In some other cases, the same CD-ROM can contain the documentation of different product-release(-version)s for a certain language.

As a general rule:

- CD-ROMs for Network Management products do not contain:
 - the Installation Guides
 - the documentation of system optional features that Customers could not buy from Alcatel-Lucent together with the main applicative SW.
- CD-ROMs for Network Elements products do not contain:
 - the documentation of system optional features (e.g. System Installation Handbooks related to racks that Customers could not buy from Alcatel-Lucent together with the main equipment).

A CD-ROM is obtained collecting various handbooks and documents in .pdf format. Bookmarks and hyperlinks make the navigation easier. No additional information is added to each handbook, so that the documentation present in the CD-ROMs is exactly the same the Customer would receive on paper.

The files processed in this way are added to files/images for managing purpose and a master CD-ROM is recorded.

Suitable checks are made in order to have a virus-free product.

After a complete functional check, the CD-ROM image is electronically transferred to the archive of the Production Department, so that the CD-ROM can be produced and delivered to Customers.

Use of the CD-ROM

The CD-ROM can be used both in PC and Unix WS environments.

The CD-ROM starts automatically with autorun and hyperlinks from the opened "Index" document permit to visualize the .pdf handbooks

Other hyperlinks permit to get, from the Technical handbooks, the specific .pdf setting documents.

In order to open the .pdf documents Adobe Acrobat Reader Version 4.0 (minimum) must have been installed on the platform.

The CD-ROM doesn't contain the Adobe Acrobat Reader program. The Customer is in charge of getting and installing it.

ReadMe info is present on the CD-ROM to this purpose.

Then the Customer is allowed to read the handbooks on the PC/WS screen, using the navigation and zooming tools included in the tool, and to print selected parts of the documentation through a local printer.

CD-ROM identification

Each CD-ROM is identified:

- 1) by external identifiers, that are printed on the CD-ROM upper surface:
 - the name of the "product-release(s)" (and "version" if applicable)
 - a writing indicating the language(s),
 - the CD-ROM Part Number),
 - the CD-ROM edition (usually first edition=01)

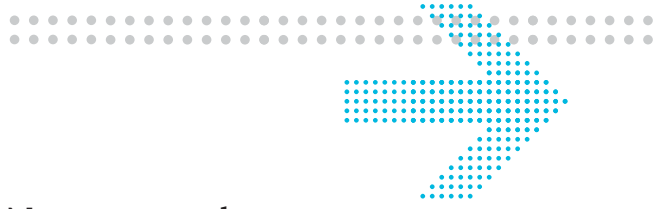
- 2) and, internally, by the list of the source handbooks and documents (P/Ns and editions) by whose collection and processing the CD-ROM itself has been created.

CD-ROM updating

The list of source handbook/document P/Ns-editions indicated in previous para. point 2) , in association with the CD-ROM's own P/N-edition, is also loaded in the Alcatel-Information-System as a structured list. Whenever a new edition of any of such handbooks/documents is released in the Alcatel-Lucent archive system, a check in the Alcatel-Information-System is made to identify the list of CD-ROMs that must be updated to include the new editions of these handbooks/documents.

This causes the planning and creation of a new edition of the CD-ROM.

Updating of CD-ROMs always follows, with a certain delay, the updating of the single handbooks composing the collection.



1 Safety, EMC, EMF, ESD Norms and Equipment Labelling

This chapter describes the equipment labelling and the norms mandatory or suggested that must be considered to avoid injuries on persons and/or damage to the equipment.

This chapter is organized as follows:

- Declaration of conformity to CE marking and Countries List
- Specific label for MPR-E equipment
- Applicable standards and recommendations
- Safety Rules
- Electromagnetic Compatibility (EMC norms)
- Equipment protection against electrostatic discharges
- Cautions to avoid equipment damage

1.1 Declaration of conformity to CE marking and Countries List

DECLARATION OF CONFORMITY

We,

ALCATEL LUCENT ITALIA S.P.A.
Piazza della Repubblica, 25
20124 MILANO
Italy

declare, under our sole responsibility that the product:

ALCATEL LUCENT 9500 MPR

Outdoor unit frequency ranges	5.925 – 6.425 GHz 7.125 - 7.9 GHz 7.7225 - 8.5 GHz 10.5 GHz 10.7 - 11.7 GHz 12.75 - 13.25 GHz 14.4 - 15.35 GHz 17.7 GHz – 19.7 GHz 21.2 - 23.6 GHz 24.5 - 26.4 GHz 27.500 – 29.520 GHz 31.8 – 33.4 GHz 37.0 - 39.46 GHz
Capacity Range Options (E1)	4x, 8x, 13x, 18x, 27x, 37x, 48x, 56x, 68x, 136x E1
Capacity Range Options (Ethernet)	10, 20, 40, 60, 80, 100, 125, 150, 300 Mbit/s
Interfaces	1 ÷ 4x 10/100/1000 baseT
Power supply	-40,5 to -57,6 VDC
Modulation	4 - 16 - 32 - 64 - 128 QAM

to which this declaration relates is in conformity, provided that it is installed and maintained in accordance with the "state of the art", manufacturer's instructions and provided that it is used under normal conditions, with the requirements of the following European Directive :

1999/5/CE of 09 March 1999, - Annex III (Directive on radio equipment and telecommunications terminal equipment : R&TTE Directive).

Applicable standards and recommendations under the scope of this Directive

- Safety requirements: EN 60950 : 2001
+ A11:2004 to EN 60950 : 2001
EN 60825-1:2001
EN 60825-2:2007
EN 50385 : 2002
- EMC requirements: EN 301 489-1 V1.6.1 (09/2005)
EN 301 489-4 V1.3.1 (08/2002)
- Spectrum requirements: EN 302 217-2-2 V1.2.3 (09/2007)

Vimercate, 25 March 2009

**Business Development
&
Global Support**

(Function of the authorised person)

A. VALSECCHI

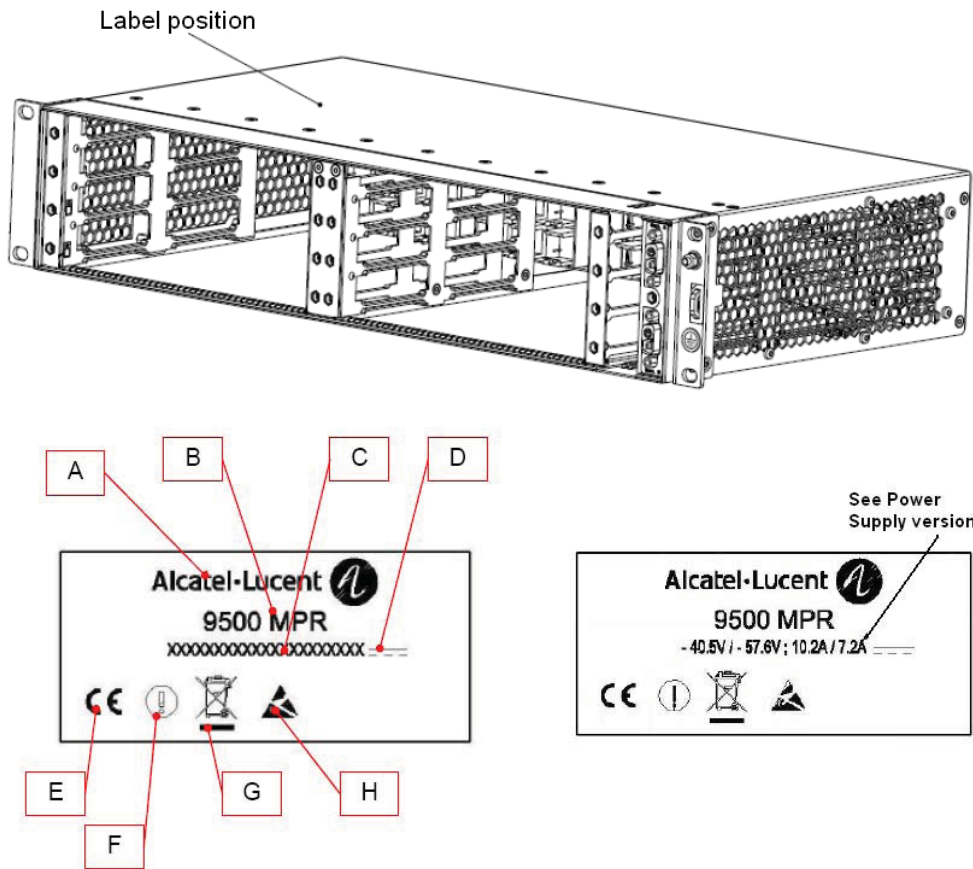
(Name of the authorised person)

(Signature)

Indication of the countries where the equipment is intended to be used: Austria (AT) - Belgium (BE) - Bulgaria (BG) - Switzerland/Liechtenstein (CH) - Cyprus (CY) - Czech Republic (CZ) - Germany (DE) - Denmark (DK) - Estonia (EE) - Finland (FI) - France (FR) - Greece (GR) - Hungary (HU) – Italy (IT) - Ireland (IE) - Iceland (IS) - Lithuania (LT) – Luxembourg (LU) - Latvia (LV) - Malta (MT) - Netherlands (NL) - Norway (NO) –Poland (PL) – Portugal (PT) - Romania (RO) – Spain (SP) - Sweden (SE) - Slovenia (SI) - Slovak Republic (SK) -United Kingdom (UK)

Indication of the intended use of the equipment: Point to Point PDH/Ethernet Transport radio Link

1.2 Specific label for MPR-E equipment



Field	Field Name	Note
A	Alcatel-Lucent Logo	
B	Equipment acronym	
C	Power Supply Version MSS-8	See NB 1
	Power Supply Version MSS-4	See NB 2
D	Feeding to continuous current	
E	European Community Logo	
F	Not harmonized frequency logo	
G	WEEE Logo	
H	Electrostatic Device Logo	

NB1: - 40.5V / - 57.6V ; 10.2A / 7.2A

NB2: - 40.5V / - 57.6V ; 7.2A / 5.0A

1.3 Applicable standards and recommendations

1999/5/CE of 09 March 1999

Safety: EN 60950, EN 60825-1, EN 60825-2, EN 50385

EMC: EN 301 489-1, EN 301 489-4

Spectrum: EN 302 217-2-2

1.4 Safety Rules

WARNING

Equipment intended for installation in Restricted Access Location

WARNING

Equipment is only to be accessed by trained service personnel

1.4.1 General Rules

Before carrying out any installation, turn-on, tests or operation and maintenance operations, read carefully the related sections of this Manual, in particular:

- Hardware Installation
- Commissioning
- Maintenance and Upgrade

Observe safety rules

- When equipment is operating nobody is allowed to have access inside on the equipment parts which are protected with Cover Plate Shields removable with tools.
- In case of absolute need to have access inside, on the equipment parts when it is operating this is allowed exclusively to service personnel, where for Service Personnel or Technical assistance is meant:
 - "personnel which has adequate Technical Knowledge and experience necessary to be aware of the danger that he might find in carrying out an operation and of the necessary measurements to reduce danger to minimum for him and for others".
 - The Service Personnel can only replace the faulty units with spare parts.
 - The Service Personnel is not allowed to repair: hence the access to the parts no specified is not permitted.
 - The keys and/or the tools used to open doors, hinged covers to remove parts which give access to compartments in which are present high dangerous voltages must belong exclusively to the service personnel.

- For the eventual cleaning of the external parts of the equipment, absolutely do not use any inflammable substance or substances which in some way may alter the markings, inscriptions ect.
- It is recommended to use a slightly wet cleaning cloth.

The Safety Rules stated in the handbook describe the operations and/or precautions to observe to safeguard service personnel during the working phases and to guarantee equipment safety, i.e., not exposing persons, animals, things to the risk of being injured/damaged.

Whenever the safety protection features have been impaired, REMOVE POWER.

To cut off power proceed to switch off the power supply units as well as cut off power station upstream (rack or station distribution frame).

The safety rules described in this handbook are distinguished by the following symbol and statement:



1.4.2 Labels Indicating Danger, Forbiddance, Command

It is of utmost importance to follow the instructions printed on the labels affixed to the units and assemblies.

- dangerous electrical voltages
- harmful optical signals
- risk of explosion
- moving mechanical parts
- heat-radiating Mechanical Parts
- microwave radiations

Pay attention to the information stated in the following, and proceed as instructed.

Note

The symbols presented in following paragraphs are all the possible symbols that could be present on Alcatel-Lucent equipment, but are not all necessarily present on the equipment this handbook refers to.

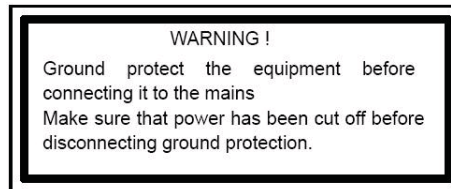
Dangerous Electrical Voltages

[1] Labeling

The following warning label is affixed next to dangerous voltages (>42.4 Vp; >60 Vdc).



If it is a Class 1 equipment connected to mains, then the label associated to it will state that the equipment will have to be grounded before connecting it to the power supply voltage, e.g.:



[2] Safety instructions

DANGER! Possibility of personal injury:

Carefully observe the specific procedures for installation / turn-up and commissioning / maintenance of equipment parts where D.C. power is present, described in the relevant installation / turn-up and commissioning / maintenance documents and the following general rules:

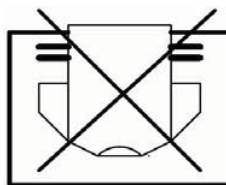
- Personal injury can be caused by -48VDC. Avoid touching powered terminals with any exposed part of your body.
- Short circuiting, low-voltage, low-impedance, DC circuits can cause severe arcing that can result in burns and/or eye damage. Remove rings, watches, and other metal jewelry before working with primary circuits. Exercise caution to avoid shorting power input terminals.

Risks of Explosions: labeling and safety instructions

This risk is present when batteries are used, and it is signaled by the following label:



Therefore, slits or apertures are made to let air circulate freely and allow dangerous gasses to down flow (battery-emitted hydrogen). A 417-IEC-5641 Norm. compliant label is affixed next to it indicating that the openings must not be covered up.



Moving Mechanical Parts: labeling and safety instructions

The following warning label is affixed next to fans or other moving mechanical parts:



Before carrying out any maintenance operation see that all the moving mechanical parts have been stopped.

Equipment connection to earth

Terminals for equipment connection to earth , to be done according to international safety standards, are pointed out by the suitable symbol:



The position of earth connection terminals is specified in the Hardware Installation section.

Heat-radiating Mechanical Parts: labeling and safety instructions

The presence of heat-radiating mechanical parts is indicated by the following warning label in compliancy with IEC 417 Norm, Fig.5041:



DANGER! Possibility of personal injury:

Carefully observe the specific procedures for installation / turn-up and commissioning / maintenance of equipment parts where heat-radiating mechanical parts are present, described in the relevant installation / turn-up and commissioning / maintenance documents and the following general rule:

Personal injury can be caused by heat. Avoid touching powered terminals with any exposed part of your body.

Optical safety

The equipment contains Class 1 laser component according to IEC 60825-1 (par. 5).

CLASS 1 LASER PRODUCT

The laser source is placed in the optional SFP plug-in, which has to be installed in the Core-E unit. The laser source is placed in the left side of the SFP plug-in.

According to the IEC 60825-1 the explanatory label is not stucked on the equipment due to the lack of space.

Microwave radiations (EMF norms)

Equipment emitting RF power (Reminder from site preparation procedure):

The site must be compliant with ICNIRP guidelines or local regulation if more restrictive.

The following rules should be strictly applied by Customer:

- Non authorized persons should not enter the compliance boundaries, if any, for the general public.
- Compliance RF boundaries, if any, related to Electro Magnetic Field exposure must be marked.
- Workers should be allowed to switch-off the power if they have to operate inside compliance boundaries.
- Assure good cable connection.
- Install the antenna as high as possible from floor or area with public access (if possible the cylinder delimitating the compliance boundaries, if any, or the cylinder corresponding to the transmission area directly in front of antenna with the same diameter as the antenna, more than 2 meters high).
- Install the antenna as far as possible from other existing equipment emitting RF power.

Anyway remind that someone standing in front of the 9500 MPR-E antenna may cause traffic shutdown.

Place the relevant stickers:



EMF emission warning sign

On the site when applicable (when people can cross the compliance boundaries and/or the transmission area of the antenna, i.e. roof top installation)

- Warning label "Do not stand on the antenna axis"

On the mast (front side)

- EMF emission warning sign (Yellow and black) to be placed at bottom of antenna, visible by someone moving in front of the antenna (roof top installation)

On the antenna (rear side)

- EMF emission warning sign, placed on the antenna.

1.5 Electromagnetic Compatibility (EMC norms)

The equipment's EMC norms depend on the type of installation being carried out (cable termination, grounding etc.,) and on the operating conditions (equipment, setting options of the electrical/electronic units, presence of dummy covers, etc.).

Before carrying out any installation, turn-on, tests & operation and maintenance operations, read carefully the related sections of this Manual, in particular:

- Hardware Installation
- Maintenance and Upgrade

The norms set down to guarantee EMC compatibility, are distinguished inside this Manual by the symbol and term:

ATTENTION

EMC Norms

[1] EMC General Norms - Installation

- All connections (towards the external source of the equipment) made with shielded cables use only cables and connectors suggested in this Manual or in the relevant Plant Documentation, or those specified in the Customer's "Installation Norms" (or similar documents)
- Shielded cables must be suitably terminated
- Install filters outside the equipment as required
- Ground connect the equipment utilizing a conductor with proper diameter and impedance
- Mount shields (if utilized), previously positioned during the installation phase, but not before having cleaned and degrease it.
- Before inserting the shielded unit proceed to clean and degrease all peripheral surfaces (contact springs and connection points, etc.)
- Screw fasten the units to the subrack.
- To correctly install EMC compatible equipment follow the instructions given.

[2] EMC General Norms - Turn-on, Tests & Operation

- Preset the electrical units as required to guarantee EMC compatibility
- Check that the equipment is operating with all the shields properly positioned (dummy covers, ESD connector protections, etc.)
- To properly use EMC compatible equipment observe the information given

[3] EMC General Norms - Maintenance

- Before inserting the shielded unit, which will replace the faulty or modified unit, proceed to clean and degrease all peripheral surfaces (contact springs and connection points, etc.)
- Clean the dummy covers of the spare units as well.
- Screw fasten the units to the subrack.

1.6 Equipment protection against electrostatic discharges

Before removing the ESD protections from the monitors, connectors etc., observe the precautionary measures stated. Make sure that the ESD protections have been replaced and after having terminated the maintenance and monitoring operations.

Most electronic devices are sensitive to electrostatic discharges, to this concern the following warning labels have been affixed:



Observe the precautionary measures stated when having to touch the electronic parts during the installation/maintenance phases.

Workers are supplied with anti static protection devices consisting of:

- an elasticized band worn around the wrist
- a coiled cord connected to the elasticized band and to the stud on the subrack

1.7 Cautions to avoid equipment damage

a. Anti static protection device kit

Whenever is necessary to handle spare parts and cards out of their own box, this kit (Illustration below) must be always worn and its termination must be connected to a grounded structure, to avoid the possible damage of the electronic devices for electrostatic discharges.

Anti static protection device kit



b. Screw fixing

In normal operation conditions, all screws (for unit box closing, cable fixing, etc.) must be always tightened to avoid item detachment and to ensure the equipment EMI-EMC performance.

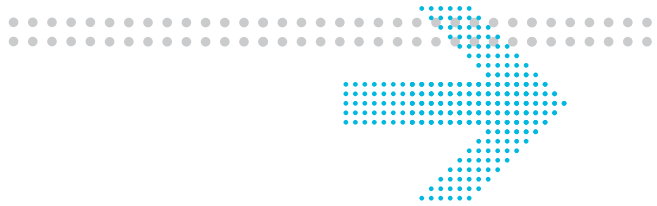
The screw tightening torque must be:

$$2.8 \text{ kg x cm (0.28 Newton x m)} \pm 10 \%$$
$$2.4317 \text{ in lb (0.2026 ft lb)} \pm 10 \%$$

Exceeding this value may result in screw breaking.

c. MSS-ODU cable disconnection / connection

Before to disconnect or connect the MSS-ODU cable (at MSS or ODU side) switch off the corresponding MSS Unit.



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2.1 Purpose and Function

The 9500 Microwave Packet Radio (MPR) is a microwave digital radio that supports PDH, SDH and packet data (Ethernet) for migrating to IP. The 9500 MPR-E provides a generic, modular IP platform for multiple network applications (including 2G/3G/HSDPA/WiMAX backhauling to Metro Ethernet areas) to accommodate broadband services. The 9500 MPR-E radio family supports low, medium, and high capacity applications using European data rates, frequencies, channel plans, and tributary interfaces.

- TDM/PDH Data Rates: E1
- SDH Data Rates: STM-1
- ATM Data Rates: E1
- Ethernet Data Speed: 10, 100, 1000 Mb/s
- RF Frequency Range: 6 to 38 GHz

2.1.1 Innovative solutions

The 9500 MPR-E innovative solutions mainly are:

- [1] **Multiservice aggregation layer:** the capacity to use Ethernet as a common transmission layer to transport any kind of traffic, independently by the type of interface. Ethernet becomes the convergence layer.
- [2] **Service awareness:** traffic handling and quality management, queuing traffic according to the type of service assigned, independently by the type of interface
- [3] **Packet node:** no service aggregation limits with all traffic aggregated in packets, in term of: capacity, type of service requirements and type of interface
- [4] **Service-driven adaptive modulation:** fully exploit the air bandwidth in its entirety by changing modulation scheme according to the propagation availability and allocate transport capacity, discriminating traffic by different services, only possible in a packet-based environment.

[1] Multiservice aggregation layer

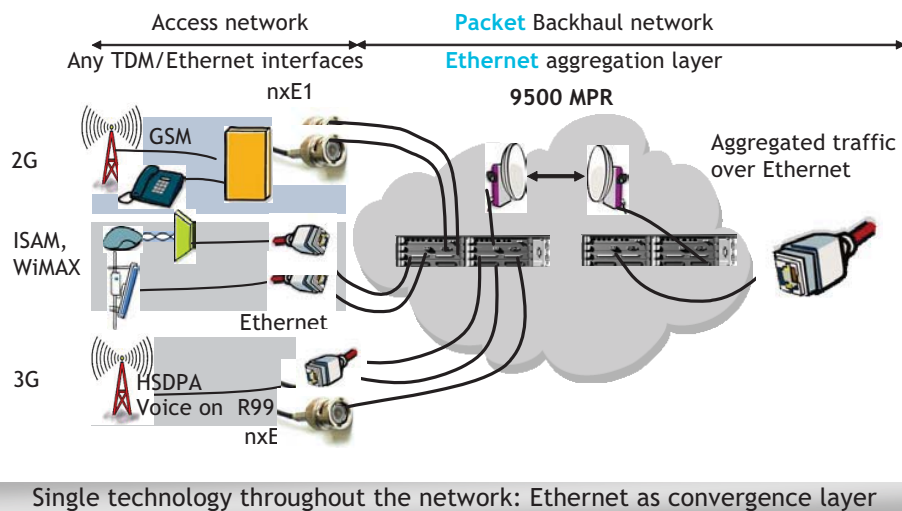


Figure 1. Multiservice Aggregation Layer

9500 MPR-E aggregates and carries over a **COMMON PACKET LAYER**: TDM 2G, 3G and IP/Ethernet. This allows sharing of common packet transmission infrastructures, regardless of the nature of carried traffic.

Due to the nature of Ethernet, each service can be discriminated based on several parameters like quality of service.

Mapping different access technologies over Ethernet is achieved by standardized protocols like circuit emulation and pseudo-wire.

[2] Service awareness

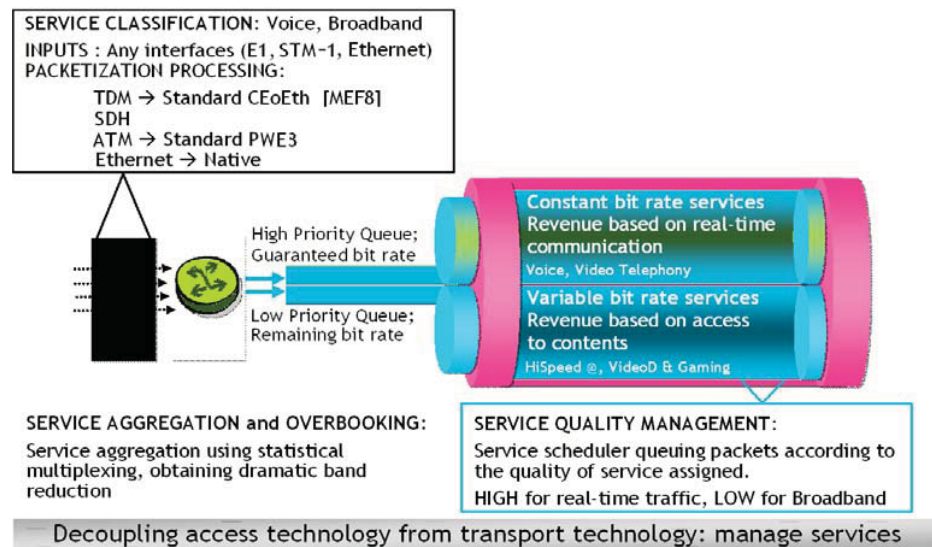


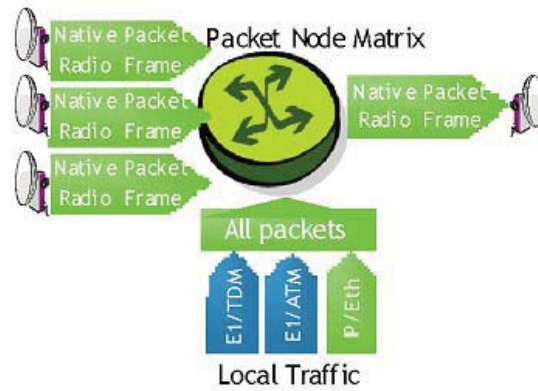
Figure 2. Service Awareness

Service awareness means the ability to discriminate the different traffic types carried over the converged Ethernet stream. The traffic flow can be composed by E1, STM-1, ATM and/or IP/Eth, coming from different sources, and therefore having different requirements.

For instance ATM traffic from a 3G base stations can carry voice (high priority, real time service) and data (lower priority and possibly non real time with high variability load, such as internet browsing, music download or video streaming).

Service awareness is what allows identifying the traffic types, and in case of the non real time variable bit rate one, optimize the band with overbooking of the radio scarce resource.

[3] Packet node



Address new data services in the best way: packet natively

Figure 3. Packet Node

9500 MPR-E offers a **SINGLE PACKET MATRIX** able to switch, aggregate and handle any of the possible incoming traffic types with virtually no capacity limits (up to 10 GBps).

[4] Service-driven adaptive modulation



Figure 4. Service-driven Packet Adaptive Modulation

Traffic with high priority will always have bandwidth available, like voice (deterministic approach).

Broadband traffic is discriminated by QoS dynamically, with modulation scheme changes driven by propagation conditions.

2.1.2 Description

The 9500 MPR-E consists of a Microwave Service Switch (MSS) and Outdoor Unit (ODU).

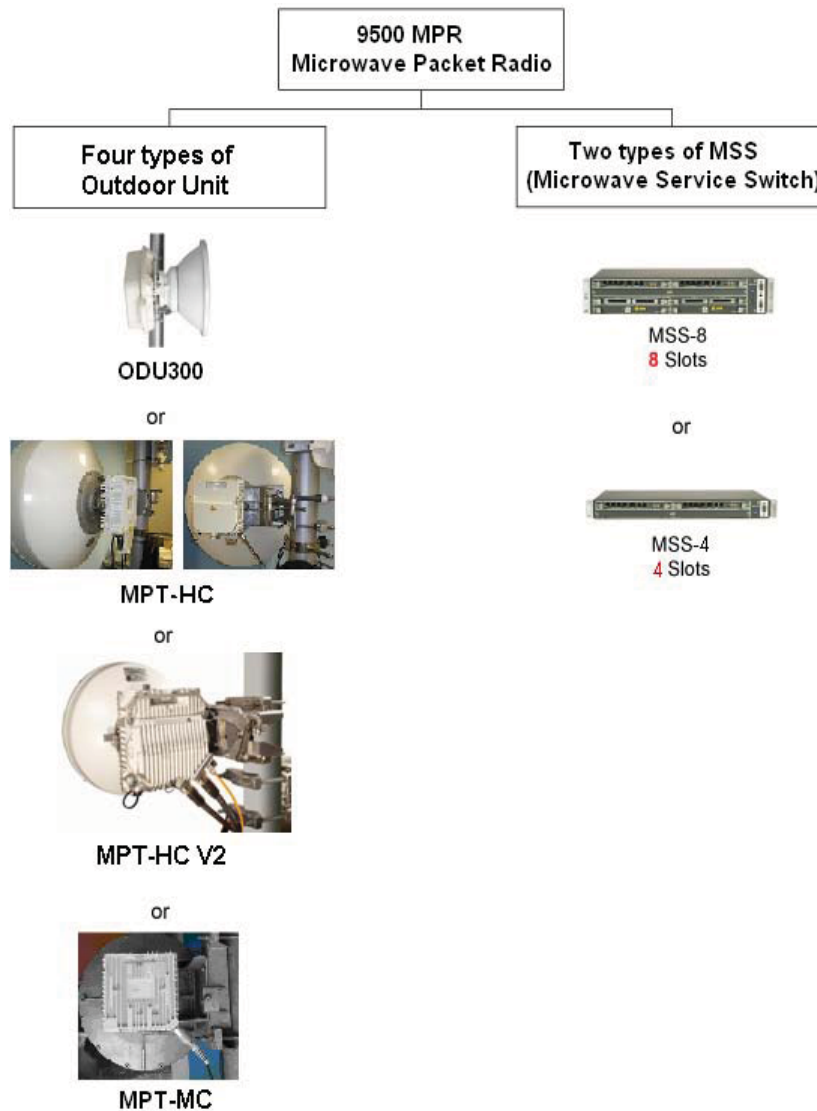


Figure 5. Naming Convention

For the interconnections between the MSS and the Outdoor Units refer to paragraph 2.1.10 on page 58.

Note: Another type of MSS is available (MSS-1c), which is described in a dedicated User Manual.

2.1.3 MSS Purpose, Function and Description

The MSS shelf houses the indoor cards. It is available in two versions:

- MSS-8
- MSS-4

The MSS provides cross-connection, port aggregation, switching, and equipment management.

The MSS shelf consists of card cage and backplane in which mounts access and radio peripheral and Core-E control plug-in cards (see Figure 6. and Figure 7.).

Slot #1: Main Core-E module	Slot #2: Spare Core-E module	Slot #9: FANS module
Slot #3: Transport module	Slot #4: Transport module	
Slot #5: Transport module	Slot #6: Transport module	
Slot #7: Transport module	Slot #8: Transport module or AUX peripheral module	

Figure 6. MSS-8 shelf

Slot #1: Main Core-E module	Slot #2: Spare Core-E module	Slot #5: FANS module
Slot #3: Transport module	Slot #4: Transport module or AUX peripheral module	

Figure 7. MSS-4 shelf

The **Core-E** modules provide six Ethernet user interfaces (4 electrical interfaces as default + 2 electrical/optical interfaces available with optional SFP. Note: for the available SFPs refer to par. 2.8.1.3), the local WebEML interface and the local debug interface.

The Main Core-E and the Spare Core-E modules have a different role.

The **Main Core-E** is always provided. It performs key node management and control functions, and provides various dc rails from the -48 Vdc input. It also incorporates a plug-in flash card, which holds node configuration and license data.

The Main Core-E also includes the cross-connection matrix, which implements all the cross-connections between the Transport modules, between the Ethernet user ports and between the Ethernet user ports and the Transport modules. The matrix is a standard Ethernet switch, based on VLAN, assigned by the WebEML.

The Ethernet ports of the Core-E can be configured in 2 ways:

- 1) to be used as GigaEthernet interface for Ethernet traffic (Note: for port#5 and port#6 the optional SFP must be installed);
- 2) to be used to connect an MPT: MPT-HC or MPT-MC to port#1 to port#4; an MPT-HC only to port#5 and port#6.

The **Spare Core-E** is an optional unit to provide aggregated traffic protection and control platform protection.

The following **Transport** modules are supported:

- **TDM 32E1/DS1 local access** module: provides the external interfaces for up to 32x E1 tributaries, manages the encapsulation/reconstruction of PDH data to/from standard Ethernet packets and sends/receives standard Ethernet packets to/from both Core-E modules; it contains the switch for the EPS Core-E protection and the DC/DC converter unit.
- **STM-1 local access** module: provides the external interfaces for up to 2 electrical or optical STM-1 signals, manages the encapsulation/reconstruction of SDH data to/from standard Ethernet packets and sends/receives standard Ethernet packets to/from both Core-E modules; it contains the switch for the EPS Core-E protection and the DC/DC converter unit.
- **ASAP** module: provides the external interfaces for up to 16x E1 tributaries carrying ATM cells, manages the encapsulation/reconstruction of ATM cells (according to the PWE3 standard) to/from standard Ethernet packets and sends/receives standard Ethernet packets to/from both Core-E modules; it contains the DC/DC converter unit.
- **ODU300 Access** module: this module is used to interface one ODU300. It sends/receives standard Ethernet packets to/from both Core-E modules, manages the radio frame (on Ethernet packet form) generation/termination, the interface to/from the alternate Radio module (for RPS management), the cable interface functions to ODU; it contains the logic for the EPS Core-E protection, the RPS logic and the DC/DC converter unit.
For each radio direction with ODU300, one ODU300 Access module in the MSS and one associated ODU300 has to be provisioned in case of 1+0 radio configuration. Two radio access modules and two associated ODU300 have to be provisioned in case of 1+1 radio configurations.
- **MPT Access (with PFoE)** module: this module is used to interface up to two MPT-HC or the MPT-MC. This module provides the Power Feed over Ethernet to the MPT (only one cable to carry Ethernet traffic and power supply). The interface to the MPT-HC is a standard GbEth interface (electrical or optical) and a power supply cable. The interface to the MPT-MC is a standard GbEth interface (electrical). It sends/receives standard Ethernet packets to/from both Core-E modules. It contains the logic for the EPS Core-E protection and the DC/DC converter unit.
For each radio direction with MPT, one MPT Access module in the MSS and one associated MPT has to be provisioned in case of 1+0 radio configuration. One (or two) MPT Access modules and two associated MPT have to be provisioned in case of 1+1 radio configurations.
- **EAS Peripheral (P8ETH)** module: provides access for customer Ethernet traffic.
It supports the following traffic external interfaces:
 - 4xEthernet 10/100/1000 Base-T
 - 4xEthernet SFP 4x1000 Base-X optical, Base-T, or Copper Cable access directly available on the EAS module. Interfaces can be 1000BASE-LX (GbE LX 10 km) or 1000BASE-SX (GbE SX 550 m) or 1000BASE-CX (GbE CX 25 m)

According to the transport modules installed different configurations can be implemented.

The optional **AUX peripheral module** provides 2x64 kbit/s service channels and the housekeeping alarms.

The optional **+24 Vdc/-48 Vdc Converter module** (to be installed in transport slot 4, 6 or 8 for MSS-8 and in transport slot 3 or 4 for MSS-4) can be used to power supply the MSS for +24 Vdc office applications.

A simplified block diagram of the MSS is shown in Figure 8. for MSS-8 and in Figure 9. for MSS-4.

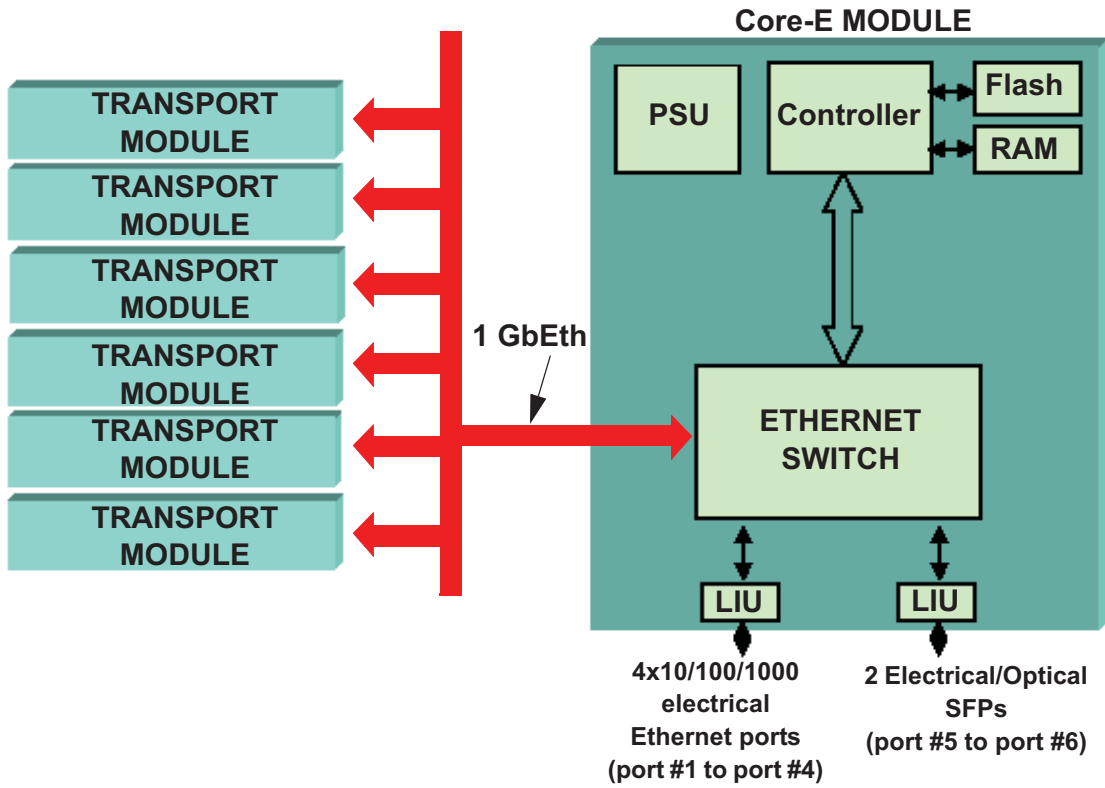


Figure 8. MSS-8 block diagram

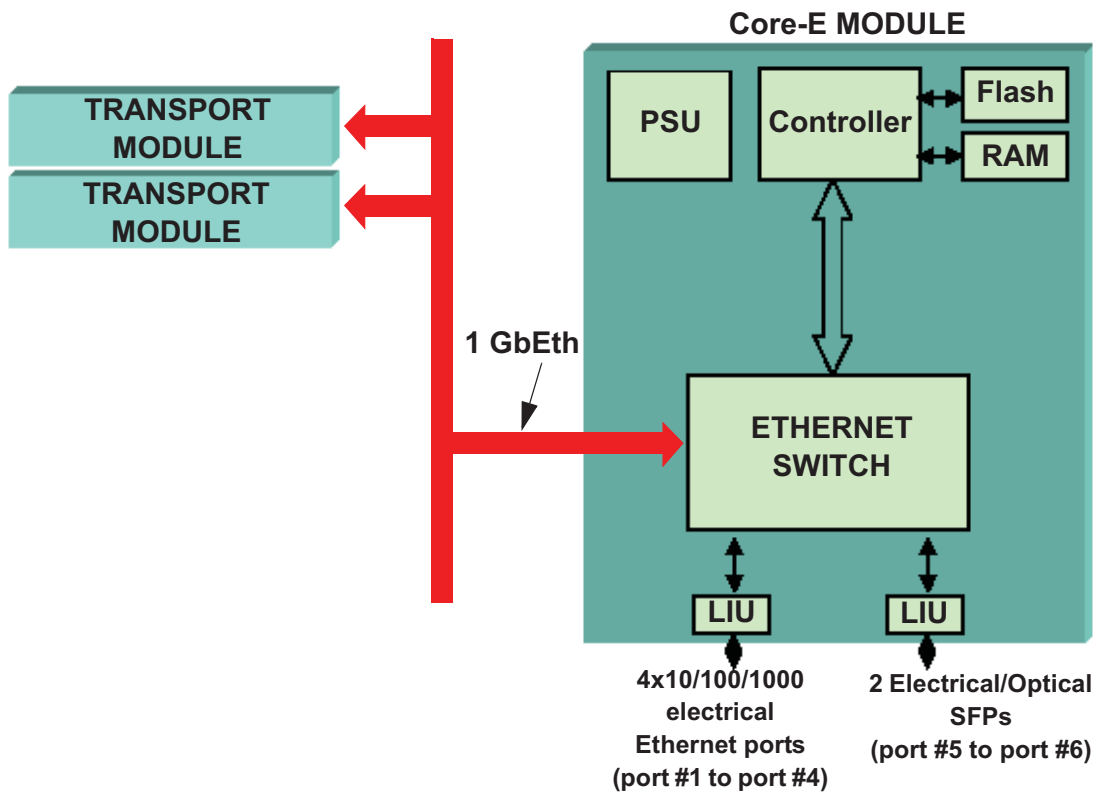


Figure 9. MSS-4 block diagram

2.1.4 Stacking configuration

To manage more directions the “**Stacking configuration**” can be realized by installing up to 3 MSS, interconnected through the Ethernet ports in the Core-E module. In the example of Figure 10 are shown the interconnected MSS.

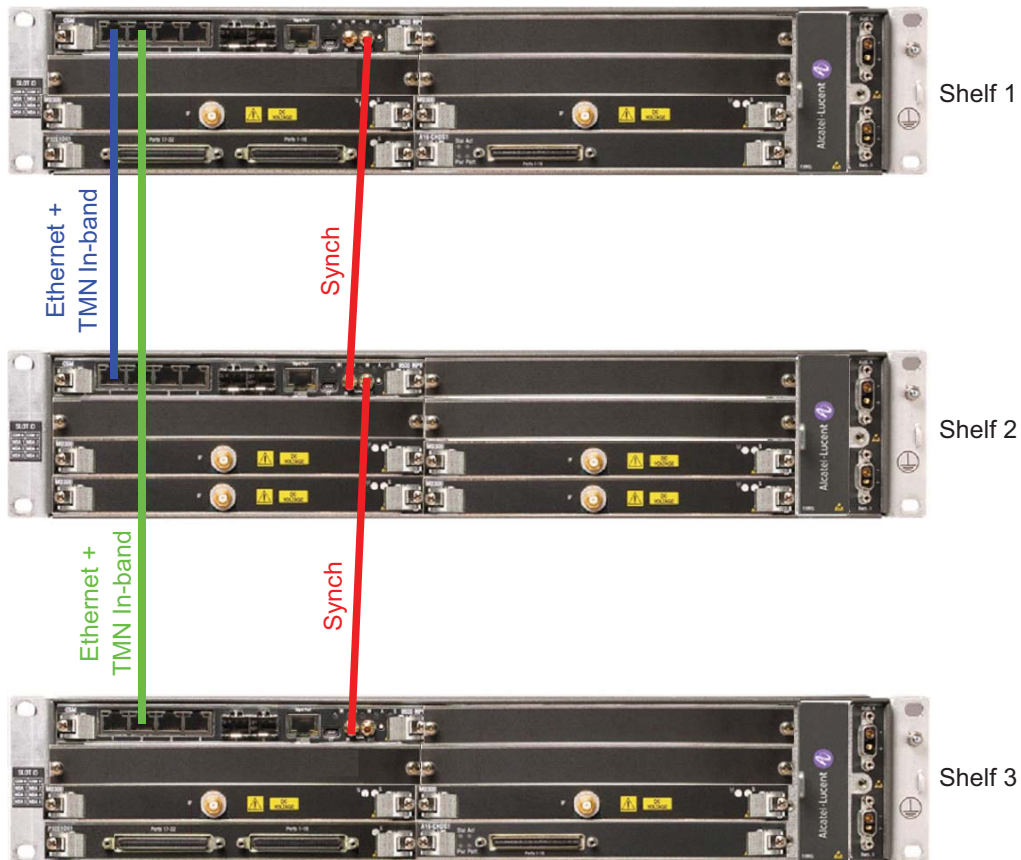


Figure 10. Stacking configuration with 3 MSS

For the Stacking configuration it is recommended to enable the Static Lag Criteria.

Also with the Core protection max. 3 MSS can be interconnected as shown in Figure 11. For the synchronization connection refer to par. 2.8.25.

To implement this configuration the LOS alarm on the Ethernet ports must be enabled as switching criterion of the Core protection. To enable this functionality the “Ethernet LOS Criteria” feature has to be enabled (refer to Menu System Setting in par. 3.4.4).

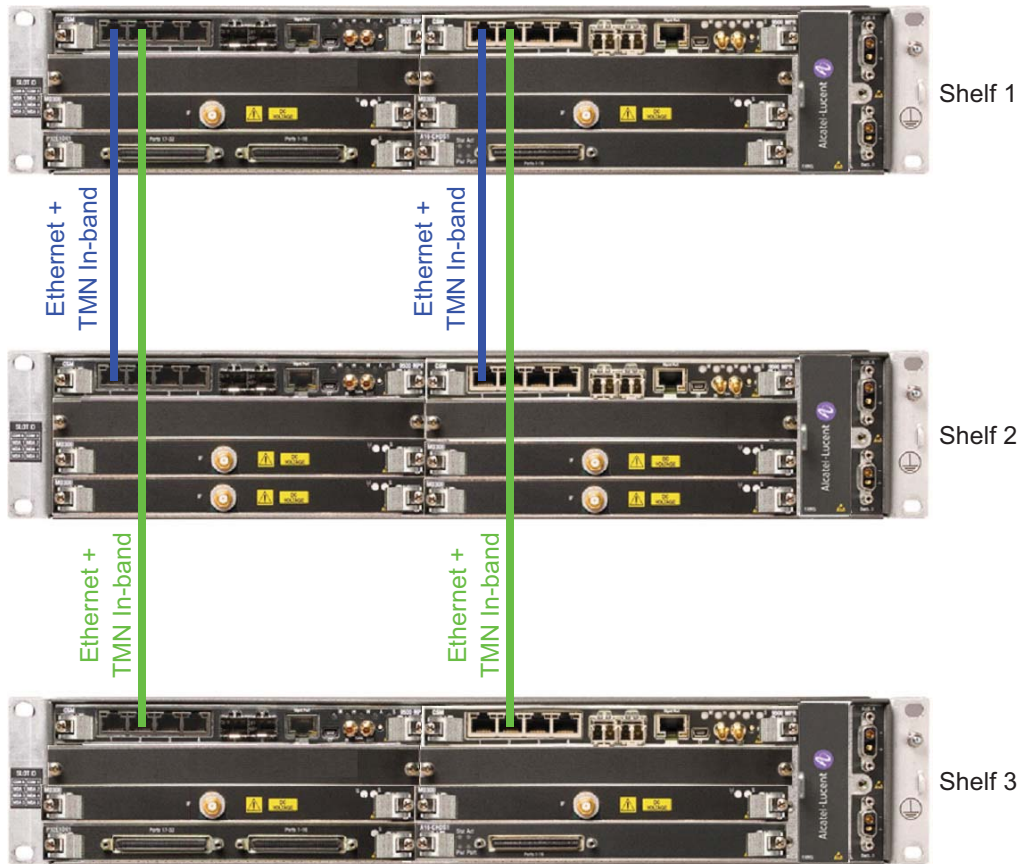


Figure 11. Stacking configuration with 3 MSS with Core protection

2.1.5 ODU300

The ODU300 is a microprocessor controlled transceiver that interfaces the MSS with the antenna.

Transmitter circuits in the ODU300 consist of cable interface, local oscillator, upconverter/mixer, power amplifier, and diplexer.

Receive circuits consist of diplexer, low-noise amplifier, local oscillator, downconverter/mixer, automatic gain control, and cable interface.

Power is provided by -48Vdc from the MSS to the ODU300 DC-DC converter.

The ODU300 is frequency dependent.



Figure 12. ODU300

2.1.6 MPT-HC

MPT-HC is a Microwave Equipment capable of transporting the Ethernet traffic over an RF radio channel.

MPT-HC is a microprocessor controlled equipment that interfaces the MSS with the antenna.

The input interface is a standard Giga Ethernet interface (electrical or optical).

The Ethernet traffic is transmitted over the radio channel according to the configured QoS and to the scheduler algorithms.

Transmitter circuits in the MPT-HC consist of Ethernet input interface, modulator, local oscillator, upconverter/mixer, power amplifier, and diplexer.

Receiver circuits consist of diplexer, low-noise amplifier, local oscillator, downconverter/mixer, automatic gain control, demodulator and Ethernet output interface.

The microprocessor manages the frequency, transmit power alarming, and performance monitoring.

The power is provided by -48 Vdc from the MSS to the MPT-HC DC-DC converter through a dedicated power supply cable.

By using the Power Extractor (refer to par. 2.1.9) the MPT-HC can be connected to the MSS by using only one cable carrying Ethernet traffic and power supply.

The MPT-HC is frequency dependent.



Figure 13. MPT-HC (11-38 GHz on the left side; 6 GHz on the right side)

2.1.7 MPT-MC

MPT-MC is similar to MPT-HC from architecture standpoint. Only differences are:

- MPT-MC is medium capacity
- MPT-MC is natively Ethernet powered through a proprietary PFoE
- MPT-MC cannot be connected in optical -> 100m length cable limitation.

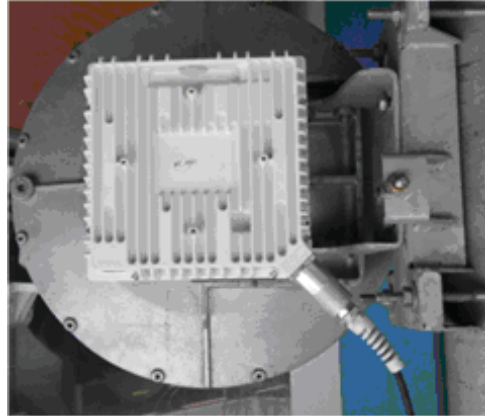


Figure 14. MPT-MC

2.1.8 MPT-HC V2

MPT-HC V2 is similar to MPT-HC from architecture standpoint and can be used as spare part of the MPT-HC. The differences are:

- MPT-HC V2 can be natively Ethernet powered through a proprietary PFoE (or as alternative by using two cables, one coaxial cable for the Power Supply and one optical cable for the Ethernet Traffic (as MPT-HC))
- MPT-HC V2 is XPIC-ready by the installation of a dedicated module.

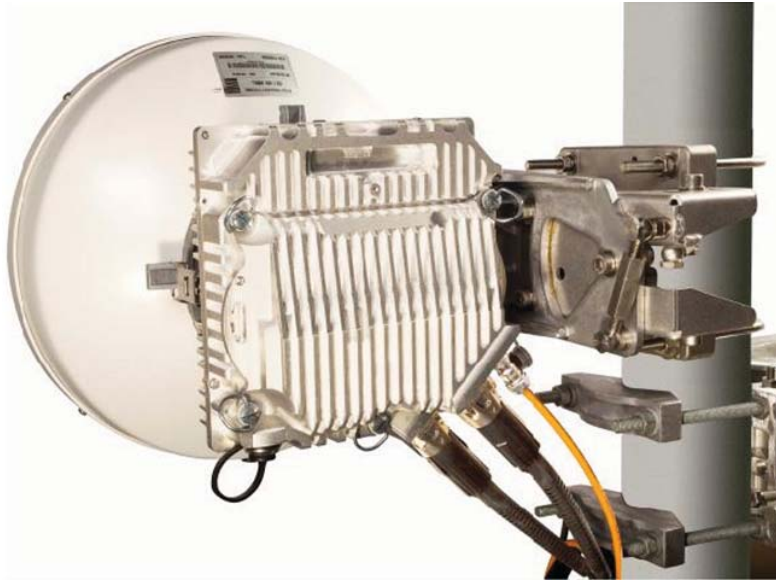


Figure 15. MPT-HC V2

2.1.9 Power Extractor

The Power Extractor is an Outdoor Device, to be installed close to the MPT-HC, which receives on one cable the “Power Feed over Ethernet” (Ethernet traffic and Power Supply), provided by the MPT Access unit, and separates the Power Supply from the Ethernet traffic to be separately sent to the MPT-HC.

Figure 16. shows the Power Extractor.

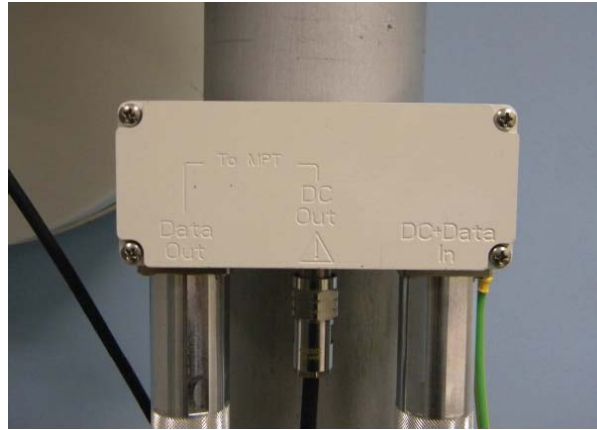


Figure 16. Power Extractor

The Power Extractor has 3 connectors:

- DC+DATA In (PFoE from the MPT Access unit)
- DC Out (Power Supply to MPT-HC)
- Data Out (Ethernet traffic to MPT-HC)

2.1.10 MSS to Outdoor Unit interconnections

2.1.10.1 MSS to ODU300 interconnection

A single 50 ohm coaxial cable connects a ODU300 Modem unit to its ODU. The max. cable length is up to 150 m. ODU cable, connectors and grounding kits are separately provided.

The ODU cable carries DC power supply for the ODU and five signals:

- Tx telemetry
- Reference signal to synchronize the ODU IQ Mod/Demod oscillator
- 311 MHz IQ modulated signal from the ODU300 Radio Interface (transmit IF)
- Rx telemetry
- 126 MHz IQ modulated signals from the ODU (receive IF)

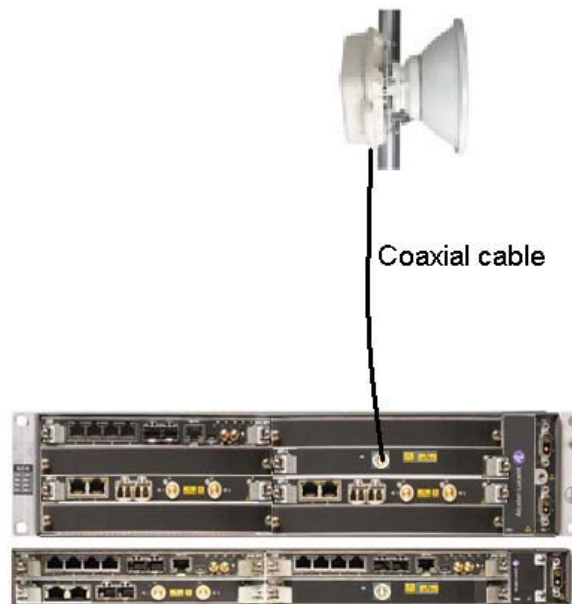


Figure 17. MSS to ODU300 interconnection

2.1.10.2 MSS to MPT-HC interconnection

The MPT-HC can be connected in 4 different ways:

- Two cables (MPT Access unit to MPT-HC) - par. 2.1.10.2.1
- One cable (MPT Access unit to MPT-HC) - par. 2.1.10.2.2
- Two cables (Core-E unit to MPT-HC) - par. 2.1.10.2.3
- One cable (Core-E unit to MPT-HC) - par. 2.1.10.2.4

2.1.10.2.1 Two cables (MPT Access unit to MPT-HC)

Two cables connect an MPT-HC Access unit in the MSS to its MPT-HC (Figure 18 and Figure 19):

- One cable is a 50 ohm coaxial cable to send the power supply to the MPT-HC.
- The second cable is an Ethernet cable (optical or electrical).
The max cable length for electrical Ethernet connection is 100 m.
The max cable length for optical Ethernet connection is 450 m.
The standard delivery is up to 300 m. The cable for up to 450 m is available on demand.

The Ethernet electrical cable is provided with connectors to be mounted on site with the specific RJ45 tool (1AD160490001). The Ethernet optical cable is preassembled and available in different lengths.

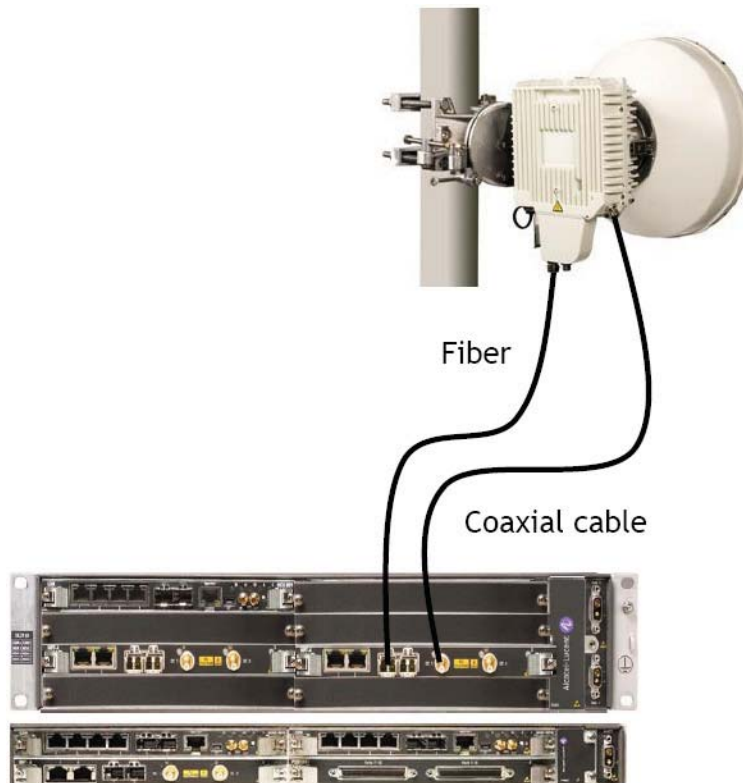


Figure 18. MSS to MPT-HC interconnection

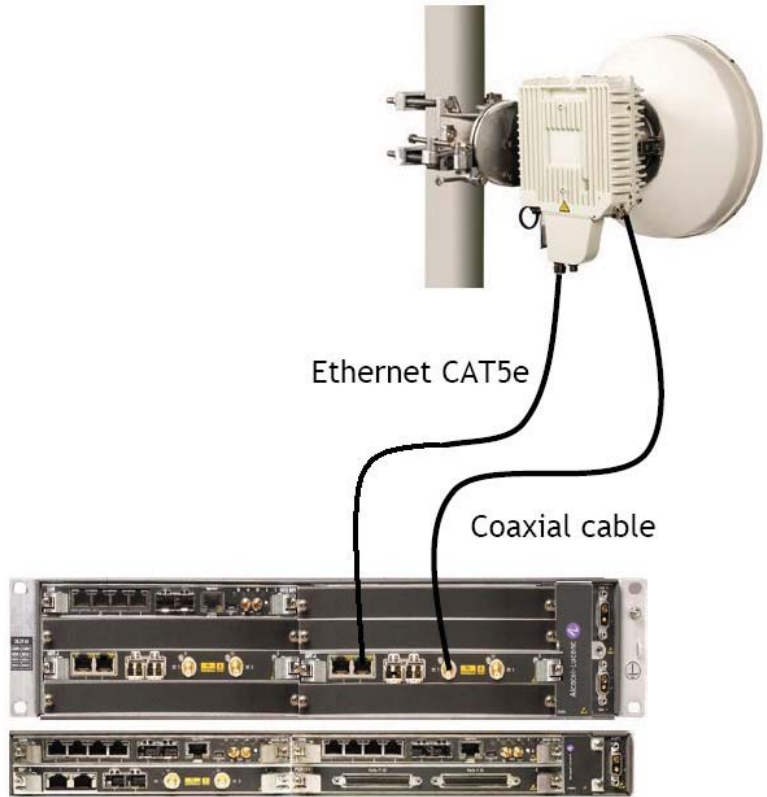


Figure 19. MSS to MPT-HC interconnection

2.1.10.2.2 One cable (MPT Access unit to MPT-HC)

By using the optional Power Extractor, installed close to the MPT-HC, the interconnection between the MSS and the MPT-HC can be made with a single electrical Ethernet cable (Figure 20) by using the Power Feed over Ethernet (Ethernet traffic and Power Supply on the same cable). The Power Extractor then separates the Power Supply from the Ethernet traffic, which are separately send to the MPT-HC.

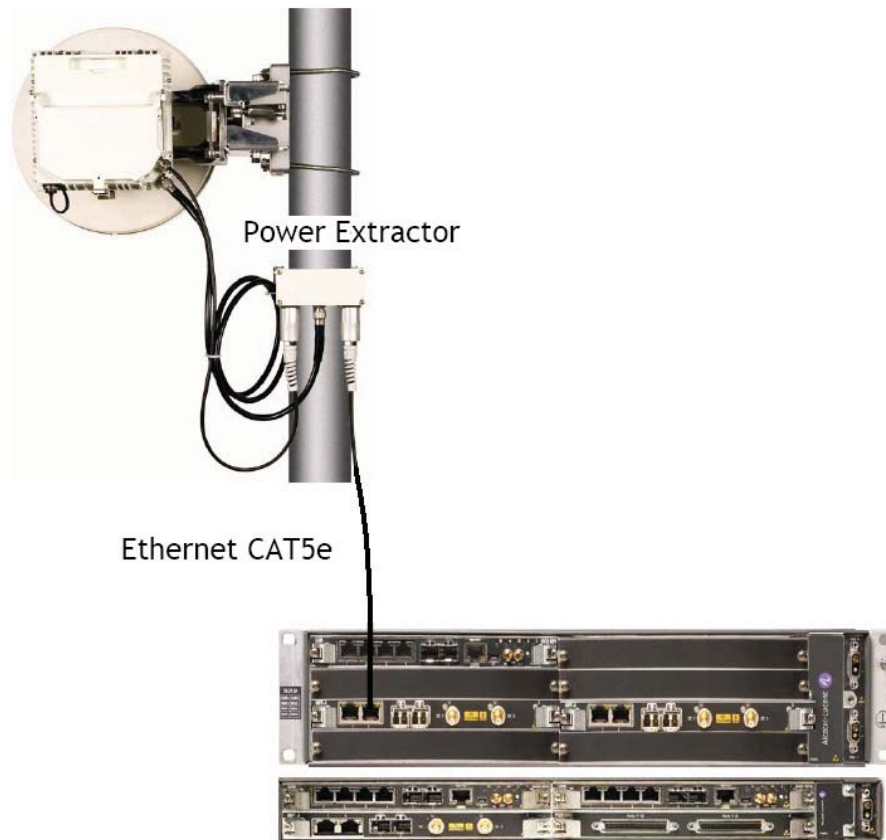


Figure 20. MSS to MPT-HC interconnection

2.1.10.2.3 Two cables (Core-E unit to MPT-HC)

Two cables connect the MPT:

- one optical cable connected to port#5 or port #6 of the Core-E unit or one electrical cable connected to the electrical ports (port#1 to port#4) of the Core-E unit.
- a coaxial cable connected to the station battery to provide the power supply.

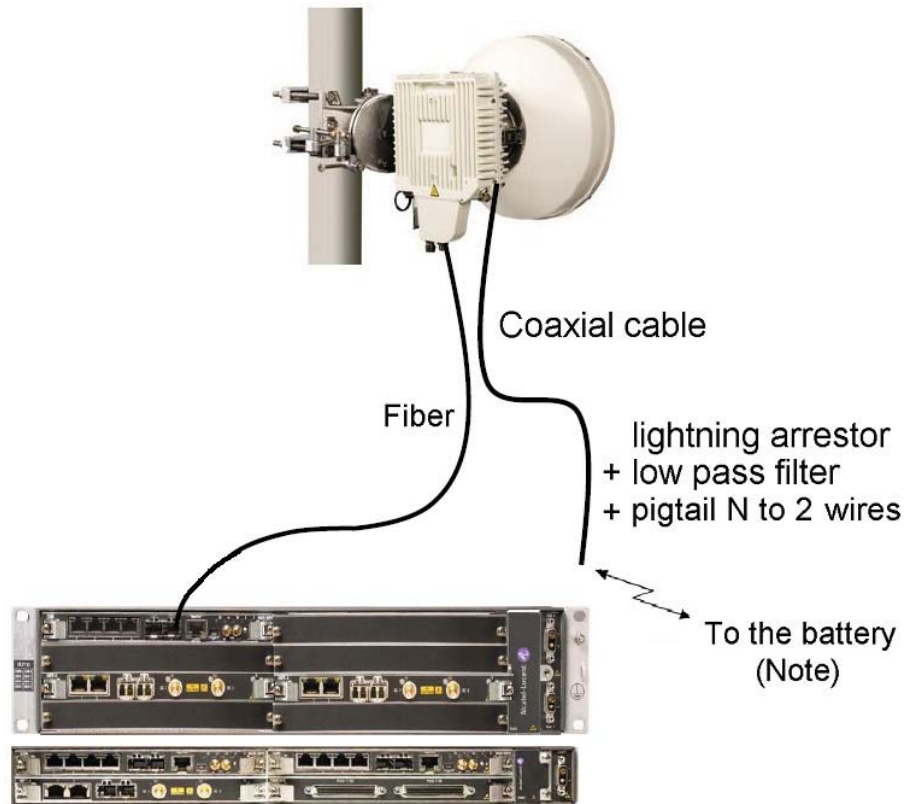


Figure 21. MSS to MPT-HC interconnection

Note: MPT-HC must be connected to a fuse or a breaker on a customer power distribution box. The recommended value is 3 Amps.

For the connection to the station battery refer to paragraph 2.1.10.4 on page 70.

2.1.10.2.4 One cable (Core-E unit to MPT-HC)

A possible option is to use only one single CAT5e cable. In this case the Power Injector is needed to merge DC+data and the Power Extractor is needed to separate them toward MPT-HC.

The max cable length is 100 m.

In Figure 22. and Figure 23. are shown the connections implemented with the two available Power Injectors.

The Power Injector box is an indoor device to be installed in a 19"/21" rack.

The Power Injector plug-in is a unit to be installed in an MSS.

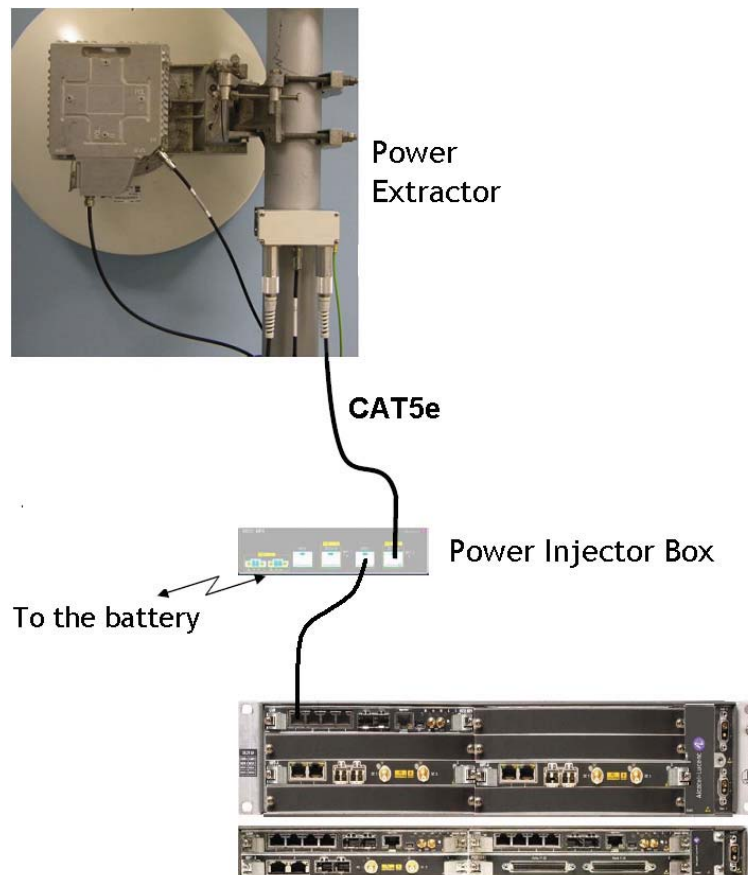


Figure 22. MPT-HC connection through the Power Injector Box

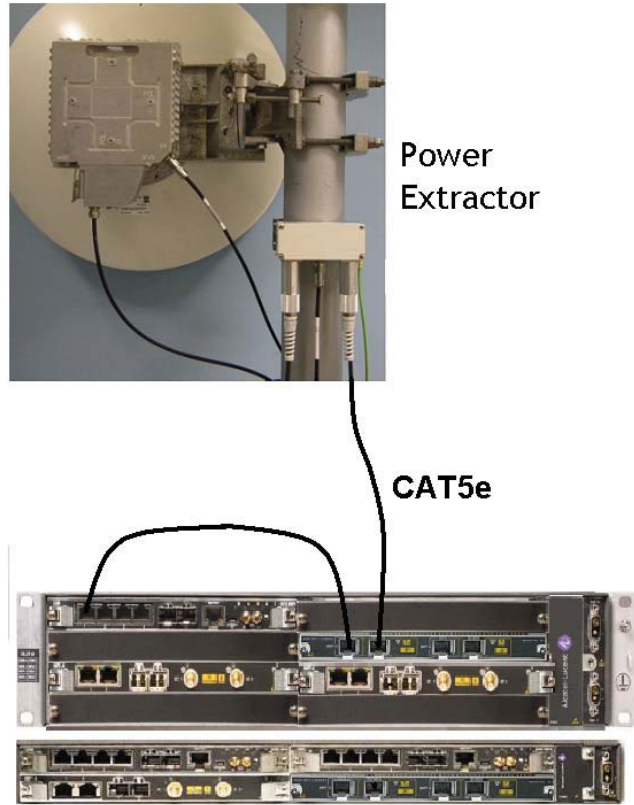


Figure 23. MPT-HC connection through the Power Injector Plug-in installed in the MSS

2.1.10.3 MSS to MPT-HC V2 interconnection

The MPT-HC V2 can be connected in 4 different ways:

- One cable (MPT Access unit to MPT-HC V2) - par. 2.1.10.3.1
- Two cables (MPT Access unit to MPT-HC V2) - par. 2.1.10.3.2
- Two cables (Core-E unit to MPT-HC V2) - par. 2.1.10.3.3
- One cable (Core-E unit to MPT-HC V2) - par. 2.1.10.3.4

2.1.10.3.1 One cable (MPT Access unit to MPT-HC V2)

One electrical Ethernet cable connects an MPT Access unit in the MSS to its MPT-HC V2 (the MPT Access unit provides the PFoE).

The max cable length is 100 m.

The Ethernet electrical cable is provided with connectors to be mounted on site with the specific RJ45 tool (1AD160490001).

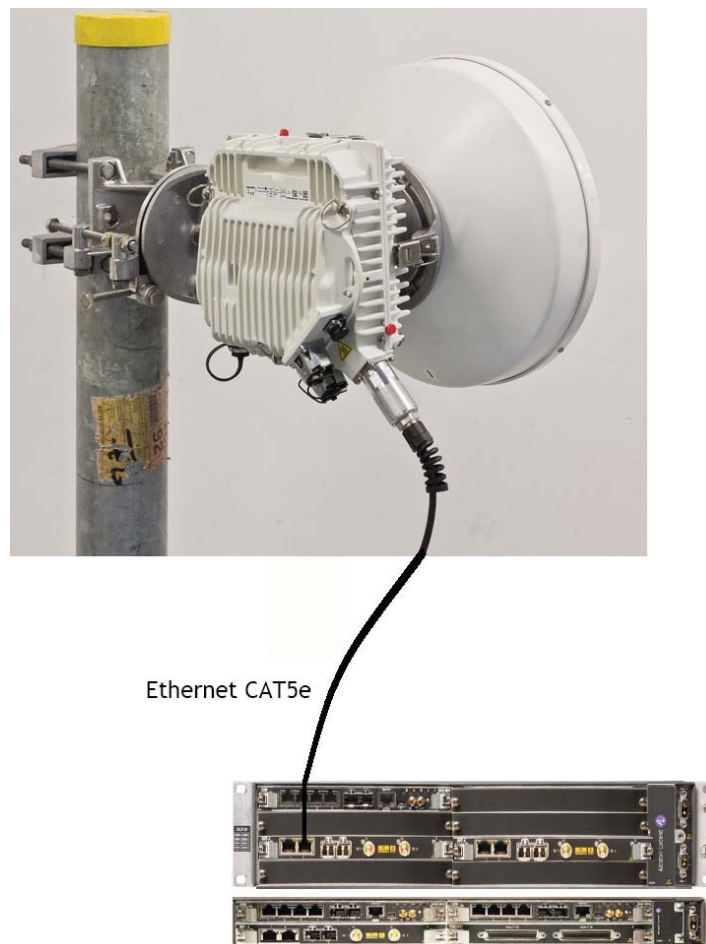


Figure 24. MSS to MPT-HC V2 interconnection

2.1.10.3.2 Two cables (MPT Access unit to MPT-HC V2)

Two cables connect an MPT Access unit in the MSS to its MPT-HC V2:

- One cable is a 50 ohm coaxial cable to send the power supply to the MPT-HC V2:
 - for length lower or equal to 100 m the power cable can be CAT5E cable to send the power supply to the MPT-HC V2 . The Ethernet electrical cable is provided with connectors to be mounted on site with the specific RJ45 tool (1AD160490001);
 - for length higher than 100m, the cable is a 50 ohm coaxial cable to send the power supply to the MPT-HC V2

Note: In case of length lower than 100m and presence in the field of 1 coaxial already installed and free it is recommended to use the coax cable to minimise the installation effort.

- The second cable is an Ethernet optical cable.
The Ethernet optical cable is preassembled and available in different lengths (up to 450 m).

Note: A special cord adapter must be connected to the coaxial cable on the MPT-HC V2.

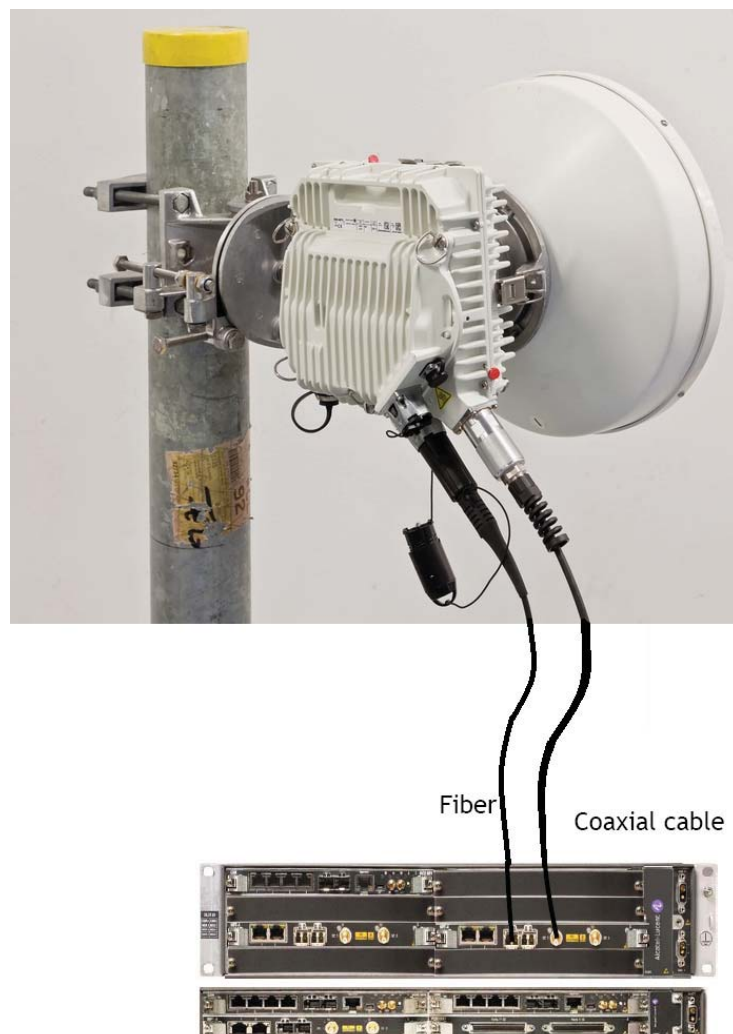


Figure 25. MSS to MPT-HC V2 interconnection

2.1.10.3.3 Two cables (Core-E unit to MPT-HC V2)

Two cables connect the MPT:

- one optical cable connected to port#5 or port #6 of the Core-E unit **or** port #6 of the Core-E unit or one electrical cable connected to the electrical ports (port#1 to port#4) of the Core-E unit.
- a coaxial cable connected to the station battery to provide the power supply.

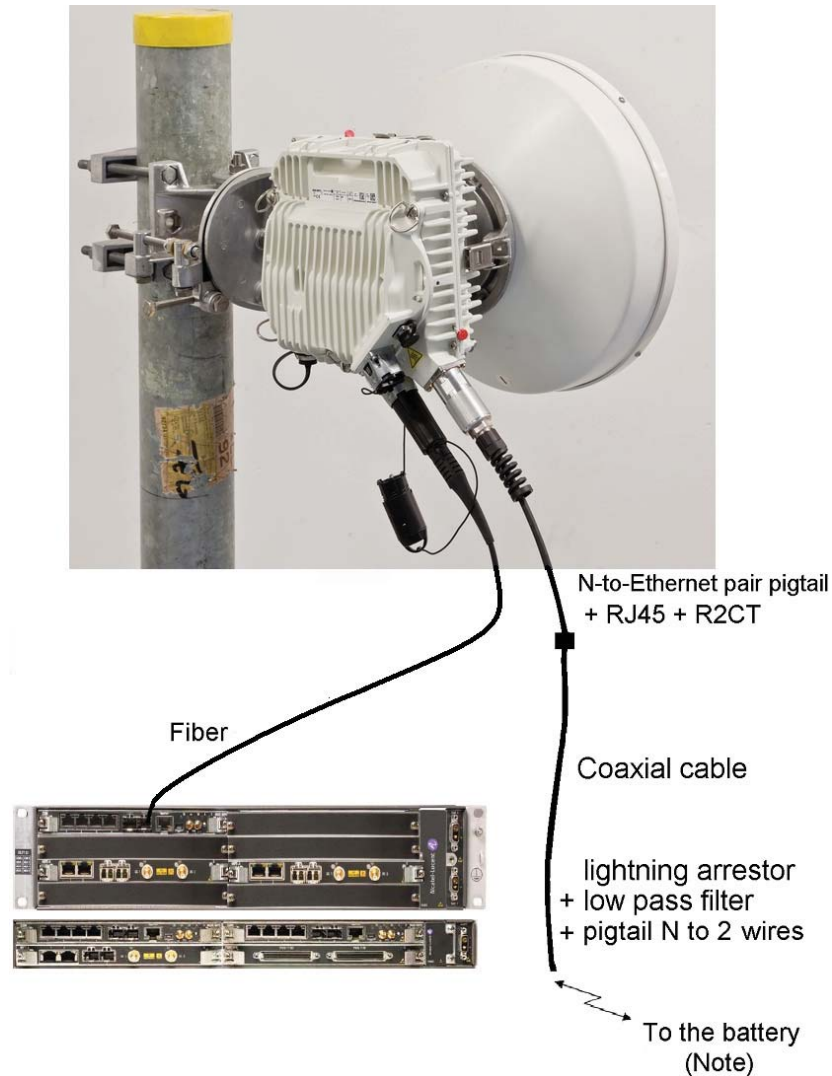


Figure 26. MSS to MPT-HC V2 interconnection

Note: MPT-HC V2 must be connected to a fuse or a breaker on a customer power distribution box. The recommended value is 3 Amps.

For the connection to the station battery refer to paragraph 2.1.10.4 on page 70.

2.1.10.3.4 One cable (Core-E unit to MPT-HC V2)

The MPT-HC V2 is connected to a Power Injector through one electrical Ethernet cable.

The max cable length is 100 m.

In Figure 31. and Figure 32. are shown the connections implemented with the two available Power Injectors.

The Power Injector box is an indoor device to be installed in a 19"/21" rack.

The Power Injector plug-in is a unit to be installed in the MSS.

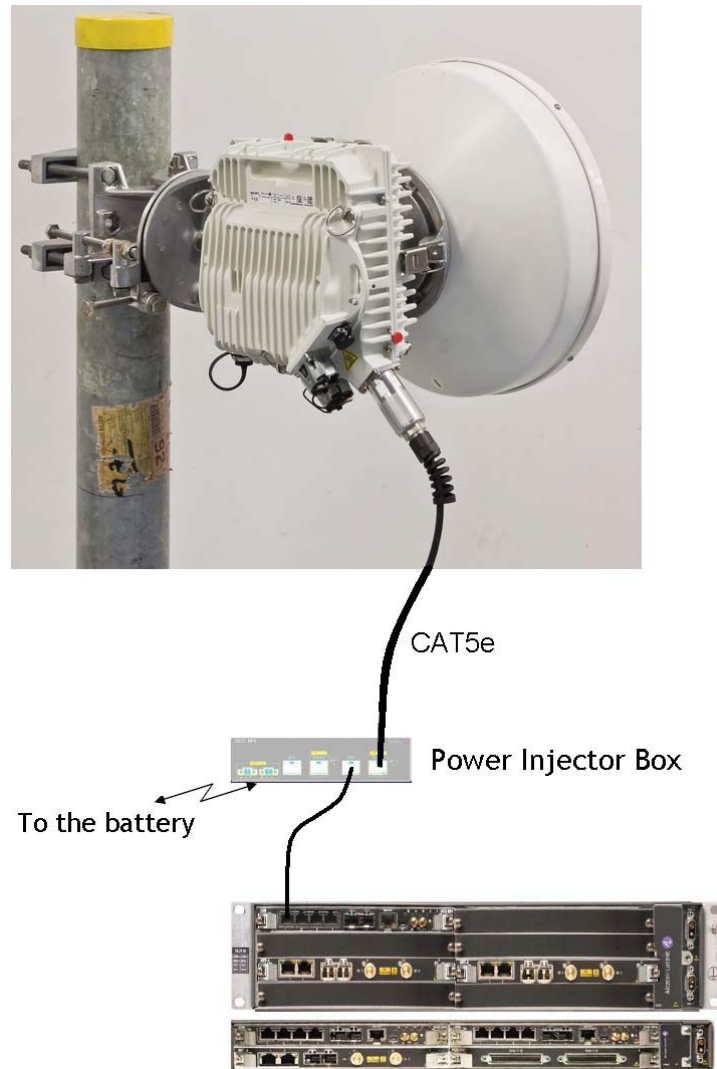


Figure 27. MPT-HC V2 connection through the Power Injector Box

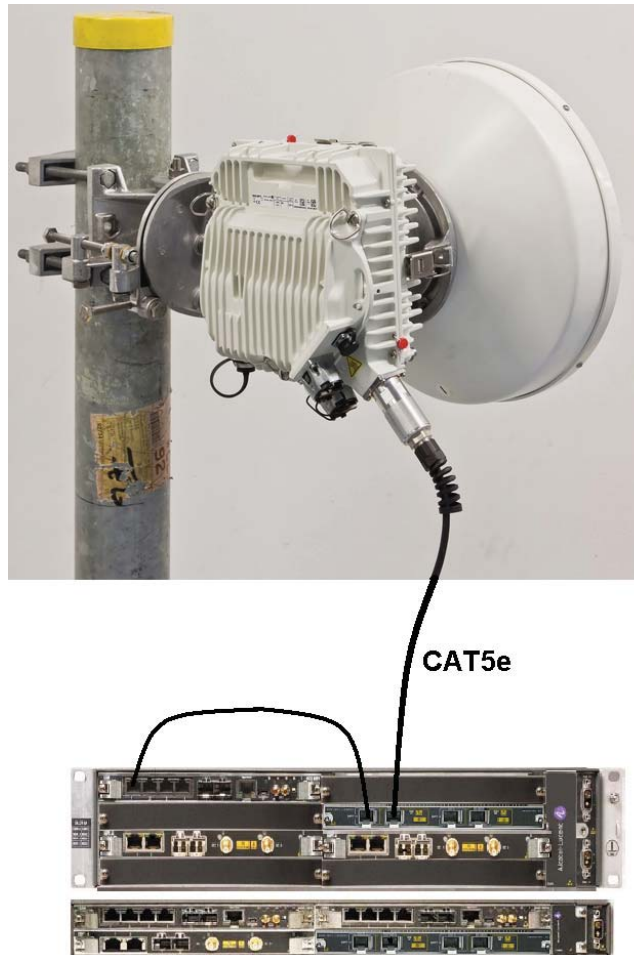


Figure 28. MPT-HC V2 connection through the Power Injector Plug-in installed in the MSS

2.1.10.4 How to connect the MPT-HC/MPT-HC V2 to the station battery

Figure 29. shows the devices used to connect an MPT directly to a battery.

From front to back:

- Coaxial cable with N connector
- Wall mount support 3CC50149AAXX (max 4 MPT)
- Lightning arrestor with its grounding cable
- Low pass filter
- Cable N to two wires ("pigtail")

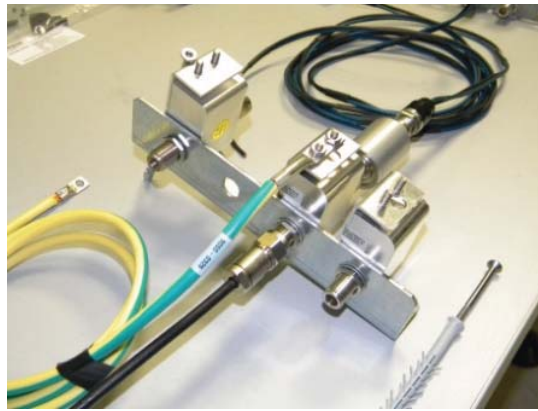


Figure 29. MPT-HC/MPT-HC V2 directly connected to the battery

2.1.10.5 MSS to MPT-MC interconnection

The MPT-MC can be connected in 2 different ways:

- One cable (MPT Access unit to MPT-MC) - par. 2.1.10.5.1
- One cable (Core-E unit to MPT-MC) - par. 2.1.10.5.2

2.1.10.5.1 One cable (MPT Access unit to MPT-MC)

One electrical Ethernet cable connects an MPT Access unit in the MSS to its MPT-MC (the MPT Access unit provides the PFoE).

The max cable length is 100 m.

The Ethernet electrical cable is provided with connectors to be mounted on site with the specific RJ45 tool (1AD160490001).

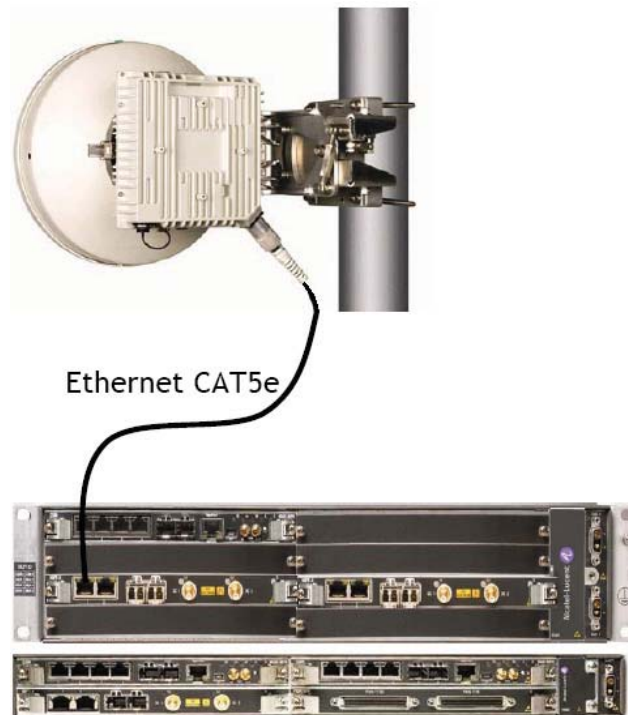


Figure 30. MSS to MPT-MC interconnection

2.1.10.5.2 One cable (Core-E unit to MPT-MC)

The MPT-MC is connected to a Power Injector through one electrical Ethernet cable.

The max cable length is 100 m.

In Figure 31. and Figure 32. are shown the connections implemented with the two available Power Injectors.

The Power Injector box is an indoor device to be installed in a 19"/21" rack.

The Power Injector plug-in is a unit to be installed in a MSS.

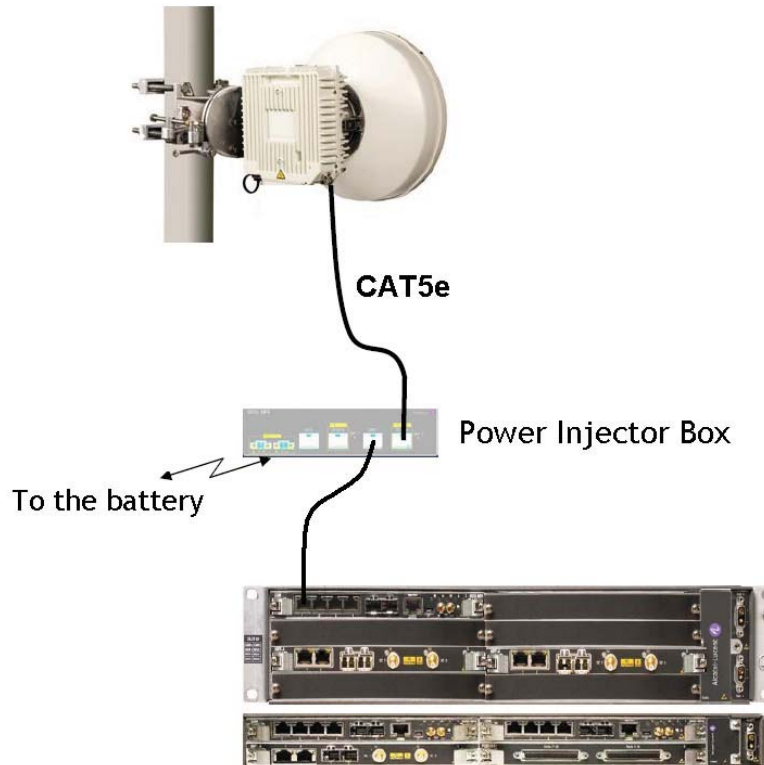


Figure 31. MPT-MC connection through the Power Injector Box

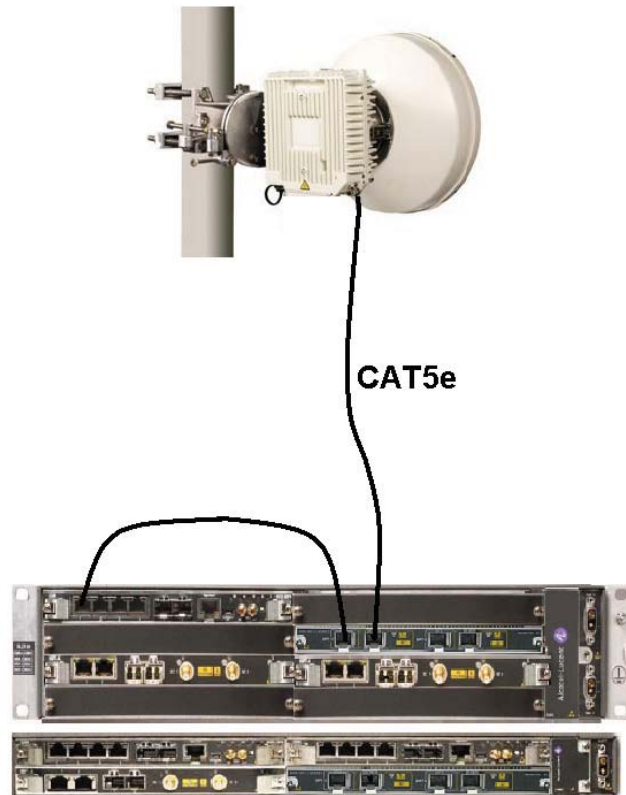


Figure 32. MPT-MC connection through the Power Injector Plug-in installed in the MSS

2.1.11 Antennas

Antennas for direct mounting an ODU are available in diameters from 0.3 m to 1.8 m, depending on the frequency band.

A polarization rotator is included within the antenna collar, and direct-mounting equal or unequal loss couplers are available for single antenna protected operation.

Antenna mounts are designed for use on industry-standard 114 mm OD pipe-mounts.

An ODU can also be used with standard antennas via a remote-mount kit and flexible waveguide.

2.2 Radio capacity, channelling and modulation

2.2.1 ODU300

Table 1. Radio capacity, channelling scheme and modulation (Static Modulation)

Channel	FCM Mode	ETSI Class	# E1 (TDM2TDM)	Capacity (Mbit/s)
7 MHz	4 QAM	2	4 E1	10,8 Mbit/s
	16 QAM	4	8 E1	21,7 Mbit/s
	64 QAM	5	13 E1	32,6 Mbit/s
14 MHz	4 QAM	2	8 E1	21,7 Mbit/s
	16 QAM	4	18 E1	43,5 Mbit/s
	64 QAM	5	27 E1	65,2 Mbit/s
28 MHz	4 QAM	2	18 E1	43,5 Mbit/s
	16 QAM	4	37 E1	87,0 Mbit/s
	32 QAM	4	48 E1	111,3 Mbit/s
	64 QAM	5	56 E1	130,5 Mbit/s
	128 QAM	5	68 E1	156,8 Mbit/s
	256 QAM	6	77 E1	177,6 Mbit/s
50 MHz	32 QAM	n.a	85 E1	196,4 Mbit/s
	128 QAM	n.a	119 E1	275,2 Mbit/s
	256 QAM	n.a	137 E1	315,2 Mbit/s
56 MHz	16 QAM	4	72 E1	166,4 Mbit/s
	128 QAM	5	136 E1	313,6 Mbit/s
	256 QAM	6	150 E1	345,6 Mbit/s

Table 2. Radio capacity, channelling scheme and modulation (Adaptive Modulation)

Channel Spacing	ACM Mode	ETSI Class	# E1 (Note) (TDM2TDM)	Capacity (Mbit/s)
28 MHz	4 QAM	2	18 E1	43,5 Mbit/s
	16 QAM	4	37 E1	87,0 Mbit/s
	64 QAM	5	56 E1	130,5 Mbit/s
14 MHz	4 QAM	2	8 E1	21,7 Mbit/s
	16 QAM	4	18 E1	43,5 Mbit/s
	64 QAM	5	27 E1	65,2 Mbit/s
7 MHz	4 QAM	2	4 E1	10,8 Mbit/s
	16 QAM	4	8 E1	21,7 Mbit/s
	64 QAM	5	13 E1	32,6 Mbit/s

Note

The Admission Control for TDM flows (cross-connected to radio direction working in Adaptive Modulation) can be enabled or disabled.

When the Admission Control is enabled, the check is performed taking into account the capacity of the 4 QAM modulation scheme for the relevant Channel Spacing.

When the Admission Control is disabled, the check is performed taking into account the capacity of the highest modulation scheme for the relevant Channel Spacing (64 QAM for 4-16-64 QAM range or 16 QAM for 4-16 QAM range).

2.2.2 MPT-HC/MPT-HC V2/MPT-MC

Table 3. Radio capacity, channelling scheme and modulation (Static Modulation)

Channel Spacing (MHz)	FCM Mode	ETSI Class	# E1 (TDM2TDM)	# STM-1 (SDH2SDH)	Typical mean Ethernet Throughput (any length: 64-1518 bytes)
3.5	4 QAM	2	2	0	4,8 Mbit/s
	8PSK	2	3	0	7,4 Mbit/s
	16 QAM	4	4	0	9,3 Mbit/s
	32 QAM	4	5	0	11,5 Mbit/s
	64 QAM	5	6	0	14,3 Mbit/s
7	4 QAM	2	4	0	9,3 Mbit/s
	8PSK	2	6	0	14,1 Mbit/s
	16 QAM	4	9	0	20,2 Mbit/s
	32 QAM	4	11	0	24,9 Mbit/s
	64 QAM	5	14	0	30,3 Mbit/s
	128 QAM	5	16	0	36,1 Mbit/s
	256 QAM (NB3)	6	19	0	41,3 Mbit/s
14	4 QAM	2	9	0	20,4 Mbit/s
	8PSK	2	14	0	30,6 Mbit/s
	16 QAM	4	19	0	41,6 Mbit/s
	32 QAM	4	23	0	51,1 Mbit/s
	64 QAM	5	29	0	62,8 Mbit/s
	128 QAM	5	34	0	74,2 Mbit/s
	256 QAM (NB3)	6	41	0	87,4 Mbit/s
28	4 QAM	2	19	0	41,9 Mbit/s
	4 QAM	2 (NB1)	20	0	43,8 Mbit/s
	8PSK	2	29	0	62,7 Mbit/s
	16 QAM	4	39	0	84,2 Mbit/s
	16 QAM	4 (NB1)	41	0	87,9 Mbit/s
	32 QAM	4	50	0	107,7 Mbit/s
	64 QAM	5	60	0	129,0 Mbit/s
	128 QAM	5	71	0	152,4 Mbit/s
	256 QAM (NB3)	6	85	1	180,7 Mbit/s

Channel Spacing (MHz)	FCM Mode	ETSI Class	# E1 (TDM2TDM)	# STM-1 (SDH2SDH)	Typical mean Ethernet Throughput (any length: 64-1518 bytes)
40 (NB2) (NB4)	64 QAM	5	88	1	186,6 Mbit/s
	128 QAM	5	104	1	220,6 Mbit/s
50	64 QAM	n.a	110	1	234,2 Mbit/s
	128 QAM	n.a	130	1	276,3 Mbit/s
	256 QAM (NB3)	n.a	148	1	314,4 Mbit/s
56 (NB2)	4 QAM	2 (NB1)	37	0	80,5 Mbit/s
	8PSK	2 (NB1)	56	0	120,2 Mbit/s
	16 QAM	4	75	1	159,9 Mbit/s
	16 QAM	4 (NB1)	76	1	161,9 Mbit/s
	32 QAM	4	92	1	196,2 Mbit/s
	64 QAM	5	119	1	252,6 Mbit/s
	128 QAM	5	141	1	298,6 Mbit/s
	256 QAM (NB3)	6	160	2	339,8 Mbit/s

N.B.1: New ETSI mask.

N.B.2: MPT-MC does not support this Channel Spacing.

N.B.3: MPT-MC does not support this FCM mode.

N.B.4: Applicable only for 6 GHz and 11 GHz RF bands.

Table 4. Modem Profiles for High Capacity application

Channel Spacing (MHz)	FCM Mode	ETSI Class	# E1 (TDM2TDM)	# STM-1 (SDH2SDH)	Typical mean Ethernet Throughput (any length: 64-1518 bytes)
28	128 QAM	5	72	1	153,2 Mbit/s
56	128 QAM	5	145	2	305,9 Mbit/s

Table 5. XPIC Modem Profiles

Channel Spacing (MHz)	FCM Mode	ETSI Class	# E1 (TDM2TDM)	# STM-1 (SDH2SDH)	Typical mean Ethernet Throughput (any length: 64-1518 bytes)
28	128 QAM	5	72	0	152,5 Mbit/s
	256 QAM	6	79	1	168,7 Mbit/s
56	128 QAM	5	141	1	298,7 Mbit/s
	256 QAM	6	160	2	339,8 Mbit/s

Table 6. XPIC SDH Modem Profiles

Channel Spacing (MHz)	FCM Mode	ETSI Class	# E1 (TDM2TDM)	# STM-1 (SDH2SDH)	Typical mean Ethernet Throughput (any length: 64-1518 bytes)
28	128 QAM	5	72	1	153,3 Mbit/s
56	128 QAM	5	145	2	306,0 Mbit/s

Table 7. Radio capacity, channelling scheme and modulation (Adaptive Modulation)

Channel Spacing (MHz)	ACM Mode Reference	ETSI Class	Modulation range	Ethernet guaranteed rate (mean) (Mbps)
3.5	4 QAM	2	4 QAM to 64 QAM	4,8 Mbit/s
	16 QAM	4	16 QAM to 64 QAM	9,3 Mbit/s
7	4 QAM	2	4 QAM to 256 QAM	9,3 Mbit/s
	16 QAM	4	16 QAM to 256 QAM	20,2 Mbit/s
	32 QAM	4	32 QAM to 256 QAM	24,9 Mbit/s
	64 QAM	5	64 QAM to 256 QAM	30,3 Mbit/s
14	4 QAM	2	4 QAM to 256 QAM	20,4 Mbit/s
	16 QAM	4	16 QAM to 256 QAM	41,6 Mbit/s
	32 QAM	4	32 QAM to 256 QAM	51,1 Mbit/s
	64 QAM	5	64 QAM to 256 QAM	62,8 Mbit/s
28	4 QAM	2	4 QAM to 256 QAM	41,9 Mbit/s
	4 QAM	2 (NB2)	4 QAM to 256 QAM	43,8 Mbit/s
	16 QAM	4	16 QAM to 256 QAM	84,2 Mbit/s
	16 QAM	4 (NB2)	16 QAM to 256 QAM	87,9 Mbit/s
	32 QAM	4	32 QAM to 256 QAM	107,7 Mbit/s
	64 QAM	5	64 QAM to 256 QAM	129,0 Mbit/s
40 (NB1)	64 QAM	5	64 QAM to 256 QAM	186,6 Mbit/s
56 (NB1)	4 QAM	2 (NB2)	4 QAM to 256 QAM	80,5 Mbit/s
	16 QAM	4	16 QAM to 256 QAM	159,9 Mbit/s
	16 QAM	4 (NB2)	16 QAM to 256 QAM	161,9 Mbit/s
	32 QAM	4	32 QAM to 256 QAM	196,2 Mbit/s
	64 QAM	5	64 QAM to 256 QAM	252,6 Mbit/s

N.B.1: MPT-MC does not support this Channel Spacing.

N.B.2: New ETSI mask.

2.3 Standard Features

More radio and site scalability and flexibility for installation teams:

- Limited need for factory presetting channel frequency or bandwidth
- Interchangeable hardware units
- Supports cellular mobile networks, and microcellular network back and common carrier, private carrier and data networks, and utility haul applications.
- 2G, 2.5G, and 3G network compatible
- Intelligent indoor nodal unit that supports up to 12 outdoor units, expandable to 36 with the stacking configuration (with MPT)
- Flexible aggregate capacity sharing between E1, STM-1 and Ethernet
- Adaptive packet transport that improves performance for priority services
- Output power agility
- ATPC
- Adaptive Modulation
- XPIC
- Packet-based internal cross-connect
- E1 MEF8 encapsulation
- STM-1 encapsulation
- EoSDH feature
- ATM over PW according to RFC 4717
- Radio and Ethernet LAGs
- Ethernet Ring
- Electrical and optical GE interfaces
- Software-based configuration
- Multiservice Switching Capacity greater than 16 Gb/s
- No single point of failure

2.4 Radio Configurations

- 1+0
 - 1+1 Hot-Standby (HSB)
 - two types of coupler for ODU300:
 - 3 dB/3 dB balanced coupler or 1.5 dB/6.0 dB unbalanced coupler
 - two types of coupler for MPT-HC/MPT-MC:
 - 3 dB/3 dB balanced coupler or 1 dB/10 dB unbalanced coupler
 - 1+1 Hot-Standby Space Diversity (HSB SD) (no coupler)
 - 1+1/2x(1+0) Frequency Diversity (FD) (co-polar)
 - 1+1/2x(1+0) Frequency Diversity (FD) (cross-polar)
 - 1+0/1+1 XPIC (with MPT-HC V2 only)
- N.B.** The 1+1 configuration with MPT-MC does not require any interconnection cable between the two ODUs. The protection is implemented by the “virtual cable” feature.
- N.B.** In 1+1 configuration the 2 Outdoor Units must be of the same types.

2.5 Typical System Configurations

- PDH/ATM Over Ethernet Packet Node - Mapping of 32 E1 and 16 E1 ATM on Ethernet (Figure 33.)
 - PDH/SDH/ATM and Ethernet Terminal Packet Transport 32 E1, 2xSTM-1 and 16 E1 ATM Access, 1 Radio Direction (Figure 34.)
 - PDH/SDH/ATM and Ethernet Add/Drop Packed Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 1 Back Link, 1 Haul Link (Figure 35.)
 - PDH/SDH/ATM and Ethernet Terminal Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 2 Back Links (Figure 36.)
 - PDH/SDH/ATM and Ethernet Add/Drop Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 1 Back Link and 2 Haul Links (Figure 37.)
 - PDH/SDH/ATM and Ethernet Add/Drop Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 2 Haul Links and 2 Back Links (Figure 38.)
- N.B.** Radio LAG and Ethernet LAGs can be created to increase the capacity and availability.

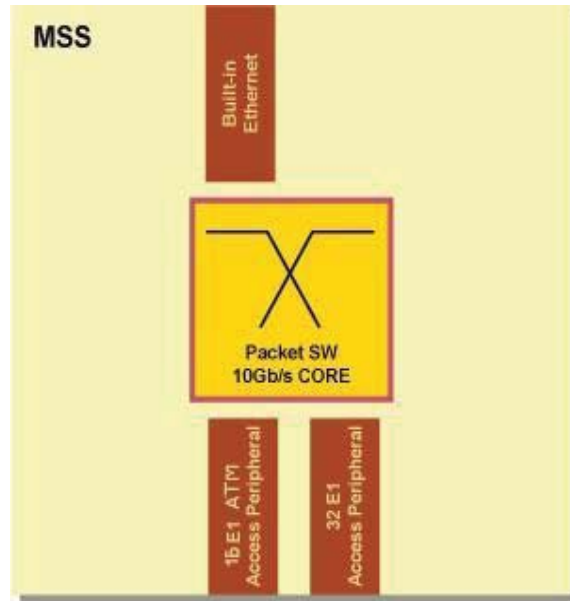


Figure 33. PDH/ATM Over Ethernet Packet Node - Mapping of 32 E1 and 16 E1 ATM on Ethernet

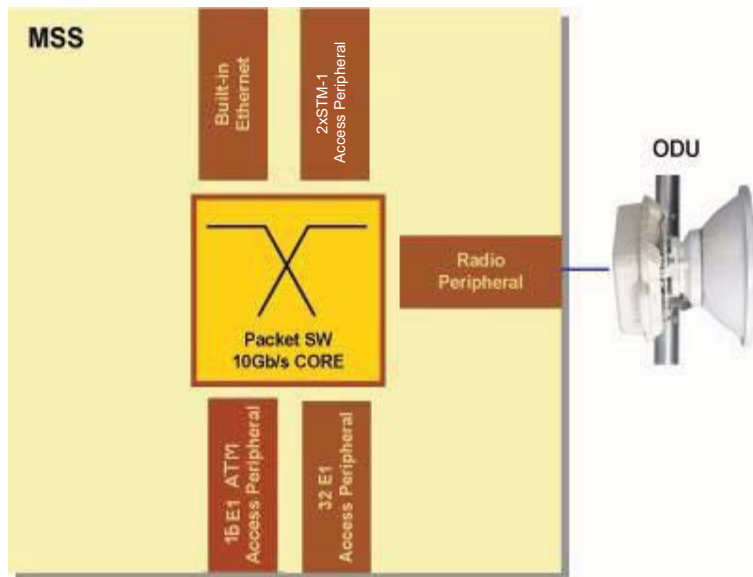


Figure 34. PDH/SDH/ATM and Ethernet Terminal Packet Transport 32 E1, 2xSTM-1 and 16 E1 ATM Access, 1 Radio Direction

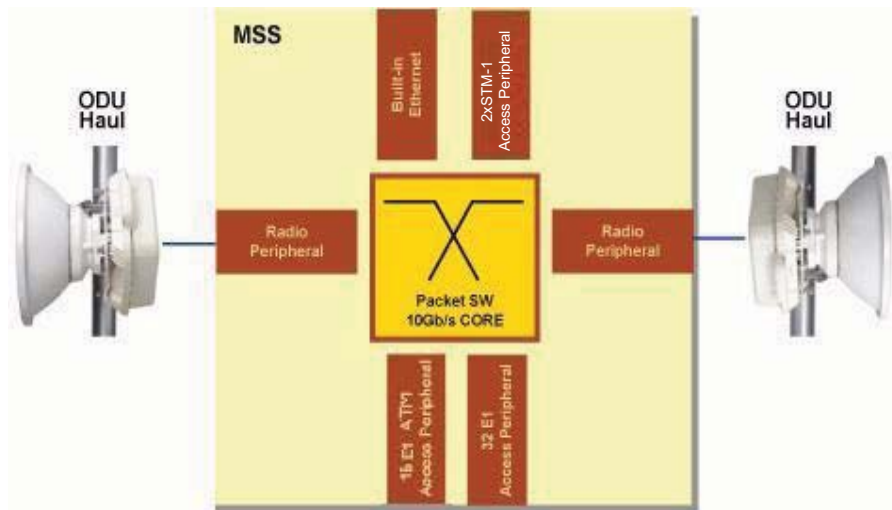


Figure 35. PDH/SDH/ATM and Ethernet Add/Drop Packed Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 1 Back Link, 1 Haul Link

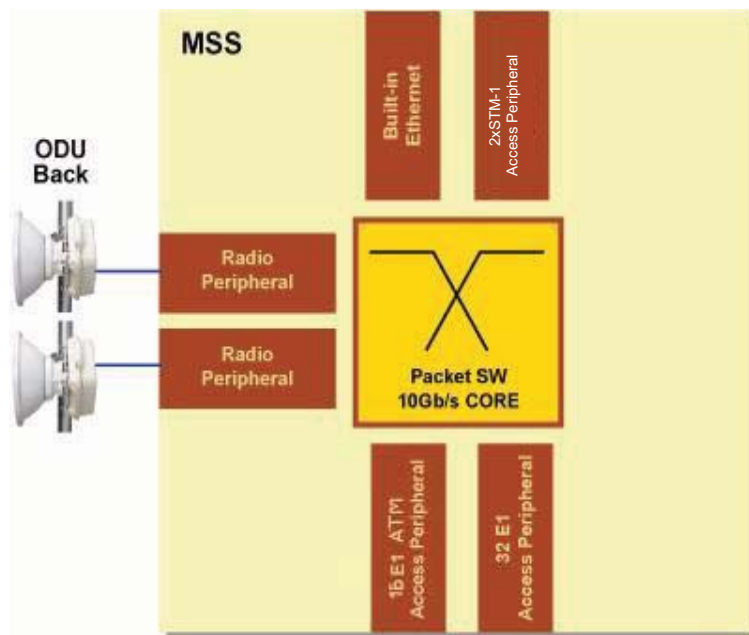


Figure 36. PDH/SDH/ATM and Ethernet Terminal Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 2 Back Links

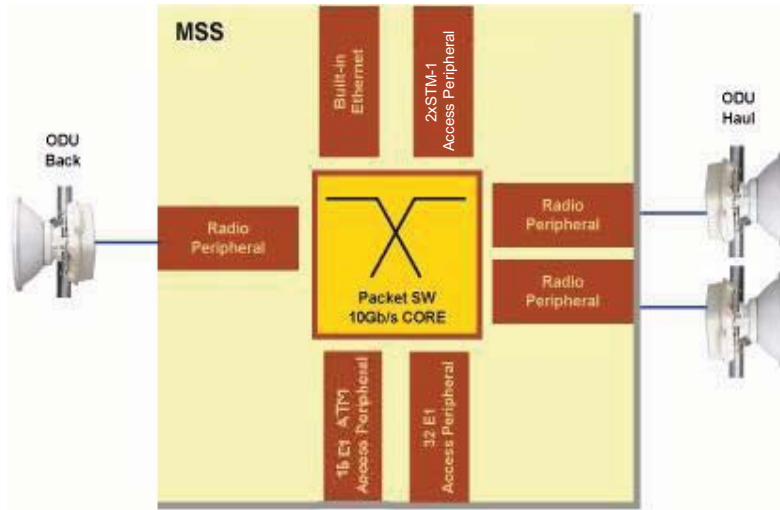


Figure 37. PDH/SDH/ATM and Ethernet Add/Drop Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 1 Back Link and 2 Haul Links

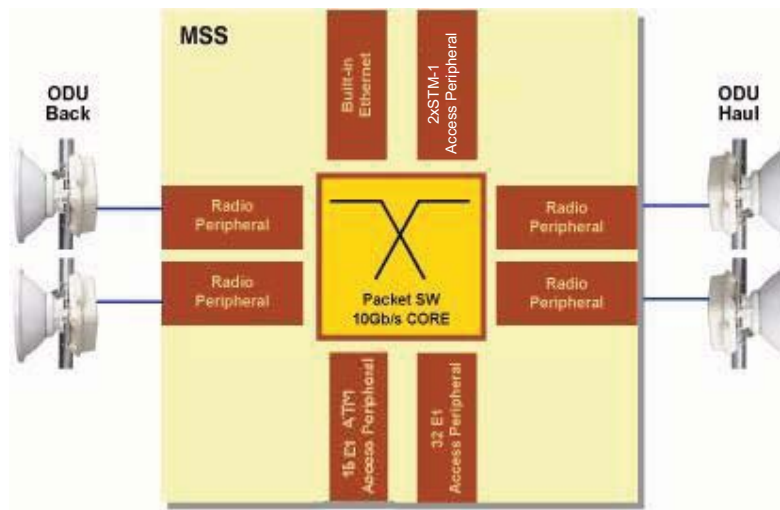


Figure 38. PDH/SDH/ATM and Ethernet Add/Drop Packet Node-Ethernet and 32 E1, 2xSTM-1 and 16 E1 ATM Local Access, 2 Haul Links and 2 Back Links

2.6 Environmental and Electrical Characteristics

- System Parameters (par. 2.6.1)
- ODU300 (par. 2.6.2)
- MPT-HC/MPT-HC V2 (par. 2.6.3)
- MPT-MC (par. 2.6.4)
- Radio performances (par. 2.6.5)
- General characteristics (Power Injector) (par. 2.6.6)
- General characteristics (Power Extractor) (par. 2.6.7)

2.6.1 System Parameters

General with ODU300	
Operating Frequency Range	6 - 38 GHz
Max Ethernet throuput	from 10 up to 310 Mbit/s
Modulation Options in FCM	4 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM
Adaptive Modulation	4 QAM, 16 QAM, 64 QAM,
General with MPT-HC/MPT-HC V2	
Operating Frequency Range	6 - 38 GHz
Max Ethernet throuput	340 Mbit/s
Bandwidth	up to 56 MHz
Modulation Options in FCM	4 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM
Adaptive Modulation	4 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM
General with MPT-MC	
Operating Frequency Range	6 - 38 GHz
Max Ethernet throuput	155 Mbit/s
Bandwidth	up to 28 MHz
Modulation Options in FCM	4 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM
Adaptive Modulation	4 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM
Radio Path Protection Options	
Non Protected, 1+0 Protected Hot Standby, 1+1 Space Diversity, 1+1 Frequency Diversity, 1+1 XPIC 1+0/1+1 (with MPT-HC V2) Radio LAG with four radio channels (with MPT-HC/MPT-HC V2/MPT-MC)	

MSS Power supply		
Input voltage range	-40.5 to -57.6 Vdc	The input voltage range can be also from -57 to -60 Vdc without any damage, but with no guaranteed performance
	+19 Vdc to +36 Vdc	The optional +24 Vdc/-48 Vdc converter module has to be installed for +24 Vdc office applications
Standards Compliance		
EMC	MSS-8/MSS-4	EN 301 489-1, EN 301 489-4 EN 55022 Class B)
Operation	ODU300/MPT	ETS 300 019, Class 4.1
Operation	MSS-8/MSS-4	ETS 300 019, Class 3.2
Storage		ETS 300 019, Class 1.2
Transportation		ETS 300 019, Class 2.3
Safety		IEC 60950-1/EN 60950-1
Radio Frequency		EN 302 217 Classes 2, 4 & E5
Water Ingress	ODU300/MPT	IEC 60529 (IPX6)
Environmental		
Operating Temperature	MSS-8/MSS-4 Guaranteed	-5° to +55° C
	ODU300/MPT Guaranteed	-33° to +55° C
Start up temperature from low temperature	ODU300	-20°C
	MPT	-40°C
Humidity	MSS-8/MSS-4 Guaranteed	0 to 95%, non-condensing
	ODU300/MPT Guaranteed	0 to 100%
Management		
Protocol	SNMP	
Interface, electrical	Ethernet 10/100/1000 Base-T (RJ45)	
Local/remote Configuration and Support Tool	JUSM	
Routing Protocols supported	Static routing and dynamic routing (OSPF)	
TMN In-band	2 interfaces	
Network Management	Alcatel-Lucent 1350 OMS Alcatel-Lucent 1352 Compact Alcatel-Lucent 5620 SAM	

2.6.2 ODU300

2.6.2.1 6 to 15 GHz

	L6/U6 GHz	7 GHz	8 GHz	10 GHz	11 GHz	13 GHz	15 GHz
System							
Frequency Range, GHz	5.925 - 6.425 6.425 - 7.11	7.125 - 7.9	7.725 - 8.5	10.0 - 10.68	10.7 - 11.7	12.75 - 13.25	14.4 - 15.35
T-R Spacings supported MHz	252.04 340	154, 161, 168, 196, 245	119, 126, 151.614, 266, 311.32	91, 230, 143.5, 350	490, 530	266	315, 420, 490, 644, 728
Maximum Tuning Range (dependent upon T-R spacing), MHz	56	56	140	165	165	84	245
Antenna Interface							
Waveguide Type	R70 (WR137)	R84 (WR112)	R84 (WR112)	R100 (WR90)	R100 (WR90)	R120 (WR75)	R140 (WR62)
Flange Type	UDR70	UDR84	UDR84	UDR100	UDR100	UBR120	UBR140
Mating Flange Type	PDR70 or CDR70	PDR84 or CDR84	PDR84 or CDR84	PDR100 or CDR100	PDR100 or CDR100	PBR120 or CDR120	PBR140 or CBR140
Guaranteed power consumption	45 W						

2.6.2.2 18 to 38 GHz

	18 GHz	23 GHz	26 GHz	28 GHz	32 GHz	38 GHz
System						
Frequency Range, GHz	17.7 - 19.7	21.2 - 23.632	24.52 - 26.483	27.5 - 29.5	31.8-33.4	37.0 - 39.46
T-R Spacings supported MHz	1010, 1092.5	1008, 1200, 1232	1008	1008	812	1260
Maximum Tuning Range (dependent upon T-R spacing), MHz	380	370	360	360	370	340
Antenna Interface						
Waveguide Type	R220 (WR42)	R220 (WR42)	R220 (WR42)	R320 (WR28)	R320 (WR28)	R320 (WR28)
Flange Type	UBR220	UBR220	UBR220	UBR320	UBR321	UBR320
Mating Flange Type	PBR220	PBR220	PBR220	PBR320	PBR321	PBR320
Guaranteed power consumption	30 W					

2.6.3 MPT-HC/MPT-HC V2

2.6.3.1 6 to 13 GHz

	L6 GHz	U6 GHz	7 GHz	8 GHz	11 GHz	13 GHz
System						
Frequency Range, GHz	5.925 - 6.425	6.425 - 7.11	7.125 - 7.9	7.725 - 8.5	10.7 - 11.7	12.75 - 13.25
T-R Spacings supported MHz	252.04	340	154, 161, 168, 196, 245	119; 126; 151.614; 208; 213.5; 266; 294; 305; 311.32	490-530	266
Antenna Interface						
Waveguide Type		WR137	WR137	WR112	WR113	WR75 WR62
Typical power consumption (MPT-HC)	38 W					
Guaranteed power consumption (MPT-HC)	40 W					
Typical power consumption (MPT-HC V2)	37 W					
Guaranteed power consumption (MPT-HC V2)	39 W					
Typical power consumption (MPT-HC V2 with RPS module)	38 W					
Guaranteed power consumption (MPT-HC V2 with RPS module)	40 W					
Typical power consumption (MPT-HC V2 with XPIC-RPS module)	45 W					
Guaranteed power consumption (MPT-HC V2 with XPIC-RPS module)	47 W					

2.6.3.2 15 to 38 GHz

	15 GHz	18 GHz	23 GHz	26 GHz	38 GHz
System					
Frequency Range, GHz	14.4 - 15.35	17.7 - 19.7	21.2 - 23.632	24.52 - 26.483	37.0 - 39.46
T-R Spacings supported MHz	308-315-322, 420, 490, 644, 728	1008-1010, 1560, 340	1008, 1050-1200-1232	1008	1260
Antenna Interface					
Waveguide Type	WR62	WR42	WR42	WR42	WR28

Typical power consumption (MPT-HC)	38 W
Guaranteed power consumption (MPT-HC)	40 W
Typical power consumption (MPT-HC V2)	37 W
Guaranteed power consumption (MPT-HC V2)	39 W
Typical power consumption (MPT-HC V2 with RPS module)	38 W
Guaranteed power consumption (MPT-HC V2 with RPS module)	40 W
Typical power consumption (MPT-HC V2 with XPIC-RPS module)	45 W
Guaranteed power consumption (MPT-HC V2 with XPIC-RPS module)	47 W

2.6.4 MPT-MC

2.6.4.1 6 to 13 GHz

	L6 GHz	U6 GHz	7 GHz	8 GHz	11 GHz	13 GHz
System						
Frequency Range, GHz	5.925 - 6.425	6.425 - 7.11	7.125 - 7.9	7.725 - 8.5	10.7 - 11.7	12.75 - 13.25
T-R Spacings supported MHz	252.04	340	154, 161, 168, 196, 245	119; 126; 151.614; 208; 213,5; 266; 294; 305; 311.32	490-500-530	266
Antenna Interface						
Waveguide Type	WR137	WR137	WR112	WR113	WR75	WR62
Typical power consumption	38 W					
Guaranteed power consumption	40 W					

2.6.4.2 15 to 38 GHz

	15 GHz	18 GHz	23 GHz	26 GHz	38 GHz
System					
Frequency Range, GHz	14.4 - 15.35	17.7 - 19.7	21.2 - 23.632	24.52 - 26.483	37.0 - 39.46
T-R Spacings supported MHz	420-475, 490	1008-1010, 1560	1008, 1050-1200-1232	1008	1260
Antenna Interface					
Waveguide Type	WR62	WR42	WR42	WR42	WR28
Typical power consumption	38 W				
Guaranteed power consumption	40 W				

2.6.5 Radio performances

The radio performances are provided in the "Technical Description" document.

2.6.6 General characteristics (Power Injector)

Power Injector	
Input Voltage range	-38.4 to -57.6 Vdc
Standards Compliance (Power Injector)	
EMC	EN 301 489-1, EN 301 489-4, EN 55022 Class B
Stationary use	ETS 300 019 1-3, Class 3.2
Storage	ETS 300 019 2-1, Class 1.2
Transportation	ETS 300 019 2-2, Class 2.3
Safety	EN 60950
Environmental	
Operating Temperature (Guaranteed)	-40° to +65° C
Humidity (Guaranteed)	0 to 95%, non condensing

2.6.7 General characteristics (Power Extractor)

Standards Compliance (Power Extractor)	
EMC	EN 301 489-1, EN 301 489-4, EN 55022 Class B
Stationary use	ETS 300 019 2-4, Class 4M5 sinusoidal, random and shock
Storage	ETS 300 019, Class 1.3
Transportation	ETS 300 019 2-2, Class 2.3
Safety	EN 60950
Environmental	
Operating Temperature (Guaranteed)	-40° to +65° C
Start up temperature from low temperature	-40° C
Humidity (Guaranteed)	0 to 100%

2.7 Parts Lists

2.7.1 Indoor items

Table 8. MSS item codes

APR Name	APR Code	Remarks
MSS-8 slot shelf	3DB18485AAXX	
MSS-4 slot shelf	3DB18219ABXX	
Core-E Card	3DB18326ABXX	
Fan Card	3DB18134BAXX	To be used in MSS-8
FAN1 Module	3DB18218ACXX	To be used in MSS-4
STM-1 Access Card	3DB18735AAXX	Up to 2 STM-1 signals
E1 Access Card	3DB18126ADXX	Up to 32 E1 TDM stream
EAS Card	3DB18206ACXX	Up to 8 Ethernet traffic interfaces. For the last four interfaces the dedicated SFP must be installed
ASAP Card	3DB18602AAXX	Up to 16 E1 streams with ATM cells
AUX peripheral Card	3DB18236ABXX	
Modem 300 Card	3DB18136ACXX	To interface the ODU300 to be used with 56 MHz bandwidth (no adaptive modulation)
	3DB18136ADXX	
Modem 300EN Card	3DB18538AAXX	To interface the ODU300 to be used with bandwidth up to 28 MHz (with or without adaptive modulation)
	3DB18538ABXX	
MPT Access Card (with PFoE)	3DB18634ABXX	To interface one or two MPT-HC or MPT-MC or one MPT-HC and one MPT-MC
+24 Vdc/-48 Vdc Converter Card	3DB18763AAXX	Two converters on the card for +24 Vdc office applications
+24 Vdc/-48 Vdc Converter Card	3DB18763ABXX	One converter on the card for +24 Vdc office applications
+24 Vdc/-48 Vdc Converter	3DB18764AAXX	To replace a failed converter on the +24 Vdc/-48 Vdc Converter Card
Front plate	3DB18163ABXX	
SFP plug-in STM-1 L1.1	1AB194670005	To be installed in the STM-1 Access card (option)
SFP plug-in STM-1 S1.1	1AB194670007	To be installed in the STM-1 Access card (option)
SFP plug-in STM-1 Copper	1AB210170001	To be installed in the STM-1 Access card (option)

APR Name	APR Code	Remarks
SFP plug-in 1000Base-Lx	1AB383760002	To be installed in the Core-E card or EAS card (option)
SFP plug-in 1000Base-Sx	1AB383760001	To be installed in the Core-E card or EAS card or MPT Access Card (option)
SFP plug-in 1000Base-T (Copper Transceiver)	1AB359780002	To be installed in the Core-E card or EAS card (option)
SFP 2xE1	3DB78012AAAA	To be installed in the Core-E card (option)
SFP S1.1 GE over STM-1	1AB380750003	To be installed in the Core-E card (option)

Table 9. Power Injector item codes

APR Name	APR Code	Remarks
Power Injector box	3CC50129AAXX	To be installed in a 19"/21" rack to provide the PFoE to the MPT-MC
Power Injector plug-in	3CC50128AAXX	To be installed in a MSS shelf to provide the PFoE to the MPT-MC or to the MPT-HC V2
Bracket	3DB77008ACXX	Bracket to be used to install the Power Injector box in a 19" rack
21" Adapter kit	3CC50065AAAA	Kit to be used with bracket item to install the Power Injector box in a 21" rack

Table 10. Licence and software codes

APR name	APR Code	License String
Flash Cards 3.1.0		
MPR Memory L6TD-210	3DB18659ABAA	R/12Cap040
MPR Memory M1TD-210	3DB18660ABAA	R/11Cap040/1Cap080
MPR Memory M2TD-210	3DB18661ABAA	R/10Cap040/2Cap080
MPR Memory M6TD-210	3DB18662ABAA	R/6Cap040/6Cap080
MPR Memory H1TD-210	3DB18663ABAA	R/11Cap040/1Cap100
MPR Memory H2TD-210	3DB18664ABAA	R/10Cap040/2Cap100
MPR Memory H6TD-210	3DB18666ABAA	R/6Cap040/6Cap100
MPR Memory V1TD-210	3DB18667ABAA	R/11Cap040/1Cap150

APR name	APR Code	License String
MPR Memory V2TD-210	3DB18668ABAA	R/10Cap040/2Cap150
MPR Memory V6TD-210	3DB18669ABAA	R/6Cap040/6Cap150
MPR Memory E1TD-210	3DB18670ABAA	R/11Cap040/1Cap300
MPR Memory E2TD-210	3DB18671ABAA	R/10Cap040/2Cap300
MPR Memory E6TD-210	3DB18672ABAA	R/6Cap040/6Cap300
MPR Memory D6TD-210	3DB18718ABAA	R/6Cap040/6Cap350
MPR Memory L12SA-210	3DB18673ABAA	R/12Cap040/TDM2Eth/ATM2Eth
MPR Memory M1SA-210	3DB18675ABAA	R/11Cap040/1Cap080/TDM2Eth/ATM2Eth
MPR Memory M2SA-210	3DB18676ABAA	R/10Cap040/2Cap080/TDM2Eth/ATM2Eth
MPR Memory M6SA-210	3DB18677ABAA	R/6Cap040/6Cap080/TDM2Eth/ATM2Eth
MPR Memory H1SA-210	3DB18678ABAA	R/11Cap040/1Cap100/TDM2Eth/ATM2Eth
MPR Memory H2SA-210	3DB18679ABAA	R/10Cap040/2Cap100/TDM2Eth/ATM2Eth
MPR Memory H6SA-210	3DB18680ABAA	R/6Cap040/6Cap100/TDM2Eth/ATM2Eth
MPR Memory V1SA-210	3DB18681ABAA	R/11Cap040/1Cap150/TDM2Eth/ATM2Eth
MPR Memory V2SA-210	3DB18682ABAA	R/10Cap040/2Cap150/TDM2Eth/ATM2Eth
MPR Memory V6SA-210	3DB18683ABAA	R/6Cap040/6Cap150/TDM2Eth/ATM2Eth
MPR Memory E1SA-210	3DB18684ABAA	R/11Cap040/1Cap300/TDM2Eth/ATM2Eth
MPR Memory E2SA-210	3DB18685ABAA	R/10Cap040/2Cap300/TDM2Eth/ATM2Eth
MPR Memory E6SA-210	3DB18686ABAA	R/6Cap040/6Cap300/TDM2Eth/ATM2Eth
MPR Memory I1TD-210	3DB18665ABAA	R/11Cap040/1Cap060
MPR Memory I2TD-210	3DB18687ABAA	R/10Cap040/2Cap060
MPR Memory I6TD-210	3DB18688ABAA	R/6Cap040/6Cap060
MPR Memory I1SA-210	3DB18689ABAA	R/11Cap040/1Cap060/TDM2Eth/ATM2Eth
MPR Memory I2SA-210	3DB18690ABAA	R/10Cap040/2Cap060/TDM2Eth/ATM2Eth
MPR Memory I6SA-210	3DB18691ABAA	R/6Cap040/6Cap060/TDM2Eth/ATM2Eth
MPR Memory A1TD-210	3DB18692ABAA	R/11Cap040/1Cap130
MPR Memory A2TD-210	3DB18693ABAA	R/10Cap040/2Cap130
MPR Memory A6TD-210	3DB18694ABAA	R/6Cap040/6Cap130
MPR Memory A1SA-210	3DB18695ABAA	R/11Cap040/1Cap130/TDM2Eth/ATM2Eth
MPR Memory A2SA-210	3DB18696ABAA	R/10Cap040/2Cap130/TDM2Eth/ATM2Eth

APR name	APR Code	License String
MPR Memory A6SA-210	3DB18697ABAA	R/6Cap040/6Cap130/TDM2Eth/ATM2Eth
MPR Memory A1TD-210A	3DB18698ABAA	R/11Cap040/1Cap130/12modAdp
MPR Memory A2TD-210A	3DB18699ABAA	R/10Cap040/2Cap130/12modAdp
MPR Memory A6TD-210A	3DB18700ABAA	R/6Cap040/6Cap130/12modAdp
MPR Memory A1SA-210A	3DB18701ABAA	R/11Cap040/1Cap130/TDM2Eth/ATM2Eth/12modAdp
MPR Memory A2SA-210A	3DB18702ABAA	R/10Cap040/2Cap130/TDM2Eth/ATM2Eth/12modAdp
MPR Memory A6SA-210A	3DB18703ABAA	R/6Cap040/6Cap130/TDM2Eth/ATM2Eth/12modAdp
MPR Memory L12TD-210A	3DB18704ABAA	R/12Cap040/12modAdp
MPR Memory M2TD-210A	3DB18705ABAA	R/10Cap040/2Cap080/12modAdp
MPR Memory M6TD-210A	3DB18706ABAA	R/6Cap040/6Cap080/12modAdp
MPR Memory V1TD-210A	3DB18707ABAA	R/11Cap040/1Cap150/12modAdp
MPR Memory L12SA-210A	3DB18708ABAA	R/12Cap040/TDM2Eth/ATM2Eth/12modAdp
MPR Memory M2SA-210A	3DB18709ABAA	R/10Cap040/2Cap080/TDM2Eth/ATM2Eth/12modAdp
MPR Memory M6SA-210A	3DB18710ABAA	R/6Cap040/6Cap080/TDM2Eth/ATM2Eth/12modAdp
MPR Memory V1SA-210A	3DB18711ABAA	R/11Cap040/1Cap150/TDM2Eth/ATM2Eth/12modAdp
MPR Memory D6SA-210A	3DB18719ABAA	R/6Cap040/6Cap350/TDM2Eth/ATM2Eth/12modAdp
MPR Memory D6TD-210A	3DB18720ABAA	R/6Cap040/6Cap350/12modAdp
SW 3.1.0		
SWP 9500 MPR-E 3.1.0 Hybrid Operating System	3DB18867AAAA	
SWP9500 MPR-E 3.1.0 Packet Operating System	3DB18868AAAA	
MPR-E 3.1.0 User Manual CD ROM EN	3DB18810AAAA	
TCO SW Suite Rel 4.4.0	3DB18866AAAA	
SWP OPTICS-IM WT SNMP V4.25	3DB18869AAAA	

2.7.2 ODU300 (with internal lightning surge suppressor)

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23216HAXX	6 GHz	340	6430-6590	ODU 300, 06GHz, T-R 340MHz, 6430-6590MHz, HP, TX LOW
3DB23216HBXX			6770-6930	ODU 300, 06GHz, T-R 340MHz, 6770-6930MHz, HP, TX HIGH
3DB23216HCXX			6515-6675	ODU 300, 06GHz, T-R 340MHz, 6515-6675MHz, HP, TX LOW
3DB23216HDXX			6855-7015	ODU 300, 06GHz, T-R 340MHz, 6855-7015MHz, HP, TX HIGH
3DB23216HEXX			6600-6760	ODU 300, 06GHz, T-R 340MHz, 6600-6760MHz, HP, TX LOW
3DB23216HFXX			6940-7100	ODU 300, 06GHz, T-R 340MHz, 6940-7100MHz, HP, TX HIGH
<hr/>				
3DB23214HAXX	6 GHz	160/170	6540-6610	ODU 300, 06GHz, T-R 160/170MHz, 6540-6610MHz, HP, TX LOW
3DB23214HBXX			6710-6780	ODU 300, 06GHz, T-R 160/170MHz, 6710-6780MHz, HP, TX HIGH
3DB23214HCXX			6590-6660	ODU 300, 06GHz, T-R 160/170MHz, 6590-6660MHz, HP, TX LOW
3DB23214HDXX			6760-6830	ODU 300, 06GHz, T-R 160/170MHz, 6760-6830MHz, HP, TX HIGH
3DB23214HEXX			6640-6710	ODU 300, 06GHz, T-R 160/170MHz, 6640-6710MHz, HP, TX LOW
3DB23214HFXX			6800-6870	ODU 300, 06GHz, T-R 160/170MHz, 6800-6870MHz, HP, TX HIGH
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3DB23215HAXX	6 GHz	252	5930-6020	ODU 300, 06GHz, T-R 252MHz, 5930-6020MHz, HHP, TX LOW
3DB23215HDXX			6182-6273	ODU 300, 06GHz, T-R 252MHz, 6182-6273MHz, HP TX HIGH
3DB23215HBXX			5989-6079	ODU 300, 06GHz, T-R 252MHz, 5989-6079MHz, HP, TX LOW
3DB23215HEXX			6241-6332	ODU 300, 06GHz, T-R 252MHz, 6241-6332MHz, HP, TX HIGH
3DB23215HCXX			6078-6168	ODU 300, 06GHz, T-R 252MHz, 6078-6168MHz, HP, TX LOW
3DB23215HFXX			6330-6421	ODU 300, 06GHz, T-R 252MHz, 6330-6421MHz, HP, TX HIGH
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APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23027HAXX	7 GHz	154	7184-7240	ODU 300, 07GHz, T-R 154MHz, 7184-7240MHz, HP, TX LOW
3DB23027HBXX			7338-7394	ODU 300, 07GHz, T-R 154MHz, 7338-7394MHz, HP, TX HIGH
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3DB23028HBXX	7 GHz	161	7124-7184	ODU 300, 07GHz, T-R 161MHz, 7124-7184MHz, HP, TX LOW
3DB23028HGXX			7282-7342	ODU 300, 07GHz, T-R 161MHz, 7282-7342MHz, HP, TX HIGH
3DB23028HCXX			7170-7230	ODU 300, 07GHz, T-R 161MHz, 7170-7230MHz, HP, TX LOW
3DB23028HIXX			7331-7391	ODU 300, 07GHz, T-R 161MHz, 7331-7391MHz, HP TX HIGH
3DB23028HDXX			7208-7268	ODU 300, 07GHz, T-R 161MHz, 7208-7268MHz, HP, TX LOW
3DB23028HKXX			7366-7426	ODU 300, 07GHz, T-R 161MHz, 7366-7426MHz, HP, TX HIGH
3DB23028HOXX			7549-7606	ODU 300, 07GHz, T-R 161MHz, 7549-7606MHz, HP, TX LOW
3DB23028HRXX			7710-7767	ODU 300, 07GHz, T-R 161MHz, 7710-7767MHz, HP, TX HIGH
3DB23028HPXX			7598-7655	ODU 300, 07GHz, T-R 161MHz, 7598-7655MHz, HP, TX LOW
3DB23028HSXX			7759-7816	ODU 300, 07GHz, T-R 161MHz, 7759-7816MHz, HP, TX HIGH
3DB23028HQXX			7633-7690	ODU 300, 07GHz, T-R 161MHz, 7633-7690MHz, HP, TX LOW
3DB23028HTXX			7794-7851	ODU 300, 07GHz, T-R 161MHz, 7794-7851MHz, HP, TX HIGH
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3DB23026HAXX	7 GHz	154/ 161/ 168	7424-7488	ODU 300, 07GHz, T-R 154/161/168MHz, 7424-7488MHz, HP, TX LOW
3DB23026HDXX			7581-7649	ODU 300, 07GHz, T-R 154/161/168MHz, 7581-7649MHz, HP, TX HIGH
3DB23026HBXX			7480-7544	ODU 300, 07GHz, T-R 154/161/168MHz, 7480-7544MHz, HP, TX LOW
3DB23026HEXX			7637-7705	ODU 300, 07GHz, T-R 154/161/168MHz, 7637-7705MHz, HP, TX HIGH
3DB23026HCXX			7512-7568	ODU 300, 07GHz, T-R 154/161/168MHz, 7512-7568MHz, HP, TX LOW
3DB23026HFXX			7666-7729	ODU 300, 07GHz, T-R 154/161/168MHz, 7666-7729MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23028HAXX	7 GHz	161	7114-7170	ODU 300, 07GHz, T-R 161MHz, 7114-7170MHZ, HP, TX LOW
3DB23028HFXX			7275-7331	ODU 300, 07GHz, T-R 161MHz, 7275-7331MHZ, HP, TX HIGH
3DB23028HUXX			7298-7358	ODU 300, 07GHz, T-R 161MHz, 7298-7358MHZ, HP, TX LOW
3DB23028HVXX			7459-7519	ODU 300, 07GHz, T-R 161MHz, 7459-7519MHZ, HP, TX HIGH
3DB23296HAXX			7125-7191	ODU 300, 07GHz, T-R 161MHz, 7125-7191MHZ, HP, TX LOW
3DB23296HBXX			7282-7352	ODU 300, 07GHz, T-R 161MHz, 7282-7352MHZ, HP, TX HIGH
3DB23296HCXX			7209-7275	ODU 300, 07GHz, T-R 161MHz, 7209-7275MHZ, HP, TX LOW
3DB23296HDXX			7367-7436	ODU 300, 07GHz, T-R 161MHz, 7367-7436MHZ, HP, TX HIGH
3DB23298HAXX	7 GHz	154/ 161/ 168	7480-7554	ODU 300, 07GHz, T-R 154/161/168MHz, 7480-7554MHZ, HP, TX HIGH
3DB23299HAXX			7637-7715	ODU 300, 07GHz, T-R 154/161/168MHz, 7637-7715MHZ, HP, TX HIGH
3DB23026HGXX			7421-7491	ODU 300, 07GHz, T-R 154/161/168MHz, 7421-7491MHZ, HP, TX HIGH
3DB23026HHXX			7581-7652	ODU 300, 07GHz, T-R 154/161/168MHz, 7581-7652MHZ, HP, TX HIGH
3DB23028HEXX	7 GHz	161	7247-7309	ODU 300, 07GHz, T-R 161/168MHz, 7247-7309MHZ, HP, TX LOW
3DB23028HLXX			7408-7470	ODU 300, 07GHz, T-R 161/168MHz, 7408-7470MHZ, HP, TX HIGH
3DB23028HWXX			7333,5-7393	ODU 300, 07GHz, T-R 161/168MHz, 7333,5-7393MHZ, HP, TX LOW
3DB23028HXXX			7494,5-7554	ODU 300, 07GHz, T-R 161/168MHz, 7494,5-7554MHZ, HP, TX HIGH
3DB23189HAXX	7 GHz	245	7428-7512	ODU 300, 07GHz, T-R 245MHz, 7428-7512MHZ, HP, TX LOW
3DB23189HBXX			7673-7757	ODU 300, 07GHz, T-R 245MHz, 7673-7757MHZ, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23189HCXX	7 GHz	245	7512-7596	ODU 300, 07GHz, T-R 245MHz, 7512-7596MHz, HP, TX LOW
3DB23189HDXX			7757-7841	ODU 300, 07GHz, T-R 245MHz, 7757-7841MHz, HP, TX HIGH
3DB23189HEXX			7568-7652	ODU 300, 07GHz, T-R 245MHz, 7568-7652MHz, HP, TX LOW
3DB23189HFXX			7813-7897	ODU 300, 07GHz, T-R 245MHz, 7813-7897MHz, HP, TX High
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3DB23186HAXX	7 GH	161/168	7443-7527	ODU 300, 07GHz, T-R 161/168MHz, 7443-7527MHz, HP, TX LOW
3DB23186HBXX			7611-7695	ODU 300, 07GHz, T-R 161/168MHz, 7611-7695MHz, HP, TX HIGH
3DB23186HCXX			7499-7583	ODU 300, 07GHz, T-R 161/168MHz, 7499-7583MHz, HP, TX LOW
3DB23186HDXX			7667-7751	ODU 300, 07GHz, T-R 161/168MHz, 7667-7751MHz, HP, TX HIGH
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3DB23188HAXX	7 GHz	196	7107-7191	ODU 300, 07GHz, T-R 196MHz, 7107-7191MHz, HP, TX LOW
3DB23188HBXX			7303-7387	ODU 300, 07GHz, T-R 196MHz, 7303-7387MHz, HP, TX HIGH
3DB23188HCXX			7163-7247	ODU 300, 07GHz, T-R 196MHz, 7163-7247MHz, HP, TX LOW
3DB23188HDXX			7359-7443	ODU 300, 07GHz, T-R 196MHz, 7359-7443MHz, HP, TX HIGH
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3DB23217HAXX	7 GHz	150	7424-7485	ODU 300, 07GHz, T-R 150MHz, 7424-7485MHz, HP, TX LOW
3DB23218HAXX			7574-7635	ODU 300, 07GHz, T-R 150MHz, 7574-7635MHz, HP, TX HIGH
3DB23219HAXX			7470-7530	ODU 300, 07GHz, T-R 150MHz, 7470-7530MHz, HP, TX LOW
3DB23220HAXX			7620-7680	ODU 300, 07GHz, T-R 150MHz, 7620-7680MHz, HP, TX HIGH
3DB23221HAXX			7515-7575	ODU 300, 07GHz, T-R 150MHz, 7515-7575MHz, HP, TX LOW
3DB23222HAXX			7665-7725	ODU 300, 07GHz, T-R 150MHz, 7665-7725MHz, HP, TX HIGH
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APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23223HAXX	7 GHz	175	7124-7185	ODU 300, 07GHz, T-R 175MHz, 7124-7185MHz, HP, TX LOW
3DB23224HAXX			7299-7360	ODU 300, 07GHz, T-R 175MHz, 7299-7360MHz, HP, TX HIGH
3DB23225HAXX			7157.5-7217.5	ODU 300, 07GHz, T-R 175MHz, 7157.5-7217.5MHz, HP, TX LOW
3DB23226HAXX			7332.5-7392.5	ODU 300, 07GHz, T-R 175MHz, 7332.5-7392.5MHz, HP, TX HIGH
3DB23227HAXX			7190-7250	ODU 300, 07GHz, T-R 175MHz, 7190-7250MHz, HP, TX LOW
3DB23228HAXX			7365-7425	ODU 300, 07GHz, T-R 175MHz, 7365-7425MHz, HP, TX HIGH
3DB23289HAXX	8 GHz	195	7718-7802	ODU 300, 08GHz, T-R 195MHz, 7718-7802MHz, HP, TX LOW
3DB23289HBXX			7913-7997	ODU 300, 08GHz, T-R 195MHz, 7913-7997MHz, HP, TX HIGH
3DB23033HEXX	8 GHz	300/ 310/ 311.32/ 305.56	7722,5-7859	ODU 300, 08GHz, T-R 300/310/311.32/305.56MHz, 7722,5-7859MHz, HP, TX LOW
3DB23033HGXX			8025-8171	ODU 300, 08GHz, T-R 300/310/311.32/305.56MHz, 8025-8171MHz, HP, TX LOW
3DB23033HFXX			7844-7981	ODU 300, 08GHz, T-R 300/310/311.32/305.56MHz, 7844-7981MHz, HP, TX LOW
3DB23033HHXX			8145-8287	ODU 300, 08GHz, T-R 300/310/311.32/305.56MHz, 8145-8287MHz, HP, TX LOW
3DB23030HAXX	8 GHz	151	8204-8275	ODU 300, 08GHz, T-R 151MHz, 8204-8275MHz, HP, TX LOW
3DB23030HCXX			8355-8426	ODU 300, 08GHz, T-R 151MHz, 8355-8426MHz, HP, TX HIGH
3DB23030HBXX			8273-8345	ODU 300, 08GHz, T-R 151MHz, 8273-8345MHz, HP, TX LOW
3DB23030HDXX			8425-8496	ODU 300, 08GHz, T-R 151MHz, 8425-8496MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23029HAXX	8 GHz	119/126	8279-8321	ODU 300, 08GHz, T-R 119/126MHz, 8279-8321MHz, HP, TX LOW
3DB23029HDXX			8398-8440	ODU 300, 08GHz, T-R 119/126MHz, 8398-8440MHz, HP, TX HIGH
3DB23029HBXX			8307-8349	ODU 300, 08GHz, T-R 119/126MHz, 8307-8349MHz, HP, TX LOW
3DB23029HEXX			8426-8468	ODU 300, 08GHz, T-R 119/126MHz, 8426-8468MHz, HP, TX HIGH
3DB23029HCXX			8335-8377	ODU 300, 08GHz, T-R 119/126MHz, 8335-8377MHz, HP, TX LOW
3DB23029HFXX			8454-8496	ODU 300, 08GHz, T-R 119/126MHz, 8454-8496MHz, HP, TX HIGH
3DB23032HAXX	8 GHz	266	7898-8021	ODU 300, 08GHz, T-R 266MHz, 7898-8021MHz, HP, TX LOW
3DB23032HCXX			8164-8290	ODU 300, 08GHz, T-R 266MHz, 8164-8290MHz, HP, TX HIGH
3DB23032HBXX			8010-8133	ODU 300, 08GHz, T-R 266MHz, 8010-8133MHz, HP, TX LOW
3DB23032HDXX			8276-8399	ODU 300, 08GHz, T-R 266MHz, 8276-8399MHz, HP, TX HIGH
3DB23034HAXX	8 GHz	310	7905-8045	ODU 300, 08GHz, T-R 310MHz, 7905-8045MHz, HP, TX LOW
3DB23034HCXX			8215-8355	ODU 300, 08GHz, T-R 310MHz, 8215-8355MHz, HP, TX HIGH
3DB23034HBXX			8045-8185	ODU 300, 08GHz, T-R 310MHz, 8045-8185MHz, HP, TX LOW
3DB23034HDXX			8355-8495	ODU 300, 08GHz, T-R 310MHz, 8355-8495MHz, HP, TX HIGH
3DB23031HAXX	8 GHz	208	8050-8148	ODU 300, 08GHz, T-R 208MHz, 8050-8148MHz, HP, TX LOW
3DB23031HCXX			8258-8356	ODU 300, 08GHz, T-R 208MHz, 8258-8356MHz, HP, TX HIGH
3DB23031HBXX			8099-8197	ODU 300, 08GHz, T-R 208MHz, 8099-8197MHz, HP, TX LOW
3DB23031HDXX			8307-8405	ODU 300, 08GHz, T-R 208MHz, 8307-8405MHz, HP, TX HIGH
3DB23031HEXX			8148-8246	ODU 300, 08GHz, T-R 208MHz, 8148-8246MHz, HP, TX LOW

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23031HFXX			8356-8454	ODU 300, 08GHz, T-R 208MHz, 8356-8454MHz, HP, TX HIGH
3DB23303HAXX	8 GHz	360	7750-7900	ODU 300, 08GHz, T-R 360MHz, 7750-7900MHz, HP, TX LOW
3DB23304HAXX			8110-8260	ODU 300, 08GHz, T-R 360MHz, 8110-8260MHz, HP, TX HIGH
3DB23305HAXX			7870-8020	ODU 300, 08GHz, T-R 360MHz, 7870-8020MHz, HP, TX LOW
3DB23306HAXX			8230-8380	ODU 300, 08GHz, T-R 360MHz, 8230-8380MHz, HP, TX HIGH
3DB23307HAXX			7990-8140	ODU 300, 08GHz, T-R 360MHz, 7990-8140MHz, HP, TX HIGH
3DB23308HAXX			8350-8500	ODU 300, 08GHz, T-R 360MHz, 8350-8500MHz, HP, TX HIGH
3DB23261HAXX	10 GHz	350	10150.5-10252	ODU 300, 10GHz, T-R 350MHz, 10150.5-10252MHz, EP, TX LOW
3DB23261HBXX			10500.5-10602	ODU 300, 10GHz, T-R 350MHz, 10500.5-10602MHz, EP, TX HIGH
3DB23261HCXX			10196-10297.5	ODU 300, 10GHz, T-R 350MHz, 10196-10297.5MHz, EP, TX LOW
3DB23261HDXX			10546-10647.5	ODU 300, 10GHz, T-R 350MHz, 10546-10647.5MHz, EP, TX HIGH
3DB23255HAXX	10 GHz	91	10500.5-10516.3	ODU 300, 10GHz, T-R 91MHz, 10500.5-10516.3MHz, EP, TX LOW
3DB23255HBXX			10591.5-10607.3	ODU 300, 10GHz, T-R 91MHz, 10591.5-10607.3MHz, EP, TX HIGH
3DB23255HCXX			10514.5-10530.3	ODU 300, 10GHz, T-R 91MHz, 10514.5-10530.3MHz, EP, TX LOW
3DB23255HDXX			10605.5-10621.3	ODU 300, 10GHz, T-R 91MHz, 10605.5-10621.3MHz, EP, TX HIGH
3DB23255HEXX			10528.5-10544.3	ODU 300, 10GHz, T-R 91MHz, 10528.5-10544.3MHz, EP, TX LOW
3DB23255HFXX			10619.5-10635.3	ODU 300, 10GHz, T-R 91MHz, 10619.5-10635.3MHz, EP, TX HIGH
3DB23255HGXX			10542.5-10558.3	ODU 300, 10GHz, T-R 91MHz, 10542.5-10558.3MHz, EP, TX LOW
3DB23255HHXX			10633.5-10649.3	ODU 300, 10GHz, T-R 91MHz, 10633.5-10649.3MHz, EP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23255HIXX	10 GHz	91	10556.5-10572.3	ODU 300, 10GHz, T-R 91MHz, 10556.5-10572.3MHz, EP, TX LOW
3DB23255HLXX			10647.5-10663.3	ODU 300, 10GHz, T-R 91MHz, 10647.5-10663.3MHz, EP, TX HIGH
3DB23255HMXX			10570.5-10586.3	ODU 300, 10GHz, T-R 91MHz, 10570.5-10586.3MHz, EP, TX LOW
3DB23255HNXX			10661.5-10677.3	ODU 300, 10GHz, T-R 91MHz, 10661.5-10677.3MHz, EP, TX HIGH
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3DB23241HAXX	10 GHz	65	10550-10560	ODU 300, 10GHz, T-R 65MHz, 10550-10560MHz, EP, TX LOW
3DB23242HAXX			10615-10625	ODU 300, 10GHz, T-R 65MHz, 10615-10625MHz, EP, TX HIGH
3DB23243HAXX			10560-10570	ODU 300, 10GHz, T-R 65MHz, 10560-10570MHz, EP, TX LOW
3DB23244HAXX			10625-10635	ODU 300, 10GHz, T-R 65MHz, 10625-10635MHz, EP, TX HIGH
3DB23245HAXX			10570-10580	ODU 300, 10GHz, T-R 65MHz, 10570-10580MHz, EP, TX LOW
3DB23246HAXX			10635-10645	ODU 300, 10GHz, T-R 65MHz, 10635-10645MHz, EP, TX HIGH
3DB23247HAXX			10580-10590	ODU 300, 10GHz, T-R 65MHz, 10580-10590MHz, EP, TX LOW
3DB23248HAXX			10645-10655	ODU 300, 10GHz, T-R 65MHz, 10645-10655MHz, EP, TX HIGH
3DB23249HAXX			10590-10600	ODU 300, 10GHz, T-R 65MHz, 10590-10600MHz, EP, TX LOW
3DB23250HAXX			10655-10665	ODU 300, 10GHz, T-R 65MHz, 10655-10665MHz, EP, TX HIGH
3DB23251HAXX			10600-10610	ODU 300, 10GHz, T-R 65MHz, 10600-10610MHz, EP, TX LOW
3DB23252HAXX			10665-10675	ODU 300, 10GHz, T-R 65MHz, 10665-10675MHz, EP, TX HIGH
3DB23253HAXX			10605-10615	ODU 300, 10GHz, T-R 65MHz, 10605-10615MHz, EP, TX LOW
3DB23254HAXX			10670-10680	ODU 300, 10GHz, T-R 65MHz, 10670-10680MHz, EP, TX HIGH
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APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23035HAXX	11 GHz	490/500/530	10675-10835	ODU 300, 11GHz, T-R 490/0500/0530MHz, 10675-10835MHz, HP, TX LOW
3DB23035HEXX			11200-11345	ODU 300, 11GHz, T-R 490/0500/0530MHz, 11200-11345MHz, HP, TX HIGH
3DB23035HBXX			10795-10955	ODU 300, 11GHz, T-R 490/0500/0530MHz, 10795-10955MHz, HP, TX LOW
3DB23035HFXX			11310-11465	ODU 300, 11GHz, T-R 490/0500/0530MHz, 11310-11465MHz, HP, TX HIGH
3DB23035HCXX			10915-11075	ODU 300, 11GHz, T-R 490/0500/0530MHz, 10915-11075MHz, HP, TX LOW
3DB23035HGXX			11430-11585	ODU 300, 11GHz, T-R 490/0500/0530MHz, 11430-11585MHz, HP, TX HIGH
3DB23035HDXX			11035-11200	ODU 300, 11GHz, T-R 490/0500/0530MHz, 11035-11200MHz, HP, TX LOW
3DB23035HHXX			11550-11705	ODU 300, 11GHz, T-R 490/0500/0530MHz, 11550-11705MHz, HP, TX HIGH
3DB23036HAXX	13 GHz	266	12751-12835	ODU 300, 13GHz, T-R 266MHz, 12751-12835MHz, HP, TX LOW
3DB23036HEXX			13017-13101	ODU 300, 13GHz, T-R 266MHz, 13017-13101MHz, HP, TX HIGH
3DB23036HBXX			12807-12891	ODU 300, 13GHz, T-R 266MHz, 12807-12891MHz, HP, TX LOW
3DB23036HFXX			13073-13157	ODU 300, 13GHz, T-R 266MHz, 13073-13157MHz, HP, TX HIGH
3DB23036HDXX			12891-12975	ODU 300, 13GHz, T-R 266MHz, 12891-12975MHz, HP, TX LOW
3DB23036HHXX			13157-13241	ODU 300, 13GHz, T-R 266MHz, 13157-13241MHz, HP, TX HIGH
3DB23036HCXX			12835-12919	ODU 300, 13GHz, T-R 266MHz, 12835-12919MHz, HP, TX LOW
3DB23036HGXX			13101-13185	ODU 300, 13GHz, T-R 266MHz, 13101-13185MHz, HHP, TX HIGH
3DB23037HAXX	15 GHz	315/322	14627-14788	ODU 300, 15GHz, T-R 315MHz, 14627-14788MHz, HP, TX LOW
3DB23037HCXX			14942-15103	ODU 300, 15GHz, T-R 315MHz, 14942-15103MHz, HP, TX HIGH
3DB23037HBXX			14760-14914	ODU 300, 15GHz, T-R 315MHz, 14760-14914MHz, HP, TX LOW
3DB23037HDXX			15075-15229	ODU 300, 15GHz, T-R 315MHz, 15075-15229MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23038HAXX	15 GHz	420	14501-14648	ODU 300, 15GHz, T-R 420MHz, 14501-14648MHz, HHP, TX LOW
3DB23038HDXX			14921-15068	ODU 300, 15GHz, T-R 420MHz, 14921-15068MHz, HP, TX HIGH
3DB23038HBXX			14641-14788	ODU 300, 15GHz, T-R 420MHz, 14641-14788MHz, HP, TX LOW
3DB23038HEXX			15061-15208	ODU 300, 15GHz, T-R 420MHz, 15061-15208MHz, HP, TX HIGH
3DB23038HCXX			14781-14928	ODU 300, 15GHz, T-R 420MHz, 14781-14928MHz, HP, TX LOW
3DB23038HFXX			15201-15348	ODU 300, 15GHz, T-R 420MHz, 15201-15348MHz, HP, TX HIGH
3DB23039HEXX	15 GHz	475/490	14403-14634	ODU 300, 15GHz, T-R 490/490MHz, 14403-14634MHz, HP, TX LOW
3DB23039HFXX			14893-15124	ODU 300, 15GHz, T-R 490/490MHz, 14893-15124MHz, HP, TX HIGH
3DB23039HAXX			14627-14873	ODU 300, 15GHz, T-R 475/0490MHz, 14627-14873MHz, HP, TX LOW
3DB23039HBXX			15117-15348	ODU 300, 15GHz, T-R 475/0490MHz, 15117-15348MHz, HP, TX HIGH
3DB23295HAXX	15 GHz	640/644/728	14500-14714.5	ODU 300, 15GHz, T-R 640/644/0728MHz, 14500-14714.5MHz, HP, TX LOW
3DB23295HBXX			15136.5-15350	ODU 300, 15GHz, T-R 640/644/0728MHz, 15136.5-15350MHz, HP, TX HIGH
3DB23039HCXX	15 GHz	475	14500-14660	ODU 300, 15GHz, T-R 475MHz, 14500-14660MHz, HP, TX LOW
3DB23039HDXX			14975-15135	ODU 300, 15GHz, T-R 475MHz, 14975-15135MHz, HP, TX HIGH
3DB23062HCXX	18 GHz	1560	17700 - 18140	ODU 300, 18GHz, T-R 1560MHz, 17700-18140MHz, HP, TX LOW
3DB23062HDXX			19260 - 19700	ODU 300, 18GHz, T-R 1560MHz, 19260-19700MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23041HAXX	18 GHz	340	18580-18660	ODU 300, 18GHz, T-R 340MHz, 18580-18660MHz, HP, TX LOW
3DB23041HDXX			18920-19000	ODU 300, 18GHz, T-R 340MHz, 18920-19000MHz, HP, TX HIGH
3DB23041HBXX			18660-18740	ODU 300, 18GHz, T-R 340MHz, 18660-18740MHz, HP, TX LOW
3DB23041HEXX			19000-19080	ODU 300, 18GHz, T-R 340MHz, 19000-19080MHz, HP, TX HIGH
3DB23041HCXX			18740-18820	ODU 300, 18GHz, T-R 340MHz, 18740-18820MHz, HP, TX LOW
3DB23041HFXX			19080-19160	ODU 300, 18GHz, T-R 340MHz, 19080-19160MHz, HP, TX HIGH
3DB23042HAXX	18 GHz	1008/ 1010/ 1092/ 1120	17700-18060	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 17700-18060MHz, HP, TX LOW
3DB23042HEXX			18710-19070	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 18710-19070MHz, HHP, TX HIGH
3DB23042HBXX			17905-18275	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 17905-18275MHz, HHP, TX LOW
3DB23042HFXX			18920-19290	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 18920-19290MHz, HP, TX HIGH
3DB23042HCXX			18110-18490	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 18110-18490MHz, HP, TX LOW
3DB23042HGXX			19130-19510	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 19130-19510MHz, HP, TX HIGH
3DB23042HDXX			18330-18690	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 18330-18690MHz, HP, TX LOW
3DB23042HHXX			19340-19700	ODU 300, 18GHz, T-R 1008/1010/1092/1120MHz, 19340-19700MHz, HP, TX HIGH
3DB23045HAXX	23 GHz	1200/ 1232	21200-21570	ODU 300, 23GHz, T-R 1200/1232MHz, 21200-21570MHz, HP, TX LOW
3DB23045HEXX			22400-22770	ODU 300, 23GHz, T-R 1200/1232MHz, 22400-22770MHz, HP, TX HIGH
3DB23045HBXX			21475-21845	ODU 300, 23GHz, T-R 1200/1232MHz, 21475-21845MHz, HP, TX LOW
3DB23045HFXX			22675-23045	ODU 300, 23GHz, T-R 1200/1232MHz, 22675-23045MHz, HP, TX HIGH
3DB23045HCXX			21750-22120	ODU 300, 23GHz, T-R 1200/1232MHz, 21750-22120MHz, HP, TX LOW
3DB23045HGXX			22950-23320	ODU 300, 23GHz, T-R 1200/1232MHz, 22950-23320MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23045HDXX	23 GHz	1200/1232	22030-22400	ODU 300, 23GHz, T-R 1200/1232MHz, 22030-22400MHz, HP, TX LOW
3DB23045HHXX			23320-23600	ODU 300, 23GHz, T-R 1200/1232MHz, 23230-23600MHz, HP, TX HIGH
<hr/>				
3DB23044HAXX	23 GHz	1008	21952-22312	ODU 300, 23GHz, T-R 1008MHz, 21952-22312MHz, HP, TX LOW
3DB23044HDXX			22960-23320	ODU 300, 23GHz, T-R 1008MHz, 22960-23320MHz, HP, TX HIGH
3DB23044HCXX			22232-22592	ODU 300, 23GHz, T-R 1008MHz, 22232-22592MHz, HP, TX LOW
3DB23044HFXX			23240-23600	ODU 300, 23GHz, T-R 1008MHz, 23240-23600MHz, HP, TX HIGH
3DB23044HBXX			22002-22337	ODU 300, 23GHz, T-R 1008MHz, 22002-22337MHz, HP, TX LOW
3DB23044HEXX			23010-23345	ODU 300, 23GHz, T-R 1008MHz, 23010-23345MHz, HP, TX HIGH
<hr/>				
3DB23043HAXX	23 GHz	600	22140-22380	ODU 300, 23GHz, T-R 600MHz, 22140-22380MHz, HP, TX LOW
3DB23043HBXX			22740-22980	ODU 300, 23GHz, T-R 600MHz, 22740-22980MHz, HP, TX HIGH
<hr/>				
3DB23259HAXX	26 GHz	1008	24549-24909	ODU 300, 26GHz, T-R 1008MHz, 24549-24909MHz, HP, TX LOW
3DB23259HBXX			25557-25917	ODU 300, 26GHz, T-R 1008MHz, 25557-25917MHz, HP, TX HIGH
3DB23259HCXX			24817-25177	ODU 300, 26GHz, T-R 1008MHz, 24817-25177MHz, HP, TX LOW
3DB23259HDXX			25825-26185	ODU 300, 26GHz, T-R 1008MHz, 25825-26185MHz, HP, TX HIGH
3DB23259HEXX			25085-25445	ODU 300, 26GHz, T-R 1008MHz, 25085-25445MHz, HP, TX LOW
3DB23259HFXX			26093-26453	ODU 300, 26GHz, T-R 1008MHz, 26093-26453MHz, HP, TX HIGH
<hr/>				

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23213HAXX	28 GHz	1008	27500-27870	ODU 300, 28GHz, T-R 1008MHz, 27500-27870MHz, HP, TX LOW
3DB23213HDXX			28508-28878	ODU 300, 28GHz, T-R 1008MHz, 28508-28878MHz, HP, TX HIGH
3DB23213HBXX			27820-28190	ODU 300, 28GHz, T-R 1008MHz, 27820-28190MHz, HP, TX LOW
3DB23213HEXX			28828-29198	ODU 300, 28GHz, T-R 1008MHz, 28828-29198MHz, HP, TX HIGH
3DB23213HCXX			28140-28510	ODU 300, 28GHz, T-R 1008MHz, 28140-28510MHz, HP, TX LOW
3DB23213HFXX			29148-29518	ODU 300, 28GHz, T-R 1008MHz, 29148-29518MHz, HP, TX HIGH
3DB48245HAXX	32 GHz	812	31800-32050	ODU 300, 32GHz, T-R 812MHz, 31800-32050MHz, HP, TX LOW
3DB48245HBXX			32612-32862	ODU 300, 32GHz, T-R 812MHz, 32612-32862MHz, HP, TX HIGH
3DB48245HCXX			31978-32228	ODU 300, 32GHz, T-R 812MHz, 31978-32228MHz, HP, TX LOW
3DB48245HDXX			32790-33040	ODU 300, 32GHz, T-R 812MHz, 32790-33040MHz, HP, TX HIGH
3DB48245HGXX			32151-32401	ODU 300, 32GHz, T-R 812MHz, 32151-32401MHz, HP, TX LOW
3DB48245HHXX			32963-33213	ODU 300, 32GHz, T-R 812MHz, 32963-33213MHz, HP, TX HIGH
3DB48245HIXX			32319-32590	ODU 300, 32GHz, T-R 812MHz, 32319-32590MHz, HP, TX HIGH
3DB48245HLXX			33131-33402	ODU 300, 32GHz, T-R 812MHz, 33131-33402MHz, HP, TX HIGH

APR CODES	Freq.	TRsp (MHz)	Frequency Range	Description
3DB23258HAXX	38 GHz	1260	37028-37368	ODU 300, 38GHz, T-R 1260MHz, 37028-37368MHz, HP, TX LOW
3DB23258HBXX			38288-38628	ODU 300, 38GHz, T-R 1260MHz, 38288-38628MHz, HP, TX HIGH
3DB23258HCXX			37308-37648	ODU 300, 38GHz, T-R 1260MHz, 37308-37648MHz, HP, TX LOW
3DB23258HDXX			38568-38908	ODU 300, 38GHz, T-R 1260MHz, 38568-38908MHz, HP, TX HIGH
3DB23258HEXX			37588-37928	ODU 300, 38GHz, T-R 1260MHz, 37588-37928MHz, HP, TX LOW
3DB23258HFXX			38848-39188	ODU 300, 38GHz, T-R 1260MHz, 38848-39188MHz, HP, TX HIGH
3DB23258HGXX			37868-38208	ODU 300, 38GHz, T-R 1260MHz, 37868-38208MHz, HP, TX LOW
3DB23258HHXX			39128-39468	ODU 300, 38GHz, T-R 1260MHz, 39128-39468MHz, HP, TX HIGH
3DB23258HIXX			37251-37526	ODU 300, 38GHz, T-R 1260MHz, 37251-37526MHz, HP, TX LOW
3DB23258HLXX			38511-38786	ODU 300, 38GHz, T-R 1260MHz, 38511-38786MHz, HP, TX HIGH
3DB23258HMXX			37058-37478	ODU 300, 38GHz, T-R 1260MHz, 37058-37478MHz, HP, TX LOW
3DB23258HNXX			38318-38738	ODU 300, 38GHz, T-R 1260MHz, 38318-38738MHz, HP, TX HIGH

2.7.3 MPT-HC with internal diplexer

Table 11. MPT-HC codes with internal diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
L6	252	1	3DB20441ABXX	5930-6049
		1P	3DB20443ABXX	6182-6302
		2	3DB20442ABXX	6048-6168
		2P	3DB20444ABXX	6301-6420
U6	340	1	3DB20437ABXX	6420-6600
		1P	3DB20439ABXX	6760-6940
		2	3DB20438ABXX	6565-6745
		2P	3DB20440ABXX	6905-7085
		3	3DB20464ABXX	6595-6775
		3P	3DB20465ABXX	6935-7115
11	530-490	1	3DB20371ABXX	10695-10955
		1P	3DB20547ABXX	11205-11485
		2	3DB20546ABXX	10935-11205
		2P	3DB20548ABXX	11445-11705
13	266	1	3DB20372ABXX	12750-12865
		1P	3DB20420ABXX	13016-13131
		2	3DB20419ABXX	12861-12980
		2P	3DB20421ABXX	13127-13246
15	308-315-322	1	3DB20466ABXX	14630-14766
		1P	3DB20468ABXX	14945-15081
		2	3DB20467ABXX	14759-14899
		2P	3DB20469ABXX	15074-15215
	420-475	1	3DB20373ABXX	14500-14724
		1P	3DB20423ABXX	14920-15144
	420	2	3DB20422ABXX	14710-14941
		2P	3DB20424ABXX	15130-15361
	490	1	3DB20425ABXX	14400-14635
		1P	3DB20427ABXX	14890-15125
		2	3DB20426ABXX	14625-14860
		2P	3DB20428ABXX	15115-15350
	640-644-728	1	3DB20448ABXX	14500-14700
		1P	3DB20449ABXX	15144-15348

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)	
18	1560	1	3DB20432ABXX	17700-18140	
		1P	3DB20433ABXX	19260-19700	
	340	1	3DB20549ABXX	18581-18700	
		1P	3DB20551ABXX	18920-19040	
		2	3DB20550ABXX	18701-18820	
		2P	3DB20552ABXX	19040-19160	
	1008-1010	1	3DB20374ABXX	17700-18201	
		1P	3DB20430ABXX	18710-19211	
		2	3DB20429ABXX	18180-18690	
		2P	3DB20431ABXX	19190-19700	
	23	1200-1232	1	3DB20473ABXX	21198-21819
			1P	3DB20475ABXX	22400-23019
1050-1200-1232		2	3DB20474ABXX	21781-22400	
		2P	3DB20476ABXX	22981-23600	
1008		1	3DB20375ABXX	22000-22315	
		1P	3DB20471ABXX	23008-23323	
		2	3DB20470ABXX	22300-22600	
		2P	3DB20472ABXX	23308-23608	
25	1008	1	3DB20376ABXX	24540-24997	
		1P	3DB20554ABXX	25548-26005	
		2	3DB20553ABXX	24994-25448	
		2P	3DB20555ABXX	26002-26456	
38	1260	1	3DB20458ABXX	37050-37620	
		1P	3DB20460ABXX	38310-38880	
		2	3DB20459ABXX	37619-38180	
		2P	3DB20461ABXX	38879-39440	

2.7.4 MPT-HC V2 with internal diplexer

Table 12. MPT-HC V2 codes with internal diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
L6	252	1	3DB20441BAXX	5930-6049
		1P	3DB20443BAXX	6182-6302
		2	3DB20442BAXX	6048-6168
		2P	3DB20444BAXX	6301-6420
U6	340	1	3DB20437BAXX	6420-6600
		1P	3DB20439BAXX	6760-6940
		2	3DB20438BAXX	6565-6745
		2P	3DB20440BAXX	6905-7085
		3	3DB20464BAXX	6595-6775
		3P	3DB20465BAXX	6935-7115
11	530-490	1	3DB20371BAXX	10695-10955
		1P	3DB20547BAXX	11205-11485
		2	3DB20546BAXX	10935-11205
		2P	3DB20548BAXX	11445-11705
13	266	1	3DB20372BAXX	12750-12865
		1P	3DB20420BAXX	13016-13131
		2	3DB20419BAXX	12861-12980
		2P	3DB20421BAXX	13127-13246
15	308-315-322	1	3DB20466BAXX	14630-14766
		1P	3DB20468BAXX	14945-15081
		2	3DB20467BAXX	14759-14899
		2P	3DB20469BAXX	15074-15215
	420-475	1	3DB20373BAXX	14500-14724
		1P	3DB20423BAXX	14920-15144
	420	2	3DB20422BAXX	14710-14941
		2P	3DB20424BAXX	15130-15361
	490	1	3DB20425BAXX	14400-14635
		1P	3DB20427BAXX	14890-15125
		2	3DB20426BAXX	14625-14860
		2P	3DB20428BAXX	15115-15350
	640-644-728	1	3DB20448BAXX	14500-14700
		1P	3DB20449BAXX	15144-15348

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
18	1560	1	3DB20432BAXX	17700-18140
		1P	3DB20433BAXX	19260-19700
	340	1	3DB20549BAXX	18581-18700
		1P	3DB20551BAXX	18920-19040
		2	3DB20550BAXX	18701-18820
		2P	3DB20552BAXX	19040-19160
	1008-1010	1	3DB20374BAXX	17700-18201
		1P	3DB20430BAXX	18710-19211
		2	3DB20429BAXX	18180-18690
		2P	3DB20431BAXX	19190-19700
23 (NB1)	1200-1232	1	3DB20473BAXX	21198-21819
		1P	3DB20475BAXX	22400-23019
	1050-1200-1232	2	3DB20474BAXX	21781-22400
		2P	3DB20476BAXX	22981-23600
	1008	1	3DB20375BAXX	22000-22315
		1P	3DB20471BAXX	23008-23323
		2	3DB20470BAXX	22300-22600
		2P	3DB20472BAXX	23308-23608
25	1008	1	3DB20376BAXX	24540-24997
		1P	3DB20554BAXX	25548-26005
		2	3DB20553BAXX	24994-25448
		2P	3DB20555BAXX	26002-26456
38	1260	1	3DB20458BAXX	37050-37620
		1P	3DB20460BAXX	38310-38880
		2	3DB20459BAXX	37619-38180
		2P	3DB20461BAXX	38879-39440

N.B.1: The MPT-HC V2 is a Tx High Power version vs. MPT-HC. Take in account it when MPT-HC V2 is used as spare of MPT-HC.

2.7.5 MPT-MC with internal diplexer

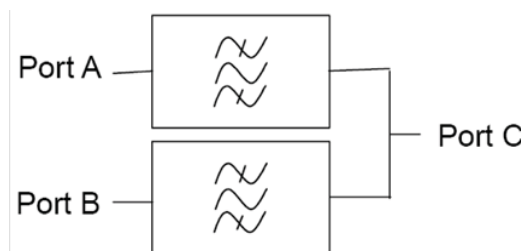
Table 13. MPT-MC codes with internal diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
L6	252	1	3DB20838AAXX	5930-6049
		1P	3DB20840AAXX	6182-6302
		2	3DB20839AAXX	6048-6168
		2P	3DB20841AAXX	6301-6420
11	490-530	1	3DB20874ABXX	10695-10955
		1P	3DB20876ABXX	11205-11485
		2	3DB20875ABXX	10935-11205
		2P	3DB20877ABXX	11445-11705
13	266	1	3DB20818AAXX	12750-12865
		1P	3DB20820AAXX	13016-13131
		2	3DB20819AAXX	12861-12980
		2P	3DB20821AAXX	13127-13246
15	420-475	1	3DB20822AAXX	14500-14724
		1P	3DB20824AAXX	14920-15144
	420	2	3DB20823AAXX	14710-14941
		2P	3DB20825AAXX	15130-15361
	490	1	3DB20826AAXX	14400-14635
		1P	3DB20828AAXX	14890-15125
		2	3DB20827AAXX	14625-14860
		2P	3DB20829AAXX	15115-15350
18	1560	1	3DB20864AAXX	17700-18140
		1P	3DB20865AAXX	19260-19700
	1008-1010	1	3DB20860AAXX	17700-18201
		1P	3DB20862AAXX	18710-19211
		2	3DB20861AAXX	18180-18690
		2P	3DB20863AAXX	19190-19700

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
23	1200-1232	1	3DB20834AAXX	21198-21819
		1P	3DB20836AAXX	22400-23019
	1050-1200-1232	2	3DB20835AAXX	21781-22400
		2P	3DB20837AAXX	22981-23600
	1008	1	3DB20830AAXX	22000-22315
		1P	3DB20832AAXX	23008-23323
		2	3DB20831AAXX	22300-22600
		2P	3DB20833AAXX	23308-23608
25	1008	1	3DB20854AAXX	24540-24997
		1P	3DB20856AAXX	25548-26005
		2	3DB20855AAXX	24994-25448
		2P	3DB20857AAXX	26002-26456
38	1260	1	3DB20870AAXX	37050-37620
		1P	3DB20872AAXX	38310-38880
		2	3DB20871AAXX	37619-38180
		2P	3DB20873AAXX	38879-39440

2.7.6 Part lists of MPT-HC/MPT-HC V2/MPT-MC with external diplexer

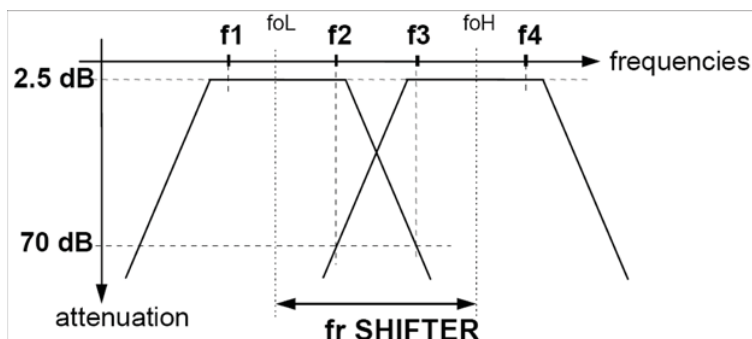
The diplexer included in the available BRANCHING assemblies refers to ITU-R F.385, 386 and RF special CUSTOMERS channelling with Tx/Rx separation specified in following Table 18. and Table 23. Each diplexer is a 3-port passive device with two band-pass filters as described hereafter.



Each BRANCHING assembly has two different variants by duplex spacing, depending on the RF_Tx output frequency band as described on the table below:

3DB Variant	Channel
3DB xxxxx AAXX	1_1p
3DB xxxxx ABXX	2_2p

The arrangement between each filters on the same branching device is described below:



WARNING: f1, f2, f3 and f4 frequencies of the branching filters refer to the extreme channel frequencies and not to the cut-off frequencies of the filters.

Table 14. 7 GHz MPT-MC codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20858AAXX	7107 - 8370
		Upper	3DB20859AAXX	7261 - 8496

Table 15. 7 GHz MPT-HC codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454ADXX	7107 - 8370
		Upper	3DB20456ADXX	7261 - 8496

Table 16. 7 GHz MPT-HC V2 codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454BAXX	7107 - 8370
		Upper	3DB20456BAXX	7261 - 8496

Table 17. 7 GHz MPT-HC V2 High Power codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454BBXX	7107 - 8370
		Upper	3DB20456BBXX	7261 - 8496

Table 18. 7 GHz Branching assemblies (for MPT-HC and MPT-MC)

Shifter MHz	Central Freq. MHz	Filter 1 MHz (Lower Band)		Filter 2 MHz (Upper Band)		BRANCHING ASSEMBLY	
		Low Limit f1	High Limit f2	Low Limit f3	High Limit f4	APR codes	Technical Description
154	7212,0	7107,0	7163,0	7261,0	7317,0	3DB 10060 AAXX	... CH1-1P P.SH. 154_C MHz
154	7547,0	7428,0	7512,0	7582,0	7666,0	3DB 06774 AAXX	... CH1-1P P.SH. 154_A MHz
154	7603,0	7484,0	7568,0	7638,0	7722,0	3DB 06774 ABXX	... CH2-2P P.SH. 154_A MHz
154	7561,0	7442,0	7526,0	7596,0	7680,0	3DB 06775 AAXX	... CH1-1P P.SH.154_B MHz
160	7561,0	7442,0	7520,0	7602,0	7680,0		... CH1-1P P.SH.160 MHz
154	7617,0	7498,0	7582,0	7652,0	7736,0	3DB 06775 ABXX	... CH2-2P P.SH.154_B MHz
160	7617,0	7498,0	7576,0	7658,0	7736,0		... CH2-2P P.SH.160 MHz
161	7240,0	7124,5	7194,5	7285,5	7355,5	3DB 06780 AAXX	... CH1-1P P.SH.161_A MHz
161	7310,0	7194,5	7264,5	7355,5	7425,5	3DB 06780 ABXX	... CH2-2P P.SH.161_A MHz
161	7365,0	7249,5	7319,5	7410,5	7480,5	3DB 06781 AAXX	... CH1-1P P.SH.161_B MHz
161	7435,0	7319,5	7389,5	7480,5	7550,5	3DB 06781 ABXX	... CH2-2P P.SH.161_B MHz
161	7390,0	7274,5	7344,5	7435,5	7505,5	3DB 06782 AAXX	... CH1-1P P.SH.161_C MHz
161	7460,0	7344,5	7414,5	7505,5	7575,5	3DB 06782 ABXX	... CH2-2P P.SH.161_C MHz
161	7540,0	7424,5	7494,5	7585,5	7655,5	3DB 06783 AAXX	... CH1-1P P.SH.161_D MHz
161	7610,0	7494,5	7564,5	7655,5	7725,5	3DB 06783 ABXX	... CH2-2P P.SH.161_D MHz
161	7665,0	7549,5	7619,5	7710,5	7780,5	3DB 06784 AAXX	... CH1-1P P.SH.161_E MHz
161	7735,0	7619,5	7689,5	7780,5	7850,5	3DB 06784 ABXX	... CH2-2P P.SH.161_E MHz
161	7690,0	7574,5	7644,5	7735,5	7805,5	3DB 06785 AAXX	... CH1-1P P.SH.161_F MHz

Shifter MHz	Central Freq. MHz	Filter 1 MHz (Lower Band)		Filter 2 MHz (Upper Band)		BRANCHING ASSEMBLY	
		Low Limit f1	High Limit f2	Low Limit f3	High Limit f4	APR codes	Technical Description
161	7760,0	7644,5	7714,5	7805,5	7875,5	3DB 06785 ABXX	... CH2-2P P.SH.161_F MHz
168	7299,0	7187,0	7243,0	7355,0	7411,0	3DB 10059 AAXX	... CH1-1P P.SH.168_B MHz
168	7569,0	7443,0	7527,0	7611,0	7695,0	3DB 06776 AAXX	... CH1-1P P.SH.168 MHz
168	7625,0	7499,0	7583,0	7667,0	7751,0	3DB 06776 ABXX	... CH2-2P P.SH.168 MHz
182	7547,0	7414,0	7498,0	7596,0	7680,0	3DB 06777 AAXX	... CH1-1P P.SH.182 MHz
182	7603,0	7470,0	7554,0	7652,0	7736,0	3DB 06777 ABXX	... CH2-2P P.SH.182 MHz
196	7247,0	7107,0	7191,0	7303,0	7387,0	3DB 06778 AAXX	... CH1-1P P.SH.196 MHz
196	7303,0	7163,0	7247,0	7359,0	7443,0	3DB 06778 ABXX	... CH2-2P P.SH.196 MHz
245	7606,5	7428,0	7540,0	7673,0	7785,0	3DB 06779 AAXX	... CH1-1P P.SH.245 MHz
245	7718,5	7540,0	7652,0	7785,0	7897,0	3DB 06779 ABXX	... CH2-2P P.SH.245 MHz

N.B. Shifter value choice to be done by WebEML.

Table 19. 8 GHz MPT-MC codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20858AAXX	7107 - 8370
		Upper	3DB20859AAXX	7261 - 8496

Table 20. 8 GHz MPT-HC codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454ADXX	7107 - 8370
		Upper	3DB20456ADXX	7261 - 8496

Table 21. 8 GHz MPT-HC V2 codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454BAXX	7107 - 8370
		Upper	3DB20456BAXX	7261 - 8496

Table 22. 8 GHz MPT-HC V2 High Power codes with external diplexer

Band (GHz)	Shifter (MHz)	Tx sub-band	APR codes	Tx frequency (MHz)
7/8	NA	Lower	3DB20454BBXX	7107 - 8370
		Upper	3DB20456BBXX	7261 - 8496

Table 23. 8 GHz Branching assemblies (for MPT-HC and MPT-MC)

Shifter MHz	Central Freq. MHz	Filter 1 MHz (Lower Band)		Filter 2 MHz (Upper Band)		BRANCHING ASSEMBLY	
		Low Limit f1	High Limit f2	Low Limit f3	High Limit f4	APR codes	Technical Description
119	8366.5	8286.0	8328.0	8405.0	8447.0	3DB 06789 AAXX	... CH1-1P P.SH.119 MHz
126	8366.5	8282.5	8324.5	8408.5	8450.5		... CH1-1P P.SH.126 MHz
119	8408.5	8328.0	8370.0	8447.0	8489.0	3DB 06789 ABXX	... CH2-2P P.SH.119 MHz
126	8408.5	8324.5	8366.5	8450.5	8492.5		... CH2-2P P.SH.126 MHz
151.614	8315.010	8204.217	8274.189	8355.831	8425.803	3DB 06787 AAXX	... CH1-1P P.SH.151 MHz
151.614	8384.982	8274.189	8344.161	8425.803	8495.775	3DB 06787 ABXX	... CH2-2P P.SH.151 MHz
208	8217.0	8064.0	8162.0	8272.0	8370.0	3DB 10073 AAXX	... CH1-1P P.SH.208 MHz
208	8301.0	8148.0	8246.0	8356.0	8454.0	3DB 10073 ABXX	... CH2-2P P.SH.208 MHz
266	8097.5	7905.0	8024.0	8171.0	8290.0	3DB 06788 AAXX	... CH1-1P P.SH.266 MHz
266	8209.5	8017.0	8136.0	8283.0	8402.0	3DB 06788 ABXX	... CH2-2P P.SH.266 MHz
294.440	7947.835	7749.755	7851.475	8044.195	8145.915	3DB 06786 AAXX	... CH1-1P P.SH.294/305/311 MHz
305.560		7738.635			8157.035		
311.320		7732.875			8162.795		
311.320	8066.435	7851.475	7970.075	8162.795	8281.395	3DB 06786 ABXX	... CH2-2P P.SH.294/305/311 MHz
294.440	8063.740	7862.965		8157.405	8264.515		
305.560		7851.845		8275.635			
213.5	8147.0	8035.0	8046.0	8248.0	8259.0	3DB 10103 AAXX	... CH1-1P P.SH.213.5 MHz

2.7.7 MPT-HC optical interface (mandatory for 1+1 configuration)

Table 24. MPT-HC optical interface (mandatory for 1+1 configuration)

Description	APR Codes	Remarks
SFP 1000Base-Sx Transceiver	1AB383760001	Optical SFP module to be installed optionally in the MPT-HC to provide the optical interface
SFP 1000Base-Lx Transceiver	1AB187280040	

2.7.8 MPT-HC V2 external modules (option)

Table 25. MPT-HC V2 external modules

Description	APR Codes	Remarks
RPS MODULE	3DB20117BAXX	All frequency bands. To be installed for 1+1 configurations.
XPIC-RPS MODULE	3DB20116BAXX	All frequency bands. To be installed for 1+1 configurations or for XPIC configurations.

2.7.9 MPT-HC/MPT-HC V2/MPT-MC couplers

Table 26. MPT-HC/MPT-HC V2/MPT-MC couplers

Description	APR Codes
6 GHz 1 dB/10 dB coupler	3CC58056ABXX
7.1-8.5 GHz 1 dB/10 dB coupler	3CC14536AAXX
11 GHz 1 dB/10 dB coupler	3CC14140ABXX
13-15 GHz 1 dB/10 dB coupler	3CC13472ABXX
18-23-25 GHz 1 dB/10 dB coupler	3CC13473ABXX
28-32-38 GHz 1 dB/10 dB coupler	3CC13474ABXX
6 GHz 3 dB coupler	3CC58056AAXX
11 GHz 3 dB coupler	3CC14140AAXX
7.1-8.5 GHz 3 dB coupler AWY MPT	3CC14536ABAA
13-15 GHz 3 dB coupler AWY MPT	3CC13472AAXX
18-23-25 GHz 3 dB coupler AWY-MPT	3CC13473AAXX
28-32-38 GHz 3 dB coupler AWY MPT	3CC13474AAXX

2.8 Functional description

2.8.1 MSS (Indoor Unit)

The MSS incorporates the base-band processing and also modem functionalities only when ODU300 is connected. MSS offers tributaries interfaces as well as supervision. The MSS is frequency-independent.

Two MSS are available:

- **MSS-8**
- **MSS-4**

The **MSS-8** is made of:

- 1 subrack (MSS-8 shelf)
- 1 or 2 Core-E Modules (Working & Spare)
- up to 6 Transport Modules
- 1 AUX Peripheral Module (option: to be installed in Transport slot #8)
- 1 +24 Vdc/-48 Vdc Converter Module (option for +24 Vdc office application: to be installed in Transport slot #4, #6 or #8)
- 1 Fans unit

The **MSS-4** is made of:

- 1 subrack (MSS-4 shelf)
- 1 or 2 Core-E Modules (Working & Spare)
- up to 2 Transport Modules
- 1 AUX Peripheral Module (option: to be installed in Transport slot #4)
- 1 +24 Vdc/-48 Vdc Converter Module (option for +24 Vdc office application: to be installed in Transport slot #3 or #4)
- 1 Fans unit

There are six types of Transport Modules:

- 32xE1 Local Access Module
- 16xE1 ATM Local Access - ASAP Module
- 2xSTM-1 Local Access Module
- Modem Module: to interface the ODU300
- MPT Access Module: to interface up to two MPT. It can provide the PFoE
- EAS Module: provides the access of up to 8 Ethernet traffic interfaces.

In the right part of the MSS shelf there are two sub-D 2-pole power supply connectors.

2.8.1.1 Power distribution

The system receives the Battery input through 2 power connectors mounted on the Subrack structure and connected directly to the Backplane.

Each board, in which a DC/DC converter is mounted, is provided with fuses and diodes on all the lines, in order to be fully independent from the other ones.

The ODU300 Modem unit provides the power supply to the ODU300.

The MPT Access unit can provide the PFoE to MPT to supply the MPT by using the same cable used also to carry the Ethernet traffic.

On the output section the Core-E (Main) board provides +3.3V in parallel with the Core-E (Spare) board to supply the Fan Unit.

A 3.3V, coming from the two Core-E units, is provided to read the EEPROM present on each board also when the DC/DC converter, present on its board, is out of order.

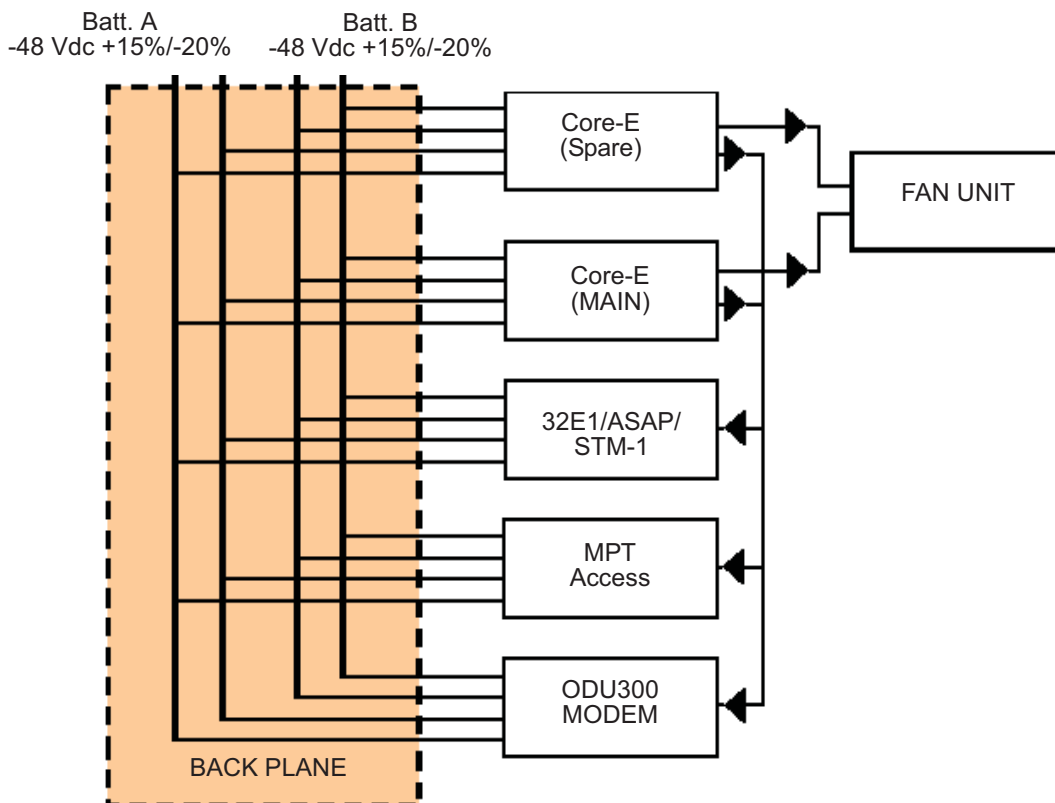


Figure 39. Power Distribution Architecture

2.8.1.2 +24 Vdc/-48 Vdc Converter unit

When office power configuration consists of +24 Vdc a +24/-48 volt power converter is required to condition office power to -48 Vdc for the MSS-4/8 shelf.

The power converter resides in slot 3 or 4 of the MSS-4 shelf and either slot 4, 6, or 8 in the MSS-8 shelf.

Office power (+24 Vdc) is connected to the PDU which in turn connects to the power converter.

The output of the Power Converter (-48 Vdc) is then connected to the MSS-4/8 shelf power connector(s).

The Power Converter supports both unprotected and protected power arrangements.

The same PDU power cables are used to connect between the PDU and the power converter.

Keyed power cables are used to connect between the power converter and the MSS-4/8 shelf.

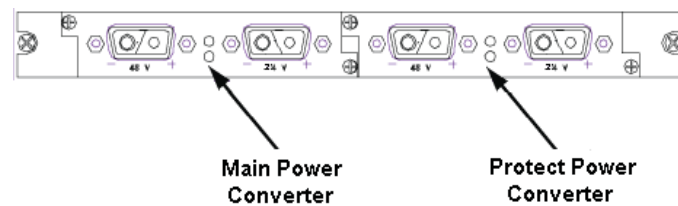


Figure 40. +24 Vdc/-48 Vdc Converter unit

2.8.1.3 Core-E unit

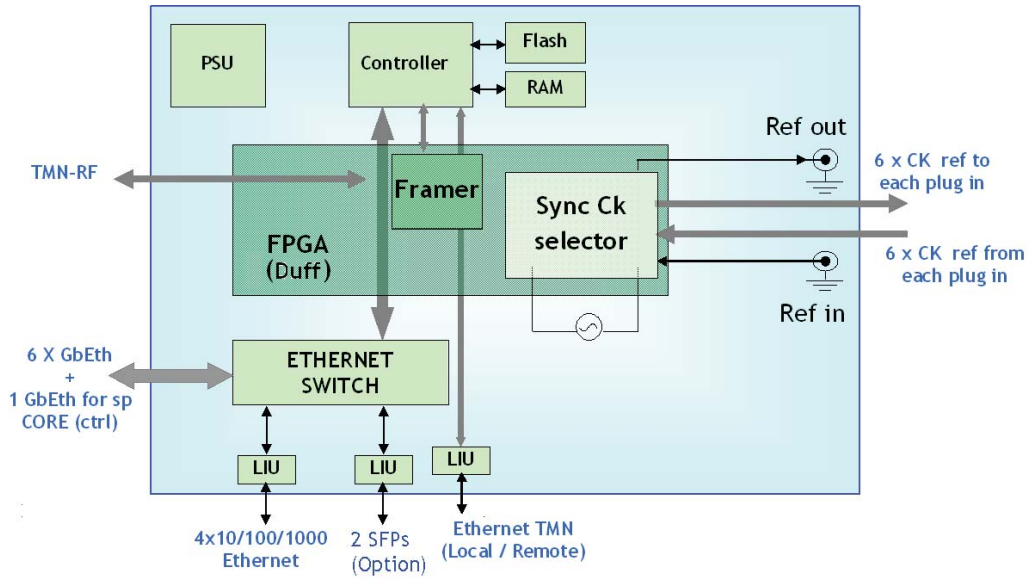


Figure 41. Core-E unit

- Based on **packet technology** with 7 GbEth serial internal interfaces between Core-E and peripherals (jumbo frames 9728 bytes allowed)
- 4x10/100/1000 Ethernet electrical embedded interface (RJ45): port #1 to port #4
- 2 optional SFPs: port #5 and port #6

The Ethernet ports of the Core-E can be configured in 2 ways:

- 1) to be used as GigaEthernet interface for Ethernet traffic (Note: for port#5 and port#6 the optional SFP must be installed);
- 2) to be used to connect an MPT: MPT-HC or MPT-MC to port#1 to port#4; an MPT-HC only to port#5 and port#6.

The flash card stores the licence type, the equipment software, the equipment MIB and the equipment MAC address.

2.8.1.3.1 Main Functions

- Controller
- Layer 2+ Eth Switch, VLAN management & MAC based
 - Ethernet MAC learning
 - x-connect function for PDH and Data payload traffic;
 - For any “packetized” flow, the switch will be in charge to manage the EPS also.
 - QoS management.
- Selection of the synchronization Ck to be distributed to all plug-in.

The Core-E unit has the option to equip two SFPs(in port #5, port #6. These ports can be also used to connect directly an MPT-HC.

2.8.1.3.2 Available SFPs for port #5 and port #6

The following SFPs are available:

- 1000BASE-LX (optical interface for Ethernet traffic)
- 1000BASE-SX (optical interface for Ethernet traffic)
- 1000BASE-T (electrical interface for Ethernet traffic)
- 2xE1 (electrical interface for 2 E1 streams)
- EoSDH (optical interface for STM-1 signal with Ethernet traffic encapsulation)

2.8.1.3.2.1 2xE1 SFP

The 2xE1 SFP is an SFP module supporting MEF8 circuit emulation of up to 2 E1.

This module supports:

- differential clock recovery
- node timing
- loop timing

This module is Synchronous Ethernet capable and it is compliant to optical SFP 1000BASE-X. It can deliver the clock recovered from one of two tributaries to hosting card through the standard SFP pin-out.

SFP module supports TDM2TDM and TDM2ETH services.

The port, in which the SFP has been installed, must be enabled by the WebEML as an optical port, then all the configuration must be done with an Enhanced Configuration File.

Note: The SFP must be installed after the Configuration File has been downloaded. If the SFP has been installed before, remove it and then plug it again.

2.8.1.3.2.2 EoSDH SFP

The Ethernet over SDH SFP is an SFP module supporting the delivery of Ethernet traffic over SDH layer by GFP encapsulation.

The module is compliant to 1000BASE-X specification and support one STM1 interface.

The NE manages the EoSDH SFP as an optical User Ethernet interface. Synchronous operation mode and SSM support are not available, when EoSDH SFP is hosted as optical User Ethernet interface.

Note: For the correct operation of the EoSDH SFP it is necessary to disable the autonegotiation via WebEML or via the Configuration File (refer to paragraph 4.2 of the Configuration File User Manual).

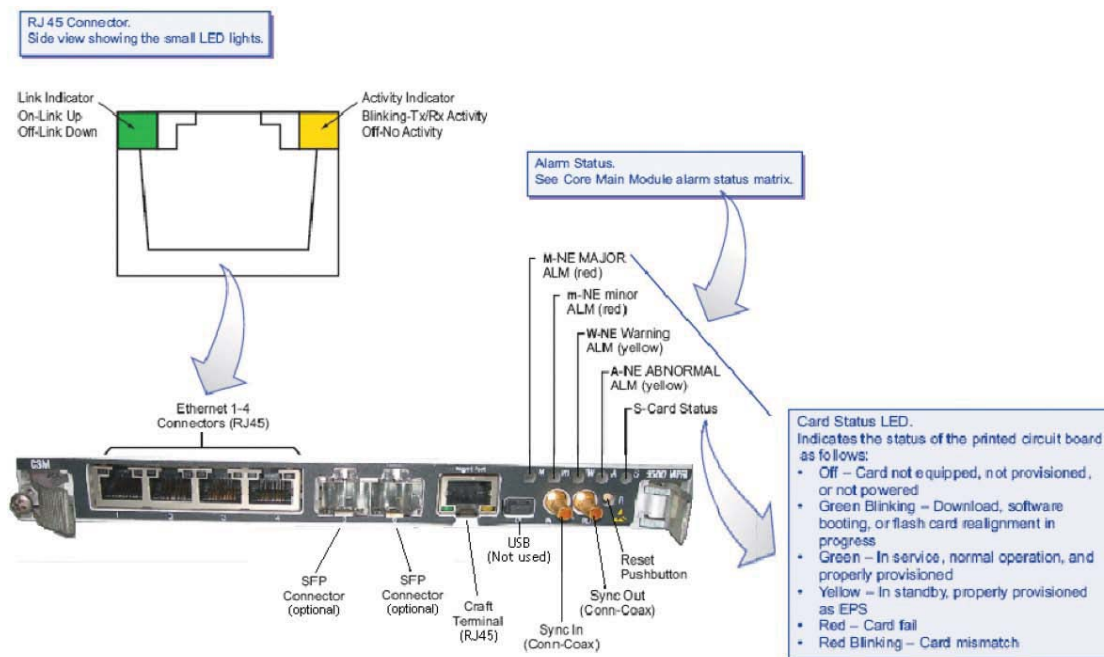


Figure 42. Core-E unit

Warning: The optional optical SFP plug-in, which has to be installed in port #5 and port #6 of the Core-E unit, contains a Class 1 laser source. The laser source is placed in the left side of the SFP plug-in. According to the IEC 60825-1 the explanatory label is not stucked on the equipment due to the lack of space.

2.8.1.4 32xE1 Local Access unit

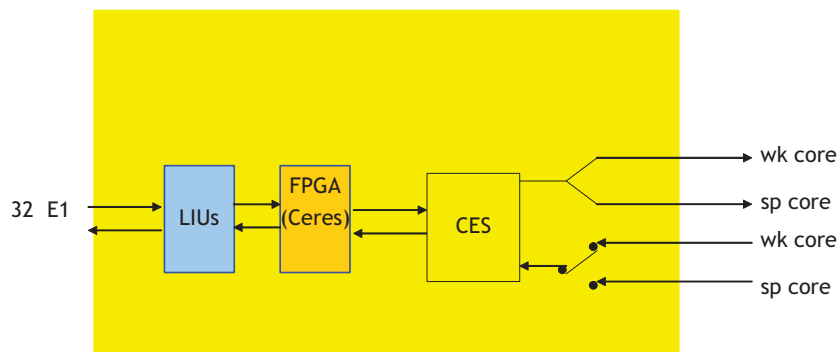


Figure 43. 32xE1 Local Access unit

In the TX direction, the E1 PDH card (E1 Access) processes and encapsulates up to 32 E1 input lines into an Ethernet packet that is sent to the Core-E card(s).

In the RX direction, the E1 Access card extracts data from the Ethernet data packets and processes the data to provide up to 32 E1 output lines.

The 32xE1 Local Access Module performs the following macro functions:

- Termination of 32 E1 signals (32 E1 bi-directional interfaces according ITU-T G.703 on the front panel)
- Framed E1 bi-directional alarm management
- Bi-directional Performance Monitoring on Framed E1
- Encapsulation/Extraction of those PDH data flows into/from standard Ethernet packets Inter Working Function
- Reconstruction of the original PDH Timing meeting G823/824 Req.
- Selection of the Active Core-E
- Sending/getting those std Eth packets to the Core-E module
- Communication with the Controller for provisioning and status report

The module communicates with the Core-E modules through two GbEth Serial copper bi-directional interfaces on the backplane.

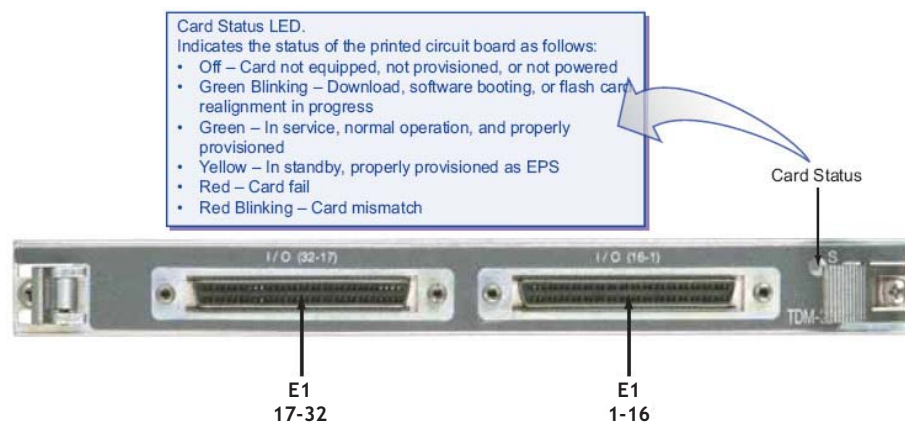


Figure 44. PDH Access unit

2.8.1.5 2xSTM-1 Local Access unit

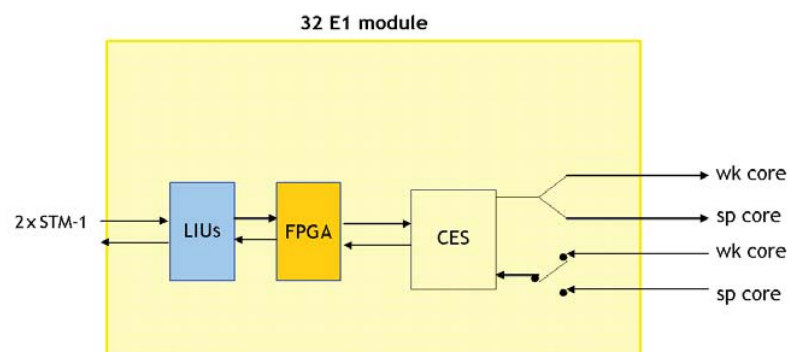


Figure 45. 2xSTM-1 Local Access unit

This unit can manage up to 2xSTM-1 by installing two optional STM-1 SFP plug-ins (electrical or optical).

The STM-1 unit can be used in two different working modes, addressing two different network scenarios:

- STM-1 channelized
- STM-1 transparent

The STM-1 channelized mode is available by provision the unit as "**SDHCHAN**" and the STM-1 transparent mode is available by provision the unit as "**SDHACC**".

The STM-1 unit can support 1 channelized STM-1 or up to 2 transparent STM-1 interfaces.

The STM-1 channelized interface works as a terminal multiplexer; it terminates or originates the SDH frame. It multiplexes Nx E1 into an STM-1 electrical/optical line connection. The clock source can be "Loop time" or "Node time". Typical application is a direct connection to SDH add-drop multiplexers (ADMs). STM-1 card manages one 155 Mbit/s STM1 interface and up to 63xE1. Standard VC4 mapping of lower-order E1 traffic streams to/from STM-1 is applied, that means that a VC4 directly maps up to 63xVC12 into an STM-1 signal (in turn each VC12 contains 1xE1).

Link options include:

- 1+0 non-protected operation
- 1+1 EPS protection (available ONLY with the optical interface)

When the protection of the unit is required (1+1 EPS protection), two STM-1 units must be installed.

Clock source from the incoming STM-1 signal can be selected as Network Element source clock. In the event the clock source is lost, clocking falls back to the internal clock or to other of any synch in options.

In the Tx direction, the STM-1 Local Access unit processes and encapsulates up to 2xSTM-1 input lines into an Ethernet packet that is sent to the Core-E card(s).

In the Rx direction, the STM-1 Local Access unit extracts data from the Ethernet data packets and processes the data to provide up to 2 STM-1 output lines.

The 2xSTM-1 Local Access Unit performs the following macro functions:

- Transparent or channelized transport of the STM-1
- Encapsulation/Extraction of the STM-1 into/from standard Ethernet packets Inter Working Function
- Reconstruction of the original STM-1 Timing
- Selection of the Active Core-E
- Sending/getting those std Eth packets to the Core-E module
- Communication with the Controller for provisioning and status report

The unit communicates with the Core-E modules through two GbEth Serial copper bi-directional interfaces on the backplane.

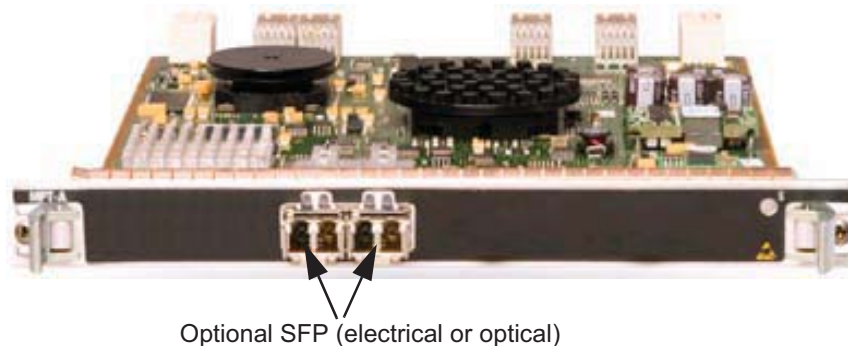


Figure 46. STM-1 Access unit

2.8.1.6 ASAP unit

The ASAP unit is used to transport 16xE1 ATM traffic, with E1/IMA physical layer, in an MPR network.

The ASAP units are unprotected (No 1+1 EPS is available).

ATM traffic is transported within MPR network as "special" Ethernet traffic.

This "special" Ethernet traffic is managed by MPR following to RFC 4717 (IETF ATM PseudoWire Edge-to-Edge Emulation, PWE3) with N-1 encapsulation format.

ATM PW Ethernet traffic is managed by MPR in such a way to emulate the native QoS that would be applied by an ATM equipment; in addition to that, specific techniques, similar to those applied to TDM2ETH traffic, are applied to have air bandwidth optimisation (ATM PW Header Compression) and reduce Cell Error Rate degradation due to packetization.

Main Characteristics

- 16xE1 G.704 supporting ATM/IMA
- IMA protocol 1.1
- Node-timed/loop-timed E1 port synch
- ATM PWE3 encapsulation with N-to-one (N=1) encapsulation format (RFC 4717)
- Max 8 IMA group
- Max 16 E1 per IMA group
- The IMA group must be in the same ASAP card
- Ingress/Egress VPI translation
- Transport of ATM traffic can be done in VCC mode or VPC mode (all the nodes of the MPR chain must have the same mode):
 - VCC mode
 - It is possible to transport max 48 VC for every IMA group. It is possible to manage VC switching (= VCI and VPI change)
 - It is possible to assign at every VC one specific QoS. Policing and shaping at ATM level has performed VC mode only
 - The VC of the same class level (CBR / UBR+ / UBR) are managed in the same radio queue, then are available 3 different radio queues
 - VPC mode
 - It is possible to transport max 48 VP for every IMA group. It is possible to manage only VP switching (=only VPI change)
 - All the VC inside the VP must have same QoS (= for ex. all CBR or all UBR)
 - The radio QoS (= radio tails) and QoS ATM (=policing and shaping) is managed only at VP level.

N.B. The sum of VP + VC configured on a single ASAP card must be ≤ 128 .

Interfaces

- 16 E1 G.704 - SCSI Connectors
- 75 ohm or 120 ohm (at NE level)

Block Diagram

(Refer to Figure 47. on page 130).

The 16xE1 ATM streams enter the ASAP unit on the front panel.

The block diagram is divided in 3 parts:

- LIU/Framer
- Network Processor
- Confederation FPGA

The main functions implemented by the LIU/Framer are:

- Internal termination supported: 75 ohm, 120 ohm.
- Line code supported: HDB3.
- Pulse shape: digitally programmable
- Framing to G.704 E1 signals and to CRC-4 multi-frame alignment signals.
- Detection of alarm conditions as loss of signal, loss of frame, loss of signaling multi-frame and loss of CRC multi-frame.

The Network Processor is the heart of the ASAP card and provides the implementation of the protocols to be supported as well as data forwarding. ATM-IMA over PseudoWire, SAToP (like on the PDH card), CESoP, ML-PPP can be supported by the SW application controlling the Data Path and running on a different MIPS processor embedded on the same chip.

The main function implemented in the confederation FPGA is the clock management.

The right-hand side is the backplane with the 1 Gb bus shared among the other slots and hence common with the other units (PDH units and Modem units).

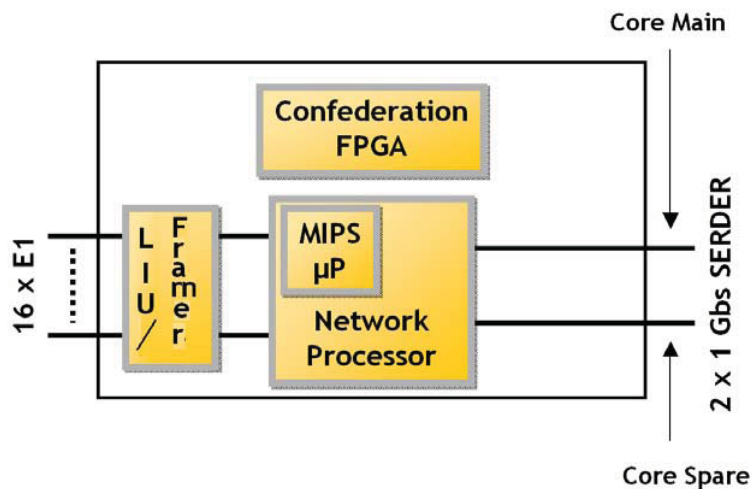


Figure 47. ASAP simplified block diagram

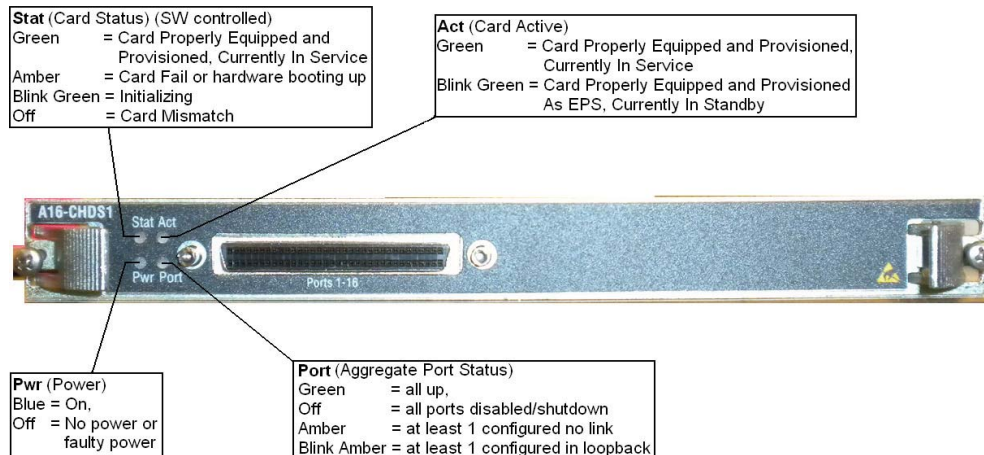


Figure 48. ASAP unit

2.8.1.7 Modem unit

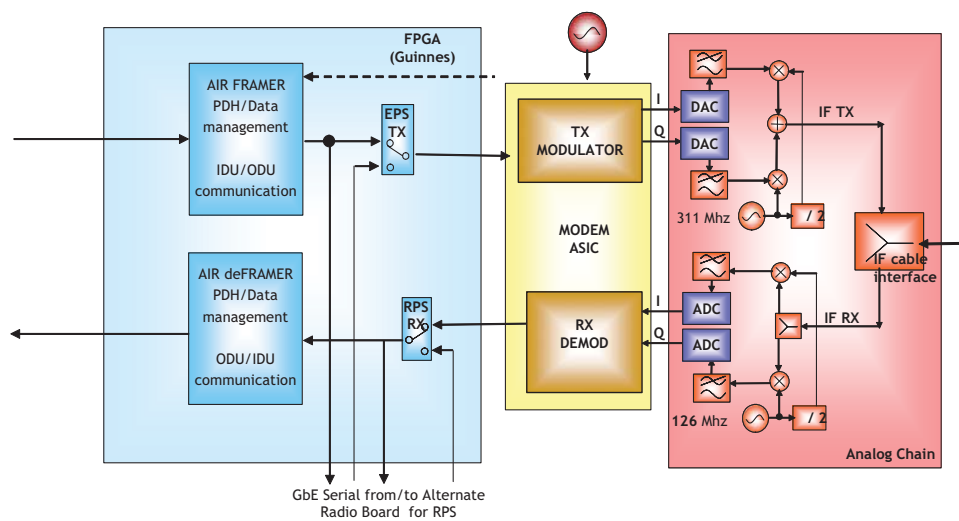


Figure 49. Modem unit

In **Tx direction**, the MODEM unit generates the IF signal to be sent to an Outdoor Unit. Such signal contains a Constant Bit Rate signal built with the Ethernet packets coming from the Core-E; those packets are managed in a different way depending on their own native nature.

Digital Framer

- Classification of incoming packets from the Core-E (QoS)
- Fragmentation
- Air Frame Generation (synchronous with NE clock)

Digital Modulator

TX Analog Chain

- DAC & low pass filtering
- Modulation to 311 MHz IF TX

In **Rx direction**, the MODEM 300 Module terminates the IF signal coming from the ODU300 extracting the original CBR and then the original Ethernet packets to be given the Core-E which distributes them to the proper Module.

RX Analog Chain

- 126 MHz IF RX demodulation to I & Q
- low pass filtering & ADC

Digital Demodulator

- Carrier & CK recovery
- Equalisation
- Error Correction

Digital Deframer

- RPS (hitless)
- Defragmentation

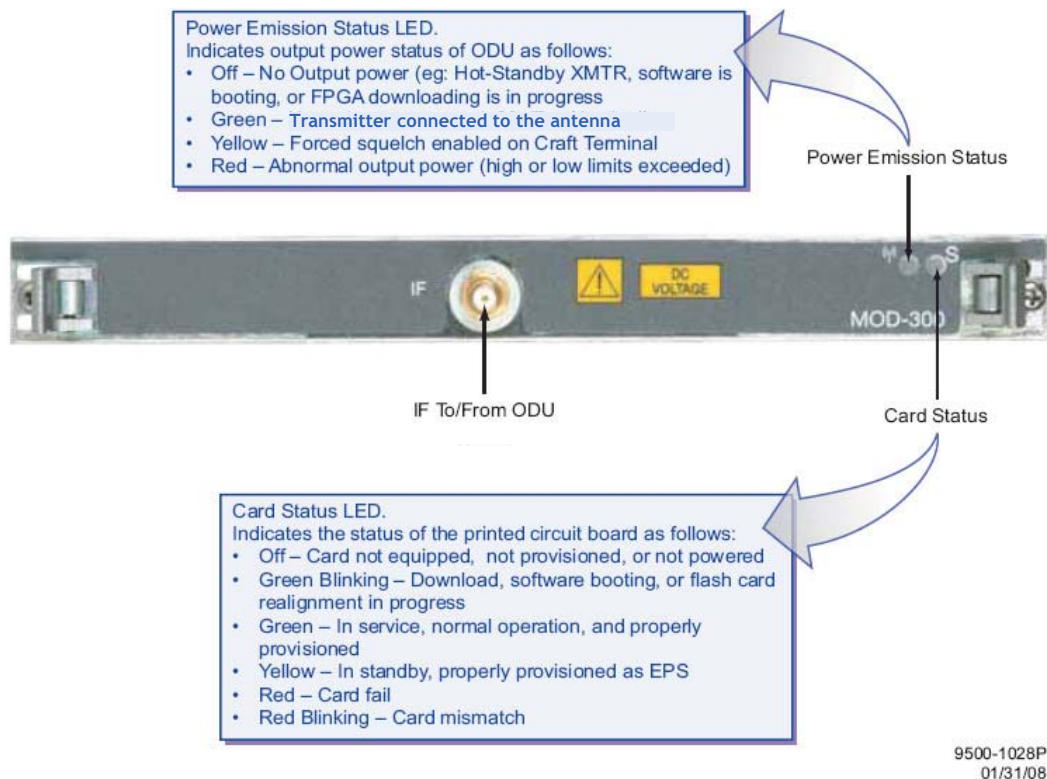


Figure 50. Modem unit

2.8.1.8 MPT Access Unit (with PFoE)

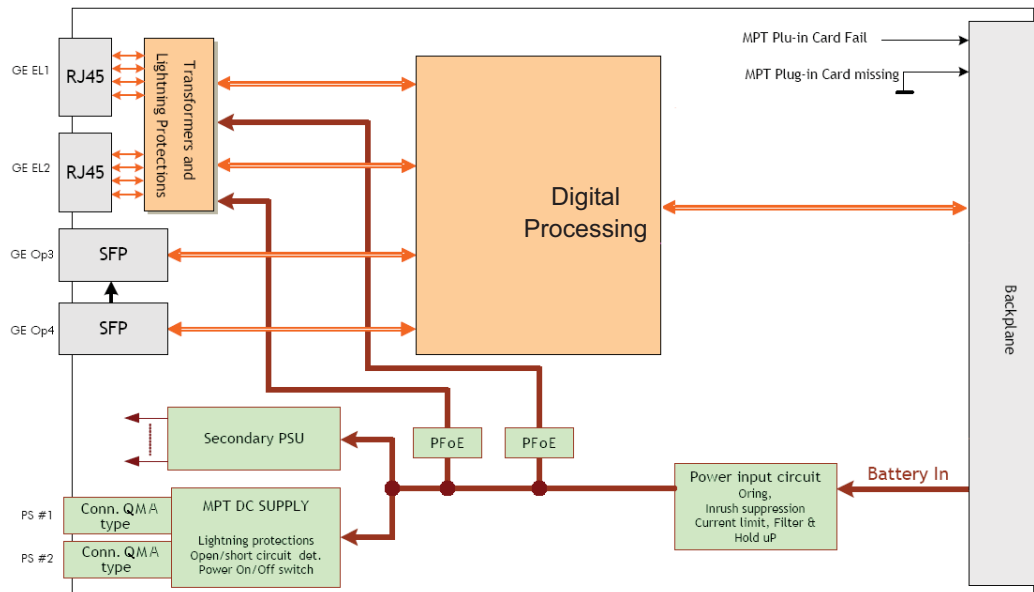


Figure 51. MPT Access unit (with PFoE) block diagram

The MPT Access Unit is the interface for two MPT: MPT-HC or MPT-MC.

Two MPT-HC or MPT-MC can be connected to one MPT Access unit.

The two MPT can be configured in unprotected or protected configuration.

The connection to the MPT-HC can be realized:

- a) by using two connectors:
 - one DC power Supply connector to send the power supply to the MPT-HC
 - one Gigabit Ethernet connector (electrical or optical) to send the Ethernet traffic and the Ethernet control frames to the MPT-HC
- b) or by using only one electrical Ethernet cable with the enabling of the PFoE (Power Feed over Ethernet) function (Ethernet traffic + Power Supply on the same cable).

If the optical port has to be used, an SFP plug-in must be installed.

N.B. If has been enabled port #1 (optical or electrical), the associated Power Supply port is #1.

N.B. If has been enabled port #2 (optical or electrical), the associated Power Supply port is #2.

The connection to the MPT-MC is realized by using only one electrical Ethernet cable with the enabling of the PFoE (Power Feed over Ethernet) function (Ethernet traffic + Power Supply on the same cable).

Main Functions

- Provide the power supply interface and the Ethernet interface
- Provide the Power Feed over Ethernet function
- Lightning and surge protection
- Ethernet and power interface supervision
- EPS/HSB management function
- Clock distribution function

- L2 packet based Proprietary clock algorithm
- Ethernet link quality monitor function
- Radio Link Quality notification through MPR Protection Protocol frames
- Communication with Core controller for provisioning and status report.

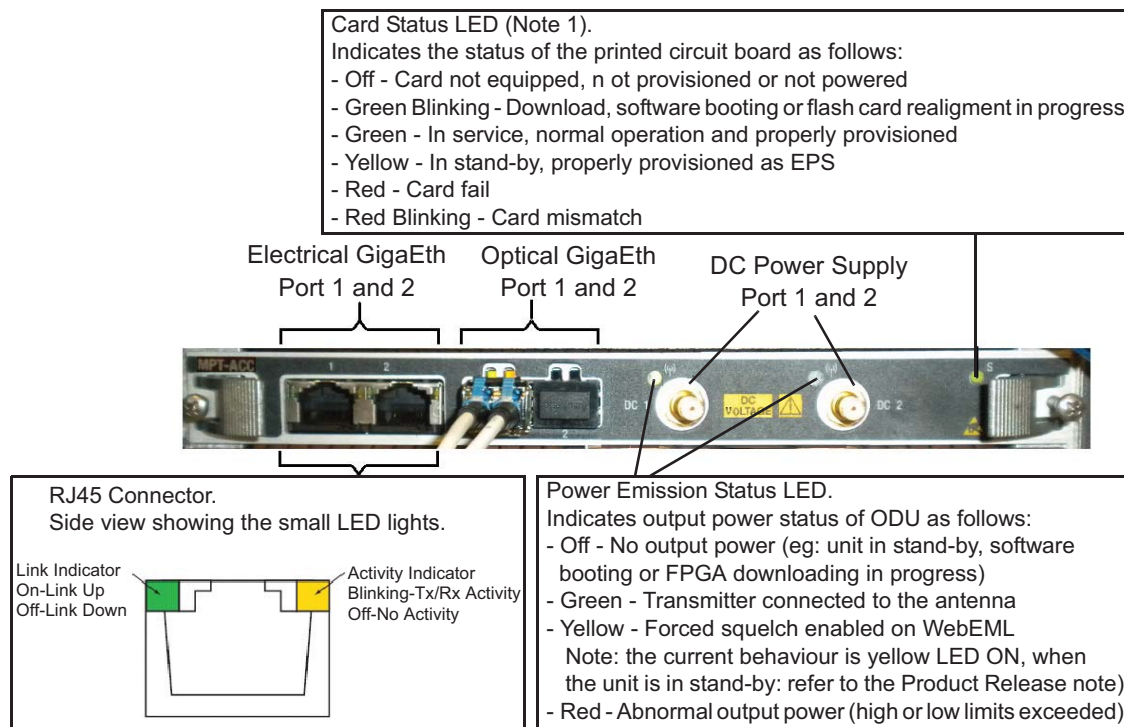


Figure 52. MPT Access Unit (with PFoE)

- Note 1:** The GREEN and YELLOW colours of the Card Status LED have different meaning, if two MPT (HC or MC) are connected:
- no MPT in 1+1 EPS protection is provisioned:
 - YELLOW colour is not applicable (traffic impact if peripheral is plugged-out)
 - 1 MPT in 1+1 EPS protection is provisioned, with mated MPT provisioned on other MPT Access peripheral:
 - GREEN if provisioned MPT is EPS Active
 - YELLOW if provisioned MPT is EPS Standby (no traffic impact if peripheral is plugged-out)
 - 1 MPT in 1+1 EPS protection is provisioned, with mated MPT provisioned on other MPT Access peripheral, 1 MPT in 1+0 is provisioned on same MPT Access peripheral:
 - YELLOW colour is not applicable (traffic impact if peripheral is plugged-out)
 - 2 MPTs in 1+1 EPS protection are provisioned, with mated MPTs provisioned on other MPT Access peripheral:
 - GREEN if at least one of provisioned MPT is EPS Active
 - YELLOW if both MPTs are EPS Standby (no traffic impact if peripheral is plugged-out)
 - 2 MPTs in 1+1 EPS protection on the same MPT Access peripheral are provisioned:
 - YELLOW colour is not applicable (traffic impact if peripheral is plugged-out)

Warning: The optional SFP plug-in, which has to be installed in the MPT Access unit, contains a Class 1 laser source. The laser source is placed in the left side of the SFP plug-in. According to the IEC 60825-1 the explanatory label is not stucked on the equipment due to the lack of space.

2.8.1.9 EAS unit

In case more than 6 local Ethernet access are needed (built-in in the Core-E unit), EAS unit (P8ETH) offers additional eight 10/100/1000 Ethernet interfaces.

An embedded 10 Gbit/sec L2 switch is present on the unit.

There are 4 Electrical 10/100/1000 base-T electrical ports and 4 optical SFP (LX and SX).

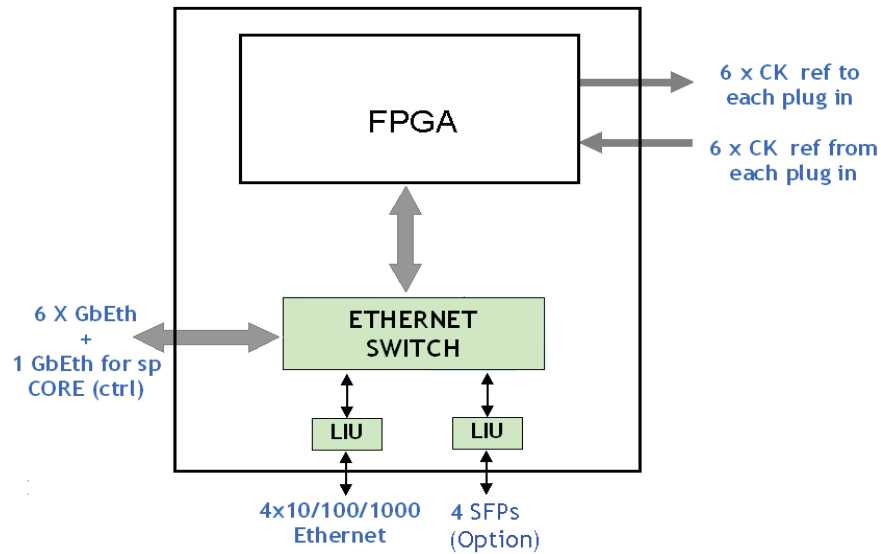


Figure 53. EAS unit block diagram

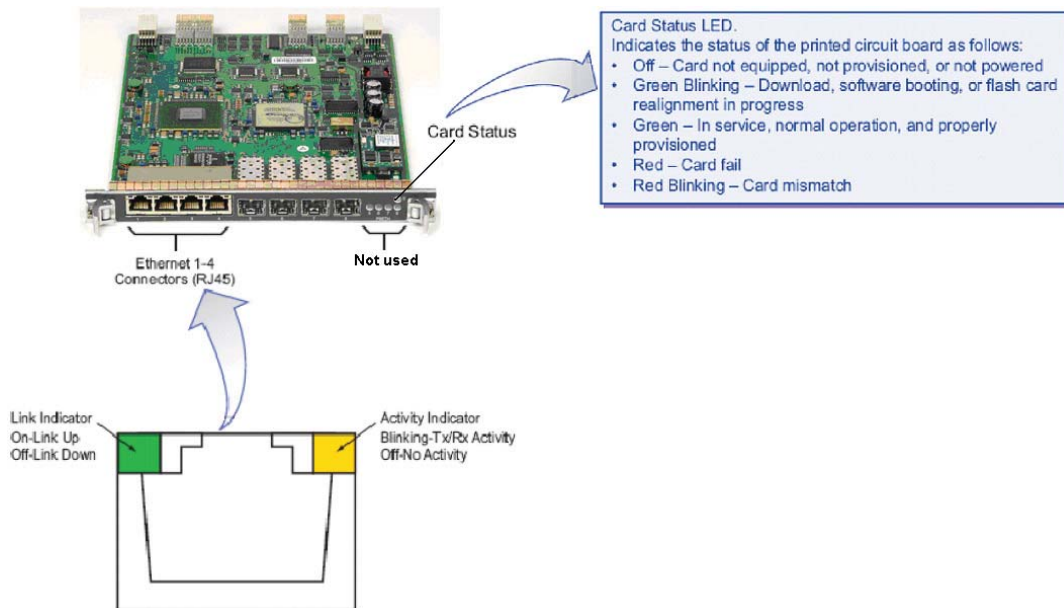


Figure 54. EAS unit

2.8.2 Power Extractor

The Power Extractor, installed close to the MPT-HC, allows to interconnect the MSS and the MPT-HC with a single electrical Ethernet cable by using the “Power Feed over Ethernet” solution (Ethernet traffic and Power Supply on the same cable). The Power Extractor then separates the Power Supply from the Ethernet traffic, which are separately sent to the MPT-HC.

The two cables, interconnecting the Power Extractor to the MPT-HC (the Power Supply cable to be connected to the **DC Out** connector of the Power Extractor and Ethernet cable to be connected to the **Data Out** connector of the Power Extractor), are provided, already terminated (2 m long), with the Power Extractor itself.



Figure 55. Power Extractor

2.8.3 Power Injector

The Power Injector is an indoor device designed to deliver the DC power supply to MPT (as shown in paragraph 2.1.10 on page 58) by using the same cable carrying the Ethernet traffic.

The Power Injector receives at the input the Ethernet traffic and the power supply on two dedicated connectors and sends to the output on one connector the Power Supply + Ethernet Traffic. This solution, called PFoE (Power Feed over Ethernet), is proprietary.

The Power Injector can supply up to 2 MPT.

The two Power Supply Sources provide power supply redundancy.

Main functions of the injector

- Securization of two DC power inputs from -48V battery
- Low pass filtering
- Insertion of the DC voltage on two Ethernet streams to power two MPT units
- Surge protection on both Ethernet output ports (K44 & K45)

Power Injector versions

Two versions are available:

- 1) **Power Injector plug-in**: installed in the MSS shelf and powered through the backplane.



Figure 56. Power Injector plug-in

The Power Injector plug-in is not managed by MSS. The Plug-in just needs an empty slot to be inserted in. As consequence, no specific commissioning activity is needed to insert a Power Injector plug-in on an existing MSS shelf.

- 2) **Power Injector box**: stand-alone box, powered through two connectors on the front providing power supply redundancy. The box can be mounted in a rack by means of a separate bracket. The bracket can support two boxes side by side. Height: 1,3 U.



Figure 57. Power Injector box

Connectors

- Two DC connectors in the front (for box version), or power from the backpanel (for plug-in version).
- Two RJ45 for the data in (DATA)
- Two RJ45 for the data + DC out (DC+DATA)

LEDs

- Two LEDs indicate the presence of DC voltage on each Ethernet output.



Figure 58. Power Injector front panel

2.8.4 ODU300

The ODUs include a waveguide antenna port, type-N female connector for the ODU cable, a BNC female connector (with captive protection cap) for RSSI access, and a grounding stud.

The ODUs, are designed for direct antenna attachment via a 9500 MPR-E-specific mounting collar supplied with the antennas.

ODU polarization is determined by the position of a polarization rotator fitted within the antenna mounting collar.

A remote ODU mounting kit is also available as an option. These may be used to connect an ODU to a standard antenna, or to a dual-polarized antenna for co-channel link operation.

ODUs are fixed for Tx High or Tx Low operation.

Where two ODUs are to be connected to a single antenna for hot-standby or frequency diversity configurations, a direct-mounting coupler is used. They are available for equal or unequal loss operation. Balanced loss is nominally 3 dB. Unbalanced loss is nominally 1/6 dB.

The ODU assembly meets the ASTM E standard for a 2000 hour salt-spray test, and relevant IEC, UL, and Bellcore standards for wind-driven rain.

The ODU housing comprises:

- Cast aluminium base (alloy 380)
- Pressed aluminium cover (sheet grade alloy 1050).
- Base and cover passivated and then polyester powder coated
- Compression seal for base-cover weatherproofing
- Carry-handle



Figure 59. ODU300 housing

ODUs are frequency-band specific, but within each band are capacity-independent up to their design maximums.

2.8.4.1 ODU block diagram

Figure 60 shows the ODU block diagram.

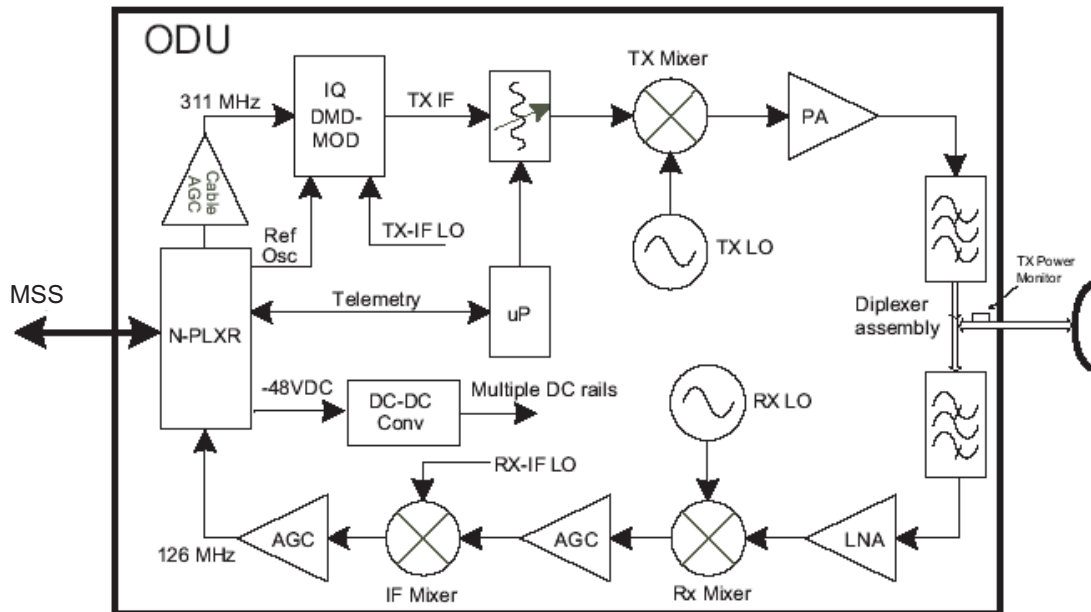


Figure 60. ODU block diagram

The quadrature modulated 311 MHz IF signal from the MSS is extracted at the N-Plexer and passed via a cable AGC circuit to an IQ demodulator/modulator.

Here the 311 MHz IF is demodulated to derive the separate I and Q signals using the 10 MHz synchronizing reference signal from the MSS.

These I and Q signals modulate a Tx IF, which has been set to a specific frequency between 1700 and 2300 MHz, such that when mixed with the Tx local oscillator signal (TXLO) in the subsequent mixer stage, provides the selected transmit frequency. Both the IF and Tx local oscillators are synthesizer types.

Between the IQ modulator and the mixer, a variable attenuator provides software adjustment of Tx power.

After the mixer, the transmit signal is amplified in the PA (Power Amplifier) and passed via the diplexer to the antenna feed port.

A microprocessor in the ODU supports configuration of the synthesizers, transmit power, and alarm and performance monitoring. The ODU microprocessor is managed under the NCC microprocessor, with which it communicates via the telemetry channel.

A DC-DC converter provides the required low-voltage DC rails from the -48 Vdc supply.

In the receive direction, the signal from the diplexer is passed via the LNA (Low Noise Amplifier) to the Rx mixer, where it is mixed with the receive local oscillator (RXLO) input to provide an IF of between 1700 and 2300 MHz. It is then amplified in a gain-controlled stage to compensate for fluctuations in receive level, and in the IF mixer, is converted to a 126 MHz IF for transport via the ODU cable to the MSS.

The offset of the transmit frequencies at each end of the link is determined by the required Tx/Rx split. The split options provided are based on ETSI plans for each frequency band. The actual frequency range per band and the allowable Tx/Rx splits are range-limited within 9500 MPR-E to prevent incorrect user selection.

A power monitor circuit is included in the common port of the diplexer assembly to provide measurement of transmit power. It is used to confirm transmit output power for performance monitoring purposes, and to provide a closed-loop for power level management over the specified ODU temperature and frequency range.

2.8.4.2 RSSI Monitoring Point

The ODU has a capped BNC female connector to access RSSI during antenna alignment.

There is a linear relationship of voltage to RSSI, as shown in the table below; an RSSI of 0.25 Vdc is equivalent to -10 dBm RSSI, and each additional 0.25 Vdc RSSI increase thereafter corresponds to a 10 dBm decrease in RSSI.

The lower the voltage the higher RSSI and better aligned the antenna is.

Table 27. RSSI Table

Units	Measurement									
BNC (Vdc)	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5
RSSI (dBm)	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100

2.8.4.3 Waveguide Flange Data

Table 28. lists the antenna port flange types used with the ODU300, plus their mating flange options and fastening hardware for remote mount installations.

UDR/PDR flanges are rectangular; UBR/PDR flanges are square.

On the ODU, the two flange styles are:

- **UDR.** 6-hole or 8-hole (6/8 bolt holes depending on frequency range/waveguide type), flush-face flange with threaded, blind holes.
- **UBR.** 4-hole flush-face flange with threaded, blind holes.

The corresponding mating flange styles are:

- **PDR.** 6-hole or 8-hole flange with gasket groove and clear holes.
- **PBR.** 4-hole flange with a gasket groove and clear holes.

All fastening hardware is metric.

Table 28. Waveguide Flange Data

Freq Band	Radio Flange	Waveguide Mating Flange	Waveguide Type	Spring Washers Req'd	Bolts Req'd	Bolt Type	Thread Spec	Hole Depth mm	Bolt Length Required
6 GHz	UDR70	PDR70	WR137	8 x M5	8	M5x0.8	6H	10	Flange thickness + Hole depth - 2mm
7/8 GHz	UDR84	PDR84	WR112	8 x M4	8	M4x0.7	6H	8	Flange thickness + Hole depth - 2mm
10/11 GHz	UDR100	PDR100	WR90	8 x M4	8	M4x0.7	6H	8	Flange thickness + Hole depth - 2mm
13 GHz	UBR120	PBR120	WR75	4 x M4	4	M4x0.7	6H	8	Flange thickness + Hole depth - 2mm
15 GHz	UBR140	PBR140	WR62	4 x M4	4	M4x0.7	6H	8	Flange thickness + Hole depth - 2mm
18/23/26 GHz	UBR220	PBR220	WR42	4 x M3	4	M3x0.5	6H	6	Flange thickness + Hole depth - 2mm
28/32/38 GHz	UBR320	PBR320	WR28	4 x M3	4	M3x0.5	6H	6	Flange thickness + Hole depth - 2mm

2.8.4.4 ODU Coupler

The ODU coupler is used in the 1+1 HSB or 1+1/2x(1+0) FD co-polar configurations.

The coupler can be equal type (3 dB/3 dB insertion loss) or unequal type (1.5 dB on the main path/6 dB on the secondary path).

The couplers are connected between the cabinets and the antenna.

2.8.5 MPT-HC

MPT-HC (Microwave Packet Transport) is a Microwave Equipment capable to transport the Ethernet traffic over an RF radio channel.

The MPT-HC includes a waveguide antenna port, type-N female connector for the DC connection, a maintenance connector (with captive protection cap) for RSSI access, 1 electrical GE interface, 2 GE optical interfaces (1 for data, 1 for for RPS) and a grounding stud.

The MPT-HC can be installed on an integrated antenna or on standard poles, wall or pedestal mount, with an appropriate fastening system.

The MPT-HC (one or two depending on the configuration 1+0 or 1+1, each one with a solar shield) incorporates the complete RF transceiver and can be associated with an integrated or separate antenna.

The cabinet is a very compact and robust weatherproof (IP 67) container, designed to be compatible with hot and very sunny climatic zones.

The MPT-HC can be rapidly installed on standard poles with an appropriate fastening system. The pole mounting is the same for 1+0 or 1+1 configurations from 6 to 38 GHz.

The MPT-HC is fixed by means of quick latches. This system allows to change the MPT-HC without altering antenna pointing.

For 6 GHz & 7/8 GHz, the MPT-HC polarization is determined by the rotation of the MPT-HC in 1+0 configuration and by the position of a polarization rotator fitted within the coupler in 1+1 configuration.

For 11 GHz to 38 GHz, the MPT-HC polarization is determined by the rotation of the nose fitted in the antenna port of the MPT-HC in 1+0 configuration and by the position of a polarization rotator fitted within the coupler in 1+1 configuration.

Where two MPT-HC have to be connected to a single antenna for hot-standby or frequency diversity configurations, a direct-mounting coupler is used. They are available for equal or unequal loss operation. Equal loss is nominally 3 dB. Unequal is nominally 1/10 dB.

Three mechanical solutions are adopted:

- [1] with embedded diplexer for cost optimisation (**11 GHz to 38 GHz**), where the branching (diplexer) is internal to the MPT-HC cabinet; this type of MPT-HC is identified by one **Logistical Item** only;
- [2] with embedded diplexer for cost optimisation and different mechanics from 11-38 GHz (**6 GHz**), where the branching (diplexer) is internal to the MPT-HC cabinet; this type of MPT-HC is identified by one **Logistical Item** only;
- [3] with external diplexer: due to a very high number of shifters the diplexer is external for the flexibility of the shifter customization (**7 GHz and 8 GHz**), where MPT-HC is composed by two independent units: the BRANCHING assembly (containing the diplexer) and the RF TRANSCEIVER assembly (containing the RF section); each of this type of MPT-HC is identified by two **Logistical Items**, one for the BRANCHING assembly and another for the RF TRANSCEIVER assembly. To read the BRANCHING assembly identification label it is necessary to separate the BRANCHING assembly from the RF TRANSCEIVER assembly.

MPT-HC is broken down to the following sections:

- **MPT-CB**: Common Belt section. This section is Frequency independent, and all the features relevant to this unit are common to all the MPT RF options.
- **MPT-RF**: Radio Frequency section that is frequency dependent.

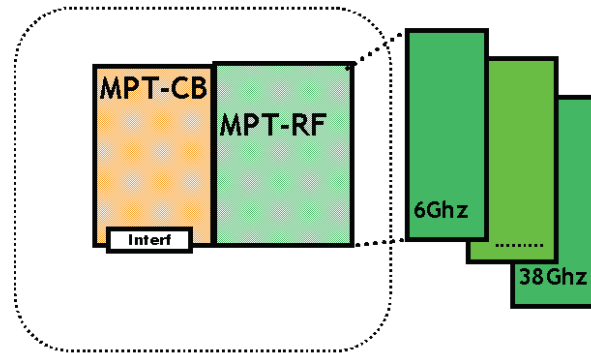


Figure 61. MPT system

The MPT-HC interface is based on a Gb Ethernet, that can be either optical or electrical depending on the needs and the cable length. If the optical port has/have to be used (data and/or RPS port), the corresponding SFP plug-in must be installed by opening the Cobox.



Figure 62. 11-38 GHz MPT-HC housing



Figure 63. 6 GHz MPT-HC housing



Figure 64. 7-8 GHz MPT-HC housing

2.8.5.1 MPT-HC block diagram

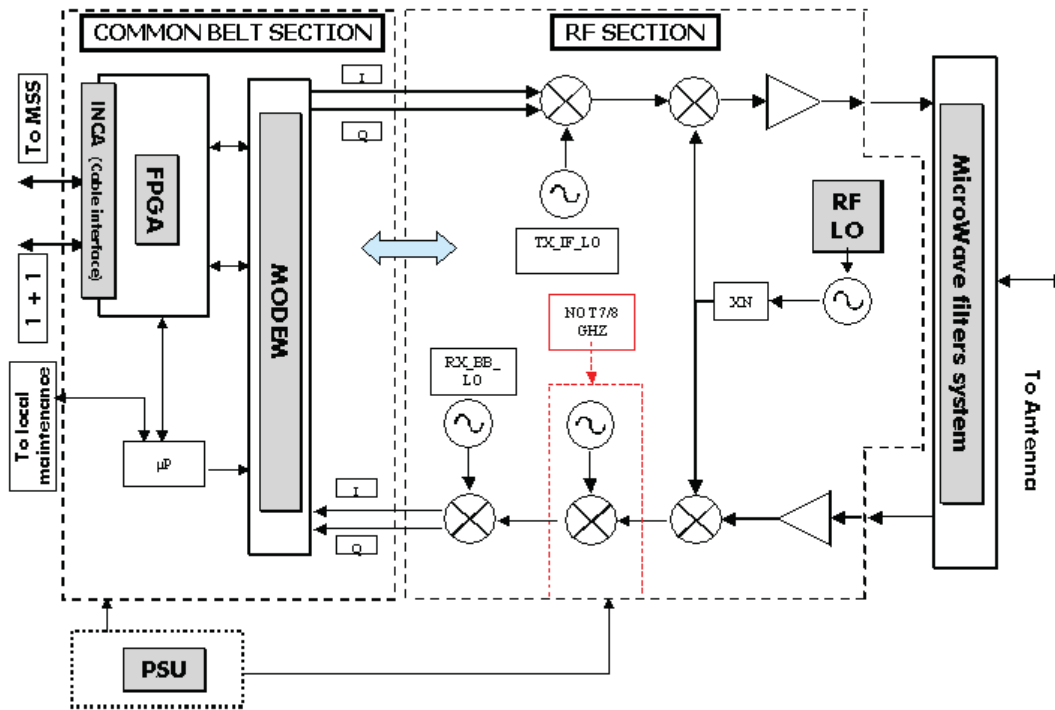


Figure 65. MPT-HC block diagram

2.8.5.1.1 Common Belt section

The Common Belt section is frequency independent. It is the digital section of the MPT-HC.

The main functions are the following:

- 1) Interfaces the MSS for traffic transport and MSS communication messages in both directions, through one Gigabit Ethernet optical or electrical cable.
- 2) Micro-Processor for
 - Indoor - MPT-HC dialogue
 - Inter-MPT-HC dialog in 1+1 configurations
 - HW configuration and monitoring of all MPT-HC parts
 - Dynamic regulation process such as ATPC
- 3) Transport of the system reference clock (synchronisation)
- 4) Switches the traffic and management to the correct port (processor port, radio port)
- 5) Performs traffic adaptation if needed
- 6) Performs Quality of Service and policing on flow to be sent over the radio link.
- 7) Modulation and demodulation of the resulting modem frame
- 8) In 1+1 configuration manages the switching, forwarding received modem frame to the second MPT-HC and sending built modem frame to the second MPT-HC.

Power supply interface

It is provided by a "N" 50 ohms connector, with the positive to ground.

The power supply is coming from the MSS in the range of -40,5 V to -58 V. MPT-HC input voltage range is from -28 V to -58 V.

Lightning protection

The lightning protection is internal to the MPT-HC. No external protection must be used.

This protection applies to:

- the Ethernet electrical cables
- the power supply coax cable

INCA module

The INCA module hosts the physical Ethernet interfaces:

- One optical SFP device for traffic interface.
- One electrical device for traffic interface.
- One optical SFP device for 1+1 protection interface with the associated MPT-HC.

In order to reach 500m the MPT-HC uses an SFP multimode 805 nm with a 50/125 fibre.

Tx Side

Following the flow from user Ethernet port to radio, the section performs:

- Reception of incoming Ethernet frames from the optical or electrical user interface (through INCA)
- Recovery of the clock coming from the MSS
- Management of the 1+1 EPS protection layer 2 messages
- Switch of the management frames from user port to internal processor
- Generation of MPT-HC to MPT-HC messages needed for radio link (ATPC, ACM, ...)
- Compression of the TDMoEth frames header (TDM2TDM - MEF8, TDM2ETH - MEF8)
- Management of the Quality of Service
- Fragmentation of the Ethernet frames
- Shaping of the traffic to adapt it to radio bandwidth
- Tx Modem frame building
- In 1+1, duplication of the built Tx modem frame and sending to the second MPT-HC through the protection coupling port
- In 1+1, reception of the Tx modem frame coming from the second MPT-HC
- In 1+1, switch of the Tx modem frame between the local and the one coming from second MPT-HC depending on the EPS position
- Tx Radio frame building (FEC, pilots, ...)
- Synchronisation of the symbol rate to the MSS recovered clock
- Modulation in I and Q analogue signals to be sent to the RF section.

Rx Side

Following the flow from radio to user Ethernet port, the section performs:

- Reception of the I and Q analogue signals coming from the RF section
- Demodulation of the Rx radio frame into Rx modem frame
- In 1+1, Recovery of the symbol clock and duplication to the second MPT-HC
- In 1+1, duplication of the Rx modem frame and sending to the second MPT-HC through the protection coupling port
- In 1+1, reception of the Rx modem frame coming from the second MPT-HC
- In 1+1, hosts the RPS decision machine
- In 1+1, switch of the Rx modem frame between the local and the one coming from second MPT-HC depending on the traditional RPS position and the modem frames quality
- Enhanced RPS

- In 1+1, switch of the recovered clock between the local and the one coming from second MPT-HC depending on the traditional RPS position
- Deframing of the Rx modem frame
- Re-assembly of fragmented Ethernet frame
- Decompression of TDMoEth frames header
- Extraction of MPT-HC to MPT-HC messages needed for radio link (ATPC, ACM, ...)
- Management of service channels frames
- Switch of the management frames from internal processor to user port.
- Management of the 1+1 EPS protection layer 2 messages
- Send the recovered clock to the MSS
- In 1+1 EPS, transmit or not the Ethernet frames to the MSS depending on the EPS position

2.8.5.1.2 RF Section

There are two architectures, the difference between these two architectures are only on Rx side:

- For the first one (used in MPT-HC band 7/8 GHz) there are only two frequency conversions between RF input frequency and base band frequency
- For the second one (used for all other MPT-HC bands) there are three frequency conversions

The block diagrams of these two architectures are shown hereafter.

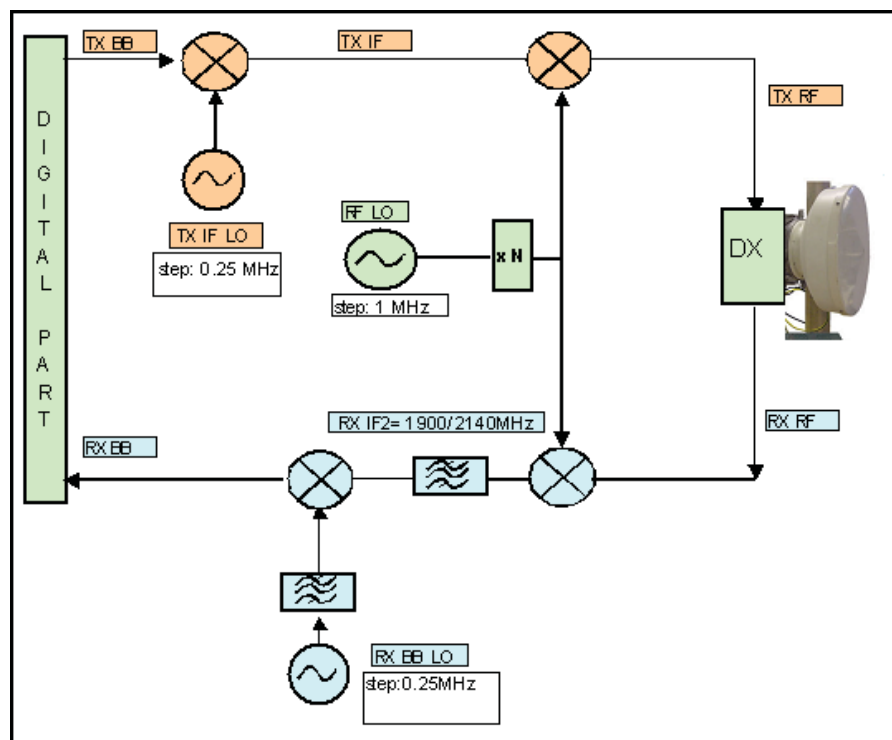


Figure 66. 7/8 GHz MPT-HC architecture

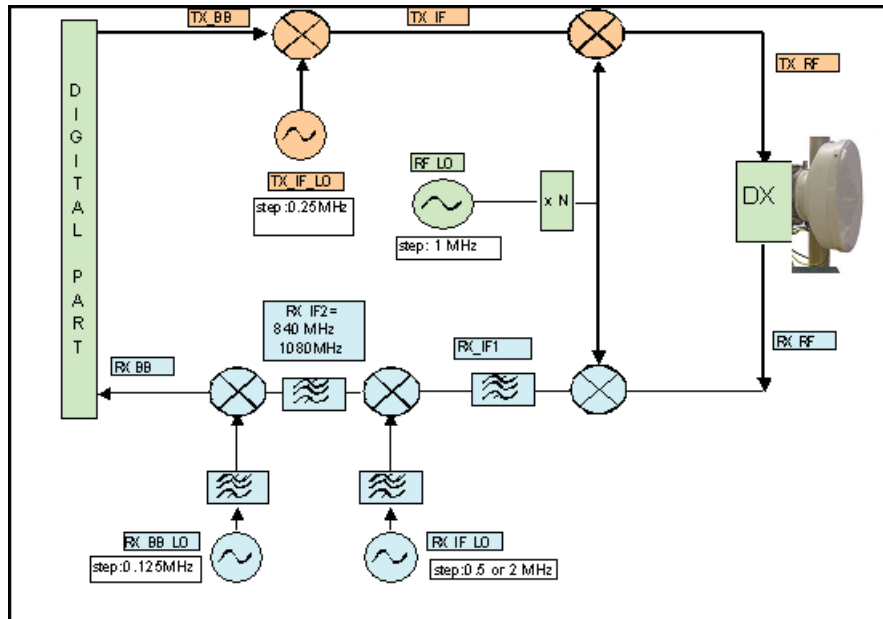


Figure 67. 11 to 38 GHz MPT-HC architecture

Main Functions

1. TX block:
 - IF TX Quadrature modulator
 - IF_Tx Synthesizer
 - RF Up-Converter
 - Output power management
2. Tx_Rx Common block:
 - RF_LO Synthesizer
3. Rx block:
 - LNA
 - RF Down Converter
 - First IF amplification and overload management
 - First IF down conversion
 - Second IF amplification and filtering (not present in 7/8 GHz)
 - Quadrature demodulator
 - Base band filter and AGC loop

2.8.5.2 RSSI Monitoring Point

The RSSI is available on the maintenance LEMO connector and is used to manually point the antenna on the field.

The higher the voltage the higher RSSI and better aligned the antenna is.

Table 29. RSSI Table

Units	Measurement (with MPT-HC)									
BNC (Vdc)	5	4.71	4.12	3.5	2.9	2.3	1.71	1.11	0.59	0.14
RSL (dBm)	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100

2.8.5.3 Waveguide Flange Data

Table 30. Waveguide Flange Data

Waveguide Type	L6 GHz	U6 GHz	7 GHz	8 GHz	11 GHz	13 GHz	15 GHz	18 GHz	23 GHz	26 GHz	38 GHz
	WR137	WR137	WR113	WR113	WR75	WR62	WR62	WR42	WR42	WR42	WR28

2.8.5.4 MPT-HC Coupler

The coupler is used in the 1+1 HSB or 1+1/2x(1+0) FD co-polar configurations.

The coupler can be equal type (3 dB/3 dB insertion loss) or unequal type (1 dB on the main path/10 dB on the secondary path).

The couplers are connected between the MPT and the antenna.

2.8.6 MPT-HC V2

MPT-HC V2 is similar to MPT-HC from architecture standpoint and can be used as spare part of the MPT-HC. The differences vs MPT-HC are:

- MPT-HC V2 can be natively Ethernet powered through a proprietary PFoE
- MPT-HC V2 is capable to host external modules (RPS module for 1+1 configurations or XPIC_RPS module for XPIC and/or 1+1 configurations).

Two mechanical solutions are adopted:

- [1] with embedded diplexer for cost optimisation (**6 GHz and 11 GHz to 38 GHz**), shown in Figure 68., where the branching (diplexer) is internal to the MPT-HC V2 cabinet; this type of MPT-HC V2 is identified by one **Logistical Item** only;
- [2] with external diplexer: due to an high number of shifters the diplexer is external for the flexibility of the shifter customization (**7 GHz and 8 GHz**), where MPT-HC V2 is composed by two independent units: the BRANCHING assembly (containing the diplexer) and the RF TRANSCEIVER assembly (containing the RF section); each of this type of MPT-HC V2 is identified by two **Logistical Items**, one for the BRANCHING assembly and another for the RF TRANSCEIVER assembly. To read the BRANCHING assembly identification label it is necessary to separate the BRANCHING assembly from the RF TRANSCEIVER assembly.

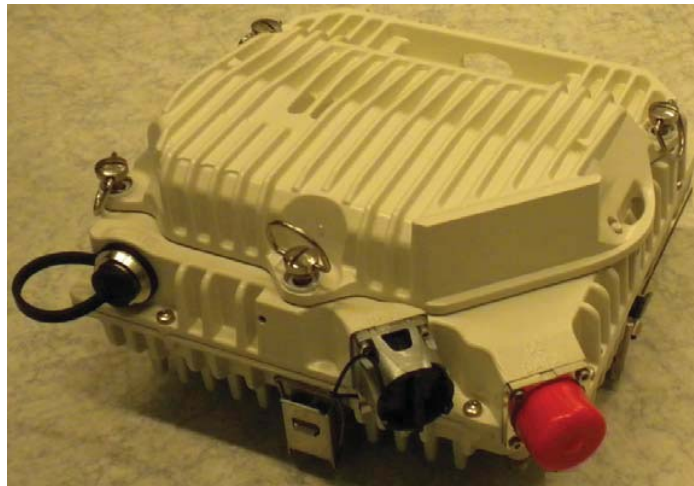


Figure 68. MPT-HC V2 housing (6 GHz and 11 GHz to 38 GHz)

2.8.7 MPT-MC

MPT-MC is similar to MPT-HC from architecture standpoint. MPT-MC has limited capacity vs MPT-HC and is natively Ethernet powered.

Two mechanical solutions are adopted:

- [1] with embedded diplexer for cost optimisation (**6 GHz and from 11 GHz to 38 GHz**), where the branching (diplexer) is internal to the MPT-MC cabinet; this type of MPT-MC is identified by one **Logistical Item** only;
- [2] with external diplexer: due to a vary high number of shifters the diplexer is external for the flexibility of the shifter customization (**7 GHz and 8 GHz**), where MPT-MC is composed by two independent units: the BRANCHING assembly (containing the diplexer) and the RF TRANSCEIVER assembly (containing the RF section); each of this type of MPT-MC is identified by two **Logistical Items**, one for the BRANCHING assembly and another for the RF TRANSCEIVER assembly. To read the BRANCHING assembly identification label it is necessary to separate the BRANCHING assembly from the RF TRANSCEIVER assembly.



Figure 69. 6 GHz and from 11 to 38 GHz MPT-MC housing



Figure 70. 7-8 GHz MPT-MC housing

2.8.7.1 MPT-MC Coupler

The coupler is used in the 1+1 HSB configuration.

The coupler can be equal type (3 dB/3 dB insertion loss) or unequal type (1 dB on the main path/10 dB on the secondary path).

The couplers are connected between the MPT and the antenna.

2.8.8 Protection schemes

2.8.8.1 Protection schemes with ODU300

Supported Protection types:

- [1] RPS (Radio Protection Switching) Hitless for each radio direction (RPS-RX)
 - RPS is distributed in 9500 MSS modules before termination of 9500 MSS frame.
- [2] EPS (Equipment Protection Switching) for each module type
 - Both Working and Spare modules send its own signal to the Core-E. Core-E selects the best signal.
- [3] HSB-TPS (Hot StandBy - Transmission Protection Switch)
 - Spare ODU module is squelched.

2.8.8.1.1 RPS Switching Criteria

The switching criteria are:

- SF (Signal Fail): generated from transmission and equipment alarms affecting the Rx radio section:
- Demodulator Fail
- IDU-ODU cable loss
- LOF of aggregate signal radio side
- Main and spare ODU, IDU HW failures (card fail)
- HBER (high BER)
- EW (Early Warning)

2.8.8.1.2 EPS Switching Criteria

The switching criteria are:

- Peripheral Card Fail (switching off of the peripheral included)
- Peripheral Card Missing
- LOS of all the tributaries (of course only in case of PDH local access peripheral protection) managed via SW.

2.8.8.1.3 HSB Switching Criteria

The switching criteria are:

- Radio Interface Peripheral Card Fail (switching off of the peripheral included)
- Radio Interface Peripheral Card Missing
- MSS-ODU cable loss
- ODU TX chain alarm (this is an OR of the following alarms: LOS at ODU input, modFail, txFail, ODU card fail).

2.8.8.2 Protection schemes with MPT-HC/MPT-HC V2

To implement the 1+1 configuration an optical cable must be connected from one MPT-HC/MPT-HC V2 to the second MPT-HC/MPT-HC V2. In Figure 71 Ethernet port 2 of one MPT-HC/MPT-HC V2 is connected to Ethernet port 2 of the second MPT-HC/MPT-HC V2.

N.B. In Figure 71 the two MPT are connected to two different MPT Access units, but they can also be connected to the same MPT Access Unit.

Supported Protection types:

- [1] RPS (Radio Protection Switching) Hitless for each radio direction
 - RPS is implemented directly on the two MPT-HC/MPT-HC V2.
- [2] EPS (Equipment Protection Switching) for the MPT-HC/MPT-HC V2
 - EPS protects the MPT-HC/MPT-HC V2 and the cables connecting it to the MSS.
- [3] HSB-TPS (Hot StandBy - Transmission Protection Switch)
 - Spare ODU module is squelched.

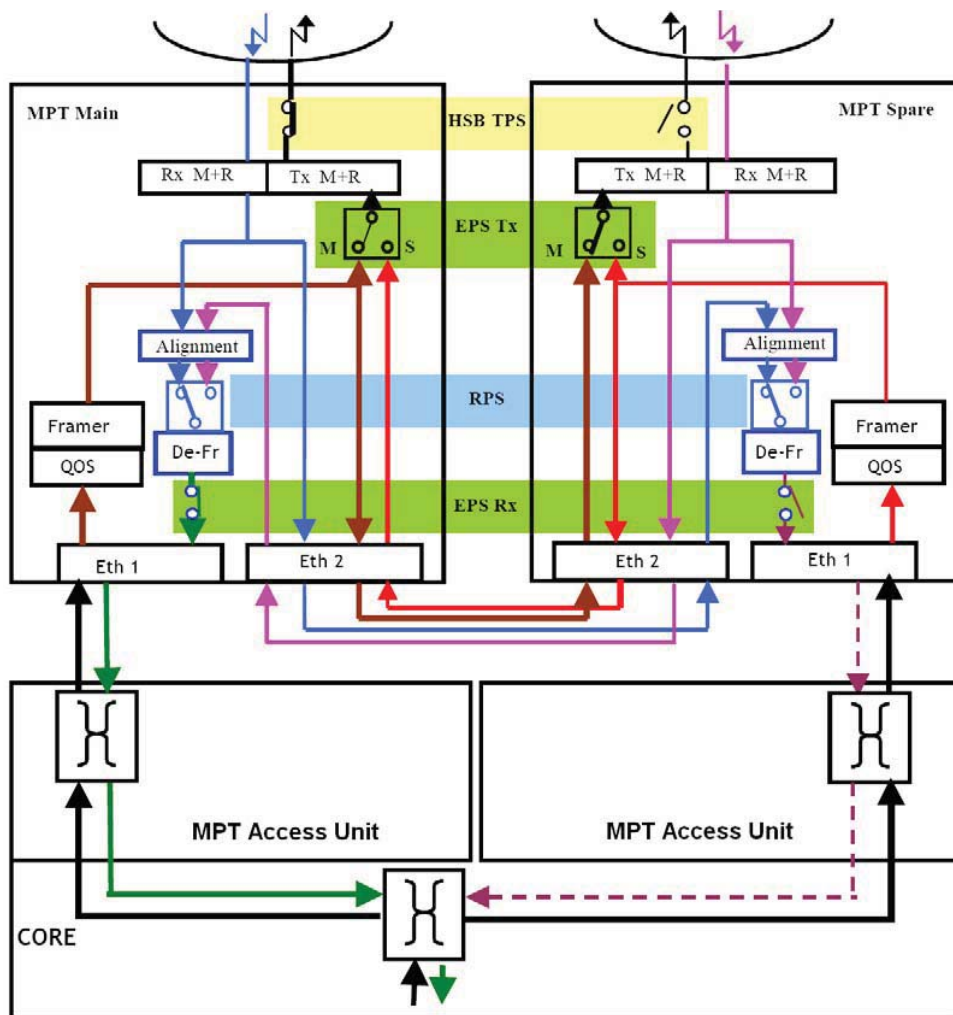


Figure 71. MPT-HC/MPT-HC V2 protection schemes

2.8.8.2.1 RPS Switching Criteria

The switching criteria are:

- SF (Signal Fail): generated from transmission and equipment alarms affecting the Rx radio section
- Rx Fail
- Demodulator Fail
- LOF of aggregate signal radio side
- inter-MPT coupling link failure
- HBER (high BER) based on the demodulated erroneous blocks ratio
- EW (Early Warning) based on MSE

Moreover, MPT-HC supports a further embedded functionality called "Enhanced RPS". Enhanced RPS is a frame-based protection mechanism, aimed to reach a quick reaction time and increasing significantly the quality of the radio interface in the Rx side. It assumes the alignment between the 2 received radio channels and it is based on frame by frame selection of the "best" frame between the frames received from the Main and the Spare radio channel. The Enhanced RPS assumes that the "classical" RPS criteria are used to give indication about the "preferred" channel, whose frame has to be selected, when the frame-based choice between the 2 streams is not possible (e.g. due to the frame alignment error). The Enhanced RPS switching criterion depends on the presence of errors in the decoded LDPC word.

2.8.8.2.2 EPS Switching Criteria

The switching criteria are:

- MPT Access Card Fail status
- IDU-ODU Connection Failure
- ICP alarm
- Mated MPT Access card Failure

2.8.8.2.3 HSB Switching Criteria

The switching criteria are:

- MPT Access Card Fail status
- IDU-ODU Connection Failure
- ICP alarm
- Incompatible Shifter alarm
- Incompatible Frequency alarm
- Incompatible Power alarm
- Incompatible Modulation Parameters alarm
- Mated MPT Access card Failure
- Inter-MPT coupling link failure. Where there is a cross configuration (EPS on Spare & TPS on main), HSB (TPS) will switch and align with EPS position, if there is an inter-MPT coupling link failure.

2.8.8.3 Protection schemes with MPT-MC

N.B. In Figure 72 the two MPT are connected to two different MPT Access units, but they can also be connected to the same MPT Access Unit.

Supported Protection types:

- [1] RPS (Radio Protection Switching) Hitless for each radio direction
 - RPS is implemented by the “virtual cable” (No physical interconnection cable must be installed between the MPT-MC. The 1+1 messages are exchanged inside the MSS-4/MSS-8).
- [2] EPS (Equipment Protection Switching) for the MPT-MC
 - EPS protects the MPT-MC and the cables connecting it to the MSS.
- [3] HSB-TPS (Hot StandBy - Transmission Protection Switch)
 - Spare ODU module is squelched.

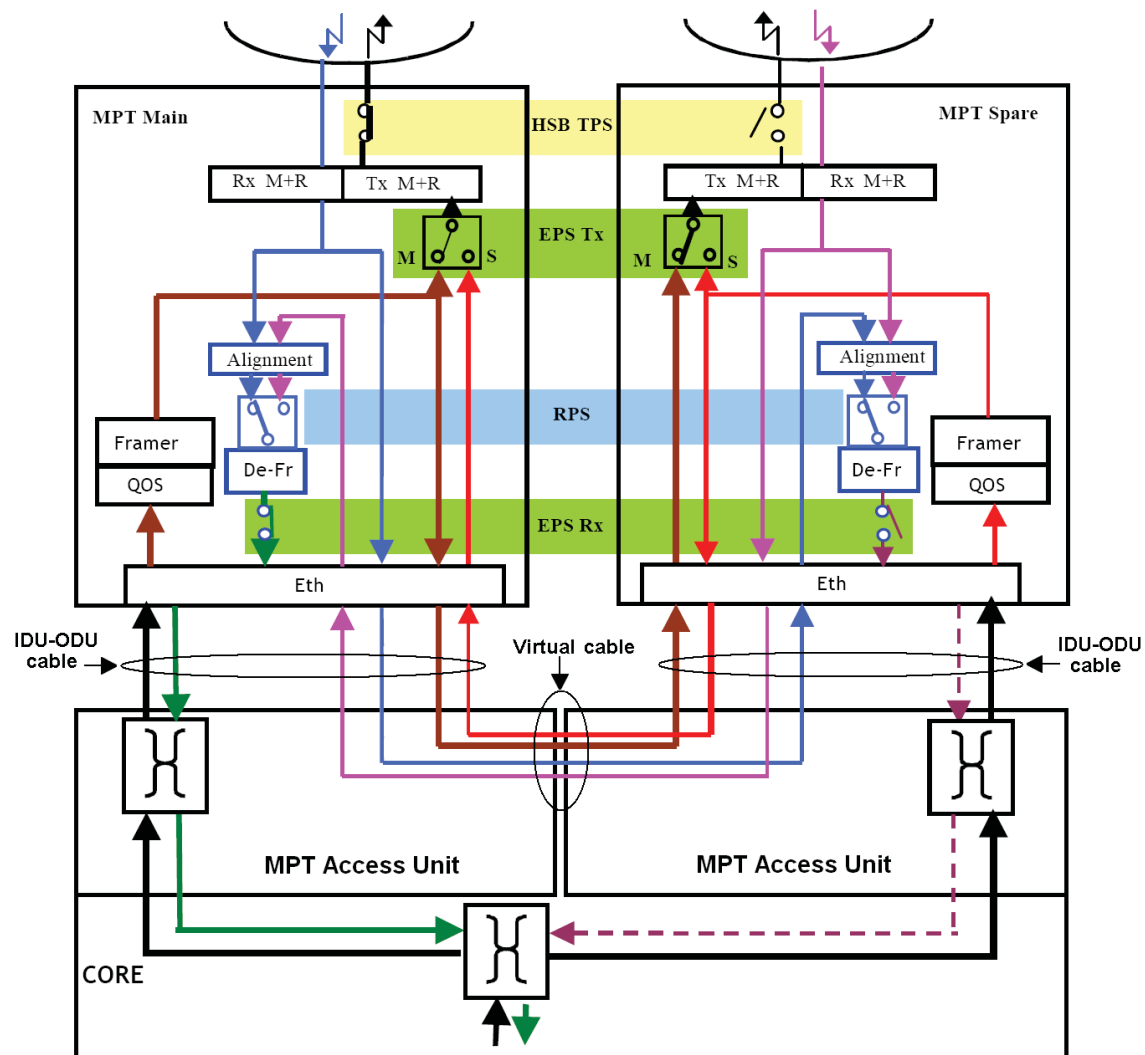


Figure 72. MPT-MC protection schemes

2.8.8.3.1 RPS Switching Criteria

The switching criteria are:

- SF (Signal Fail): generated from transmission and equipment alarms affecting the Rx radio section
- Rx Fail
- Demodulator Fail
- LOF of aggregate signal radio side
- inter-MPT coupling link failure
- HBER (high BER) based on the demodulated erroneous blocks ratio
- EW (Early Warning) based on MSE

Moreover, MPT-MC supports a further embedded functionality called "Enhanced RPS". Enhanced RPS is a frame-based protection mechanism, aimed to reach a quick reaction time and increasing significantly the quality of the radio interface in the Rx side. It assumes the alignment between the 2 received radio channels and it is based on frame by frame selection of the "best" frame between the frames received from the Main and the Spare radio channel. The Enhanced RPS assumes that the "classical" RPS criteria are used to give indication about the "preferred" channel, whose frame has to be selected, when the frame-based choice between the 2 streams is not possible (e.g. due to the frame alignment error). The Enhanced RPS switching criterion depends on the presence of errors in the decoded LDPC word.

2.8.8.3.2 EPS Switching Criteria

The switching criteria are:

- MPT Access Card Fail status
- IDU-ODU Connection Failure
- ICP alarm
- Mated MPT Access card Failure

2.8.8.3.3 HSB Switching Criteria

The switching criteria are:

- MPT Access Card Fail status
- IDU-ODU Connection Failure
- ICP alarm
- Incompatible Shifter alarm
- Incompatible Frequency alarm
- Incompatible Power alarm
- Incompatible Modulation Parameters alarm
- Mated MPT Access card Failure

2.8.8.4 Core-E protection

The logic of this protection is distributed in each access and radio peripheral unit. All the switching criteria coming from both the Core units, are available (via backpanel) to each peripheral in order to allow to each logic to take the same decision.

Both the Cores (main and spare) send their signals to all the traffic peripherals.

Core protection supports two different types of protection:

- Traffic/services protection (protection of all the transport functions with the exception of the control platform)
- Control Platform protection

In order to provide this protection the Flash Cards on the two Core boards are kept aligned (in terms of SW and configuration data) both in case of new operations done by the management systems and in case of Flash Card replacement.

User Ethernet interfaces protection

In order to support User Ethernet interfaces protection using an external device, the User Ethernet ports of the Core in standby status are switched off.

The switch on of the User Ethernet interfaces when the Core in standby status becomes active, due to operator commands or automatic switch, is done within few seconds. In case of Optical Ethernet interface, the Lambda, Link Length, Connector and Gigabit Ethernet Compliance Code information are read from the active Core.

TMN Local Ethernet interface protection

In order to support TMN Local Ethernet interface protection using an external device, the relevant Ethernet port of the Core in standby status is switched off.

The switch on of the TMN Local Ethernet interface when the Core in standby status becomes active, due to operator commands or automatic switch, is done within 5 seconds.

In order to avoid impact on the Core, the external device used for the TMN Local Ethernet interface protection is kept separate from the one used for protection of User Ethernet interface.

External synchronization interface protection

The Protection of the external synchronization interface is supported. The output port on the stand-by Core is muted.

Node-Timed PDH interface protection

In case of node-timed PDH interface the protection of the NE Clock provided by Core is supported.

Core protection restoration mode

The restoration mode is always non revertive: the Core main becomes active as soon as it has recovered from failure or when a switch command is released.

2.8.8.4.1 Core-E protection Switching Criteria

The switching criteria are:

- Core Card Fail
- Core Card Missing
- Control Platform operational status failure
- Flash Card realignment in progress
- Flash Card failure

If the “Ethernet LOS Criteria” feature has been enabled the following additional switching criteria are added:

- Card Fail of SFP optical module
- Card Missing of SFP optical module
- LOS of any Electrical User Ethernet interfaces, including the LOS of the forth User Ethernet interface working as TMN Local Ethernet interface.

N.B. In case of stand-by Flash Card realignment in progress, the application SW refuses/removes a manual switch command.

2.8.8.4.2 Port #5 and port #6 protection

- If in the Port #5 and/or port #6 a 2xE1 SFP or EoSDH SFP has been installed, the protection is implemented by using special splitters (refer to paragraph 4.1.3.3 on page 584 and paragraph 4.1.3.4 on page 584).

2.8.9 Stacking for EAS unit/MPT Access unit

Two EAS units or two MPT Access units installed on the same row (i.e. slot #3 and slot #4) are automatically configured in stacking configuration.

The benefits of the stacking are:

- 1) the intra-board traffic between the two units does not transit through the Core-E unit (no traffic impact in case of Core-E switch);
- 2) each port of the units can be individually segregated from the other ports.

2.8.10 Ethernet Ring Protection

The implemented Ethernet Ring Protection Switching (ERPS) is according to ITU-T G.8032 recommendation. The ERPS is a protection mechanism for Ethernet ring topologies.

2.8.10.1 Definitions

2.8.10.1.1 Topology

An ERPS Topology is a collection of Ethernet Ring Nodes forming a closed physical loop. Each Ethernet Ring Node is connected to two adjacent Ethernet Ring Nodes via a duplex communications facility. Only one topology is supported.

Note: The minimum number of Ethernet Ring Nodes in an Ethernet Ring is **3** and the max. number is **16**.

2.8.10.1.2 Ring Link and Ring Port

Each Ethernet Ring Node is connected to adjacent Ethernet Ring Nodes participating in the same ERPS Topology, using two independent Ring Links. A Ring Link is bounded by two adjacent Ethernet Ring Nodes and a port for a Ring Link is called a Ring Port.

2.8.10.1.3 Ring Protection Link (RPL)

The loop avoidance in the ring is achieved by guaranteeing that, at any time, traffic may flow on all but one of the Ring Links. This particular link is called the Ring Protection Link (RPL).

2.8.10.1.4 RPL Owner

One designated node, the RPL Owner, is responsible to block traffic over the RPL.

Under a ring failure condition, the RPL Owner is responsible to unblock the RPL, allowing the RPL to be used for traffic.

2.8.10.1.5 R-APS Protocol

An APS protocol, called R-APS (Ring Automatic Protection Switching), is used to coordinate the protection actions over the ring.

2.8.10.1.6 ERPS Instance

An ERPS Instance is an entity responsible for the protection of a subset of the VLANs that transport traffic over the physical ERPS Topology. Each ERPS Instance is independent of other ERPS Instances that may be configured on the physical ERPS Topology. Only two ERPS instances are supported.

Each ERPS Instance has its own RPL and RPL Owner.

Additionally, an independent session of R-APS protocol is used, over a dedicated R-APS VID, for the ERPS Instance protection coordination.

2.8.10.2 ERPS operation

The protection switching mechanism is based on the Automatic Protection Switching protocol for Ethernet ring topologies (called R-APS). This protocol is used to coordinate the protection actions over the ring.

The fundamentals of this ring protection switching architecture are:

- principle of loop avoidance.
- utilization of learning, forwarding, and address table mechanisms defined in the Ethernet flow forwarding function.

The loop avoidance in the ring is achieved by guaranteeing that, at any time, traffic may flow on all but one of the ring links. This particular link is called the Ring Protection Link (RPL).

Under normal conditions this link is blocked, i.e., not used for traffic. One designated node, the RPL Owner, is responsible to block traffic over the RPL.

Under a ring failure condition, the RPL owner is responsible to unblock the RPL, allowing the RPL to be used for traffic.

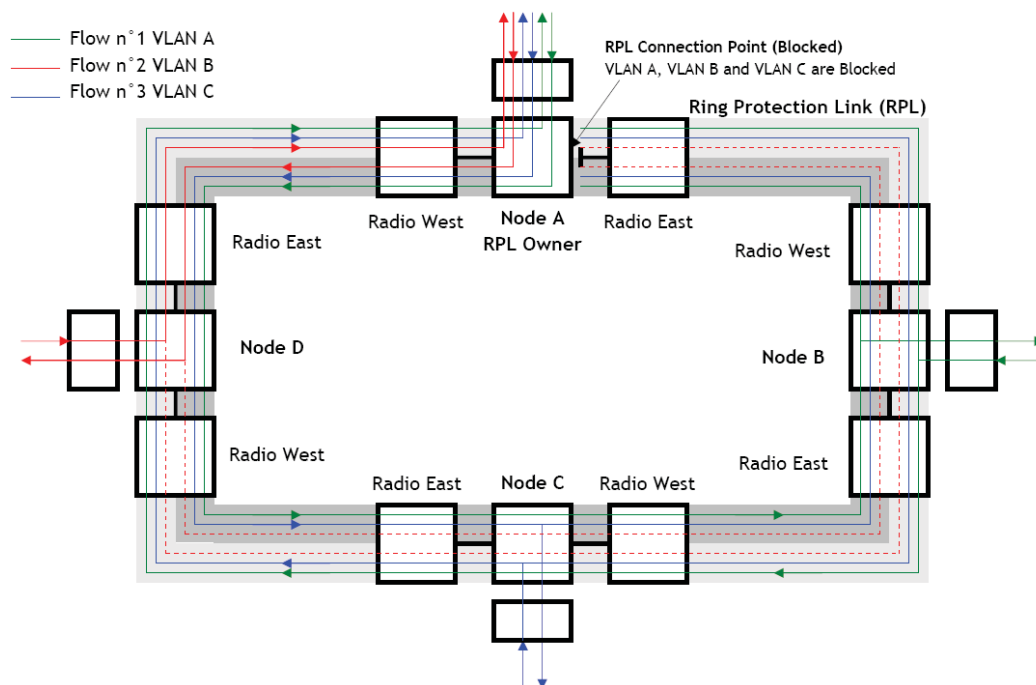


Figure 73. Normal Operation (No-fault)

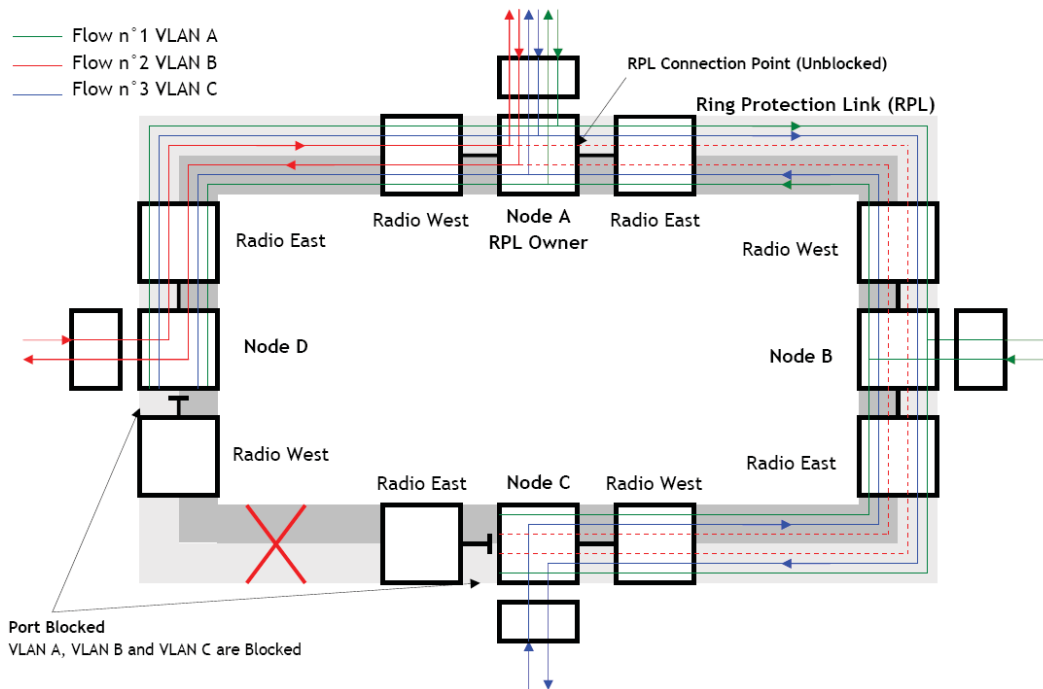


Figure 74. Single link failure

Two ERPS Control Processes are instantiated on each ring's node. Each instance selects its own RPL and RPL Owner.

The ERPS Control Process controls the forwarding function to perform the following actions:

- to disable forwarding over the set of VLANs assigned to the ERPS instance corresponding to blocked ring links;
- to flush the learned MAC address table.

Only revertive switching mechanism is supported.

The Wait-to-Restore is managed by the RPL Owner, it is configured by the operator in 1 minute steps between 1 and 12 minutes. The default value is 5 minutes.

Note: In case of a double failure, if the restoring of the two failures takes place at the same time, an out of service equal to the WTR could occur. To note that a switching off of a single NE causes a double failure in the Ring.

A Guard Timer is used to prevent ring nodes from receiving outdated R-APS messages. During the duration of the guard timer, all received R-APS messages are ignored by the ERPS Control Process. The period of the guard timer may be configured by the operator in 10 ms steps between 10 ms and 2 seconds, with a default value of 500 ms.

The Holdoff timer is not managed and fixed to 0 since no server layer protection switching mechanism are present. The Ethernet MAC (ETH) layer, where the ERPS take place, is supported by radio links acting as Ethernet PHY (ETY) layer in 1+0 configuration.

Since the ERPS instances operate "per VLAN" on a logical ring protecting a set of VLANs, this set must consequently be configured.

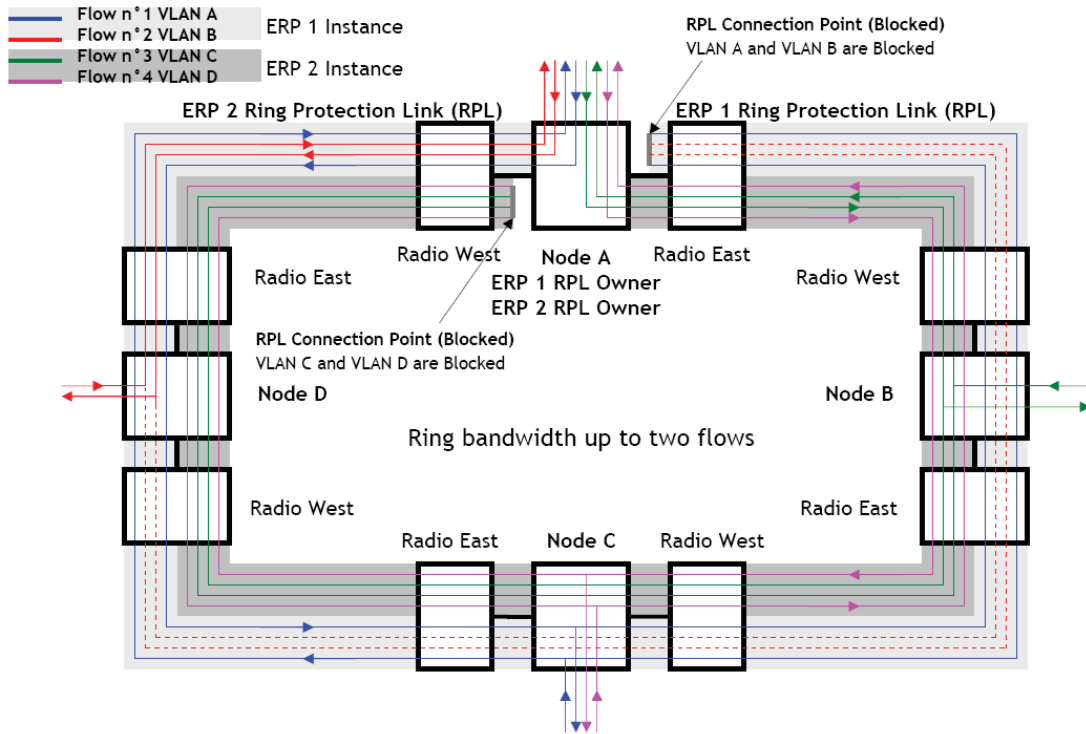


Figure 75. Multiple ERPS instances (Normal No-fault Operation)

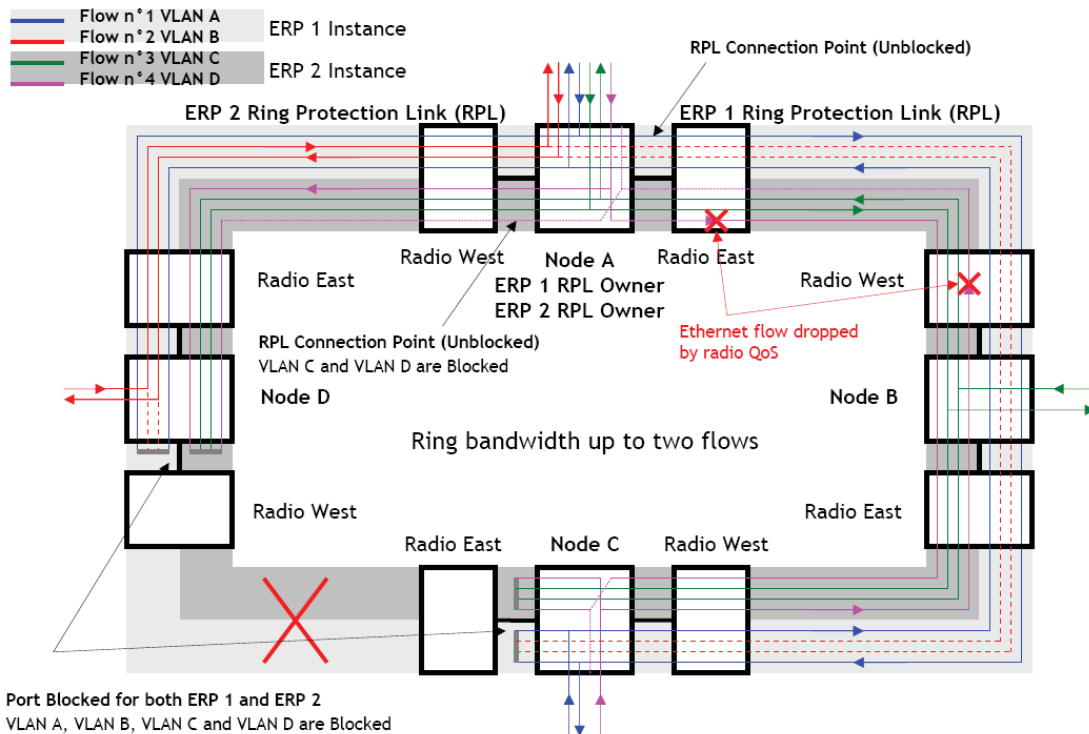


Figure 76. Multiple ERPS instances (Single Link Failure)

2.8.11 Radio Transmission Features with ODU300

2.8.11.1 Frequency Agility

The Frequency Agility feature gives the Operator the possibility to set via ECT the frequency of a single Transceiver within a chosen sub-band to select the RF working channel. This implies benefits for spare parts, order processing and frequency co-ordination.

2.8.11.2 Automatic Transmit Power Control (ATPC)

The Automatic Transmit Power Control (ATPC) function automatically increases or decreases the transmit output power upon request from the opposite terminal. The opposite terminal constantly monitors Receive Signal Level (RSL), receive signal quality, and aggregate Bit Error Rate (BER) of the receive signal.

When ATPC Enabled is checked on the Modem Card Settings screen, the transmit output will remain at it's lowest level until a fade occurs (or a receive circuit alarm is detected). When the change in RSL is detected at the receive end, a command is sent to the transmit end to increase power in 1 dB steps to it's highest level. After the fade is over, the receive end commands the transmit power to decrease in 1 dB steps to the lowest level.

The ATPC range (high and low limits) is variable, determined by link distance, link location, and link frequency. When ATPC Enabled is checked, the range values are shown in parenthesis (minimum - maximum) following ATPC Range.

When ATPC Enabled is not checked on the Modem Card Settings screen, the transmit output will always operate at it's highest level.

2.8.11.3 Transmitted power control: RTPC function

The capability to adjust the transmitted power in a static and fixed way (RTPC = Remote Transmit Power Control) has been introduced for those countries where, due to internal rules, the ATPC function is not accepted or for those hops in which due to the short length and interface problems, a fixed reduced transmitted power is preferred. The range of the possible attenuation depends on the frequency band involved. The setting of the transmitted power can be performed locally through ECT.

Output power is band and modulation dependent.

2.8.11.4 Power Monitoring

The ODU300 incorporates a detector for Tx power measurement. It is used to provide measurement of forward power as a performance parameter, and to provide a calibration input for transmitter operation over temperature and output range.

Viewed Tx power ranges always match the capabilities of the ODU300 for a given modulation. When modulation is changed, the WebEML automatically adjusts/restricts Tx Power to be within valid range.

2.8.11.5 Adaptive Equalization

Adaptive equalization (AE) is employed to improve reliability of operation under dispersive fade conditions, typically encountered over long and difficult paths.

This is achieved through a multi-tap equalizer consisting of two registers, one with feed-forward taps, the other with feed-back taps. Each of these registers multiply successive delayed samples of the received signal by weighting-coefficients to remove propagation induced inter-symbol interference.

2.8.11.6 XPIC (with MPT-HC V2 only)

The MPT-HC V2 supports Co-channel Dual Polarized (CCDP) operation using a built-in Cross-polarized Interference Cancellation (XPIC) function (this function is implemented by installing the “RPS+XPIC” external module). Two links are operated on the same radio channel, with one using the vertical polarization, the other the horizontal. XPIC typically provides 20 dB improvement in polarization discrimination. The actual improvement will then depend on the native discrimination provided at antenna alignment, and any reduction of this discrimination caused by atmospheric effects (fading).

XPIC working mode supports modulation scheme 128 QAM and 256 QAM with channel spacing 28 MHz or 56 MHz.

Adaptive Modulation and ATPC are not supported with the XPIC function.

Radio configuration supported:

- Single 2+0 XPIC
- Double 1+1 HSB co-channel XPIC

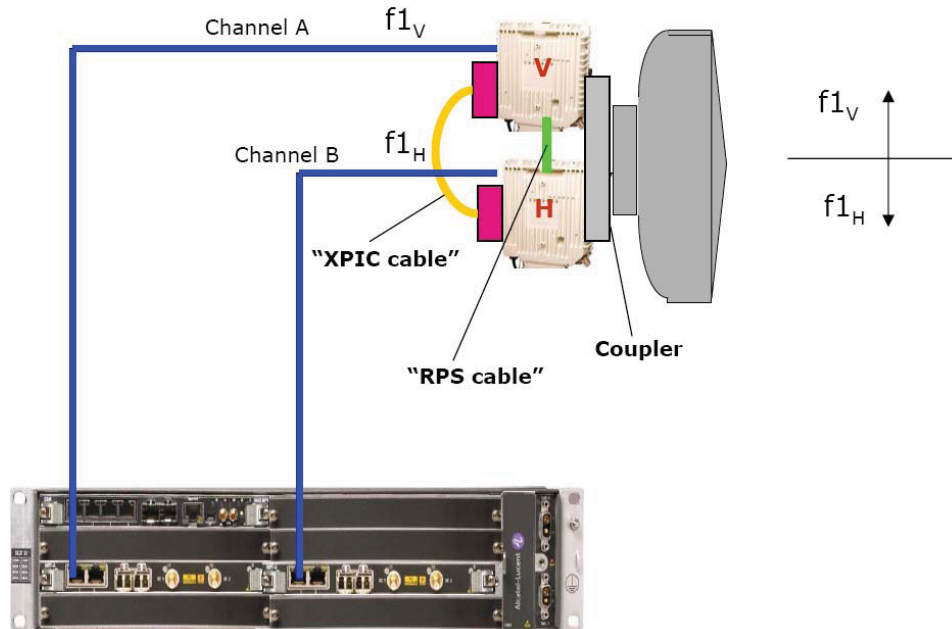


Figure 77. Single 2+0 XPIC

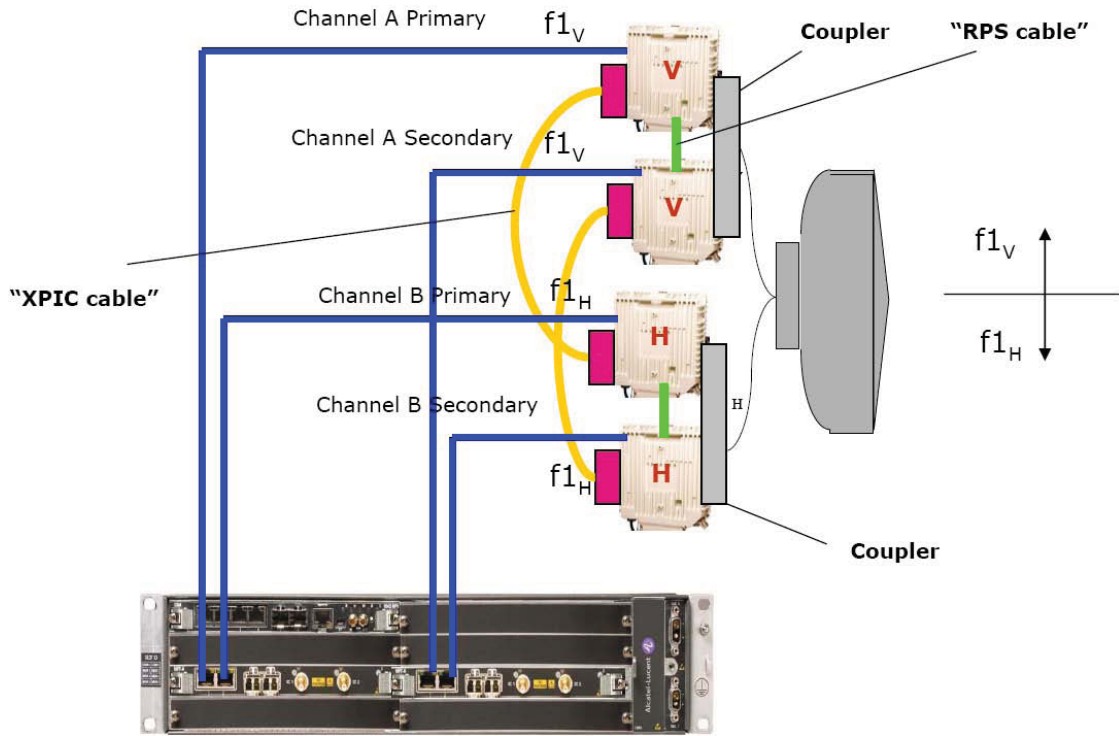


Figure 78. Double 1+1 HSB co-channel XPIC

2.8.11.7 Link identifier

The amount of microwave links, especially in urban areas puts the problem of possible interferences during installation and turn-on phase.

The digital frame incorporates link identity coding capabilities to prevent the capture of an unwanted signal.

Link identifier management can be enabled or disabled by the management systems.

2.8.11.8 Loopbacks with ODU300

To facilitate the installation/commissioning and the remote maintenance one loopback is available.

As the activation of a loopback affects the traffic, the presence of a loopback is indicated to the management systems as an abnormal condition.

The loopback is "loop and cut" type (the signal sent after the loopback execution is the same signal sent back).

The loopback supported by the Radio board is shown in the following figure.

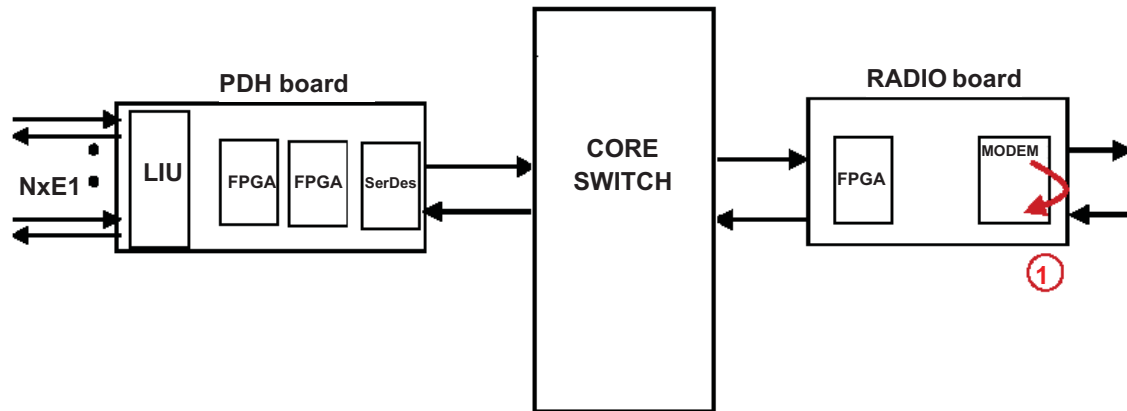


Figure 79. Available loopbacks

- 1) IF Radio loopback: is implemented in the analog IF part of the ODU300 Radio Module, the traffic received from switch side is redirected toward the switch itself; this loopback can be activated only on the aggregate traffic. When this loop is enabled the behaviour is the following:
 - TDM2TDM flows: before transmitting the packets towards the switch, the FPGA looking the VLAN will rebuild the right Ethernet header.
 - TDM2ETH flows: before transmitting the packets towards the switch, the FPGA looking the VLAN will rebuild the right Ethernet header.
 - The Ethernet flows are dropped.

2.8.12 Radio Transmission Features with MPT-HC/MPT-HC V2/MPT-MC

2.8.12.1 Frequency Agility

The Frequency Agility feature gives the Operator the possibility to set via ECT the frequency of a single Transceiver within a chosen sub-band to select the RF working channel. This implies benefits for spare parts, order processing and frequency co-ordination.

2.8.12.2 Automatic Transmit Power Control (ATPC)

The Automatic Transmit Power Control (ATPC) function automatically increases or decreases the transmit output power upon request from the opposite terminal. The opposite terminal constantly monitors Receive Signal Level (RSL), receive signal quality, and aggregate Bit Error Rate (BER) of the receive signal.

When the ATPC is Enabled the transmit output will remain at it's lowest level until a fade occurs (or a receive circuit alarm is detected). When the change in RSL is detected at the receive end, a command is sent to the transmit end to increase power in 1 dB steps to it's highest level. After the fade is over, the receive end commands the transmit power to decrease in 1 dB steps to the lowest level.

The ATPC range (high and low limits) is variable, determined by link distance, link location, and link frequency. When ATPC Enabled is checked, the range values are shown in parenthesis (minimum - maximum) following ATPC Range.

When the ATPC is disabled the transmit output will always operate at it's highest level.

2.8.12.3 Transmitted power control: RTPC function

The capability to adjust the transmitted power in a static and fixed way (RTPC = Remote Transmit Power Control) has been introduced for those countries where, due to internal rules, the ATPC function is not accepted or for those hops in which due to the short length and interface problems, a fixed reduced transmitted power is preferred. The range of the possible attenuation depends on the frequency band involved. The setting of the transmitted power can be performed locally through ECT.

Output power is band and modulation dependent.

2.8.12.4 Power Monitoring

The MPT-HC/MPT-HC V2 incorporates a detector for Tx power measurement. It is used to provide measurement of forward power as a performance parameter, and to provide a calibration input for transmitter operation over temperature and output range.

Viewed Tx power ranges always match the capabilities of the MPT-HC/MPT-HC V2 for a given modulation. When modulation is changed, the WebEML automatically adjusts/restricts Tx Power to be within valid range.

2.8.12.5 Adaptive Equalization

Adaptive equalization (AE) is employed to improve reliability of operation under dispersive fade conditions, typically encountered over long and difficult paths.

This is achieved through a multi-tap equalizer consisting of two registers, one with feed-forward taps, the other with feed-back taps. Each of these registers multiply successive delayed samples of the received signal by weighting-coefficients to remove propagation induced inter-symbol interference.

2.8.12.6 Link identifier

The amount of microwave links, especially in urban areas puts the problem of possible interferences during installation and turn-on phase.

The digital frame incorporates link identity coding capabilities to prevent the capture of an unwanted signal.

In case of "Link Identifier Mismatch" all the traffic is dropped.

The Link identifier management can be enabled or disabled by the management systems.

2.8.12.7 Loopbacks with MPT-HC/MPT-HC V2/MPT-MC

To facilitate the installation/commissioning and the remote maintenance one loopback is available.

As the activation of a loopback affects the traffic, the presence of a loopback is indicated to the management systems as an abnormal condition.

The loopback is "loop and continue" type (the signal sent after the loopback execution is the same signal sent back).

The loopbacks supported are shown in the following figure.

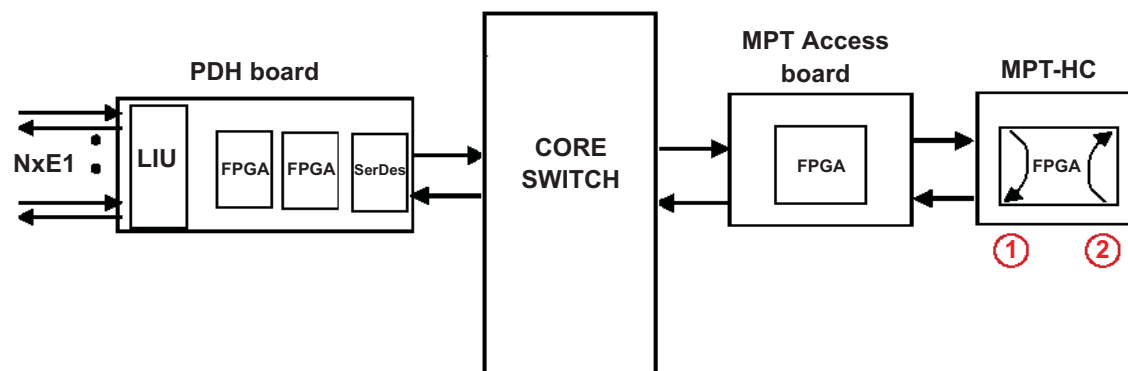


Figure 80. Available loopbacks

- 1) Core facing radio loopback: this loopback routes data from the output of the Tx Data Awareness block (after compression) to the input of the Rx data awareness (decompression). This is an internal loopback provided by the MPT FPGA. It is a Loop and Continue. It is possible to enable this loopback only at aggregate level. When this loopback is activated the behavior is the following:
 - Compressed flows (TDM2TDM, TDM2ETH and ATM PW) are forwarded back to Core module with proper assignment of source and destination MAC addresses (e.g. incoming MAC SA is used as MAC DA for looped frame, while MAC SA in the looped frame is the MAC assigned to slot hosting radio card).
 - For TDM2ETH flows the loopback works only if the ECID Tx and ECID Rx are the same, in case of ECID Tx is different form ECID Rx the loopback doesn't work.
 - For ATM PW flows the loopback works only if the Inbound and Outbound PW Labels are the same, in case they are different the loopback doesn't work.

- Generic Ethernet flows are dropped.

The Core facing radio loopback operation implies the "Automatic Tx mute" before the execution of the command and the "Tx mute removal" after the execution of the loopback command.

- 2) Radio facing Circuit loopback: remote loopback allows an over-the-air loopback test to be performed when the modem is operating in a continuous mode.

The loopback is internally provided by the MPT FPGA and connects the Receive data interface to the Transmit data interface.

This is a line external loopback. This loopback is a Loop and Continue.

It is possible to enable this loopback only at aggregate level.

When this loop is enabled the expected behavior is the following:

- Compressed flows (TDM2TDM, TDM2ETH and ATM PW) are forwarded back to Core module with proper assignment of source and destination MAC addresses (e.g. incoming MAC SA is used as MAC DA for looped frame, while MAC SA in the looped frame is the MAC assigned to slot hosting radio card).
- For TDM2ETH flows the loopback works only if the ECID Tx and ECID Rx are the same, in case of ECID Tx is different from ECID Rx the loopback doesn't work.
- For ATM PW flows the loopback works only if the Inbound and Outbound PW Labels are the same, in case they are different the loopback doesn't work.
- Generic Ethernet flows are dropped.

2.8.12.8 Loopback activation

The loopback can be activated by each management system (local or remote). The activation command permits to define the duration of the loopback (time-out).

The two loopbacks (Core facing and Radio facing) cannot be supported at the same time.

The time-out period starts at the activation time and expires at the end of the period spontaneously in the NE, a part for the case in which another reconfiguration of the time-out period is requested at the operator interface during the activation time. In this case, if the loopback point is still active because the activation time-out is not expired yet, the time-out period is reconfigurable and the specified time range starts again from the new updated activation date, overwriting the previous activation date and time-out values.

2.8.12.9 Loopback life time

In order to avoid the risk of a permanent disconnection from ECT/NMS of a remote NE after the execution of a loopback, a time-out mechanism is supported.

The management system's operator has to provide the time range of the loopback time-out period expressed in hours/minutes starting from the time of the loopback activation.

A default time-out period may be suggested at the operator interface, even if it could be modified on user-needs basis.

After the NE reset, the activation of each loopback point is lost and must be recreated again if needed, starting with a new time-out period.

2.8.13 TMN interfaces

On 9500 MPR-E Network Element the following types of TMN communication interfaces are present:

- TMN channel carried by Ethernet frames in the dedicated TMN port (on the front panel of the Core-E module) (this port is normally used to connect the WebEML);
- TMN channel carried up to 512 kbit/s channel inside Radio frame;
- TMN channel carried by Ethernet frames in User Ethernet port# 4 (on the front panel of the Core-E module);
- Two TMN In-band interfaces (by using the Ethernet traffic ports).

2.8.14 Admission control in Adaptive Modulation (only with ODU300)

Note

With the MPT-HC or MPT-HC V2 or MPT-MC the Admission Control is always enabled (and cannot be disabled). The total available capacity is the capacity available with the minimum modulation scheme.

2.8.14.1 What does “Admission Control” mean?

The Admission Control is a feature that is available only when operating in Adaptive modulation. It ensures that the requested TDM flows are kept when the modulation scheme is downgraded automatically by the system due to the degraded propagation condition.

The Admission Control check is optional: from WebEML, it is possible to decide to enable or not the admission control check (default value is Enabled).

2.8.14.2 Radio capacity in case of adaptive modulation

When the terminal operates in adaptive modulation, it is possible to commission a total capacity of both Ethernet and TDM traffic, up to a bandwidth corresponding to the maximum modulation scheme chosen by the operator. The Table 2. summarizes the E1 equivalent capacity supported by the MPR when using the adaptive modulation. This capacity depends on the channel spacing and the modulation scheme.

2.8.14.3 Adaptive modulation and admission control enabled

The Admission Control feature allows the operator to protect the TDM traffic when this kind of traffic is provisioned.

When admission control is enabled (default operator choice), the whole TDM traffic is kept. The maximum number of E1 links that can be provisioned (or cross-connected in a given radio direction) is the one that is fitting with 4QAM capacity.

N.B. There is no possibility to provision a number of E1s greater than the one fitting in 4QAM modulation. Indeed, as all the E1 links have the same priority, it is not possible from a system point of view to decide "which" E1s should be dropped when the modulation scheme is downgraded from 16QAM to 4QAM. To secure provisioning and commissioning operations, the **admission control** check at WebEML level has been inserted, avoiding a possible mistake from the user to provision a number of E1s that are not fitting inside 4QAM bandwidth.

Depending on the channel spacing value, the maximum number of E1 that can be provisioned is (refer to Table 2.):

- Channel spacing of 7 MHz: 4 x E1
- Channel spacing of 14 MHz: 8 x E1
- Channel spacing of 28 MHz: 18 x E1

The remaining capacity is devoted to other types of traffic such as Ethernet best effort.

When RSL (received signal level) value decreases, modulation scheme is downgraded first from 64QAM to 16QAM: the traffic with lower priority exceeding 16QAM bandwidth is dropped and all the E1s are kept.

As soon as the RSL value further decreases, modulation scheme is downgraded to 4QAM and the whole traffic exceeding 4QAM bandwidth is dropped while the E1s are kept.

Figure 81., Figure 82. and Figure 83. here below show how the system operates, in case of modulation changes when admission control is enabled (case of 28 MHz bandwidth).

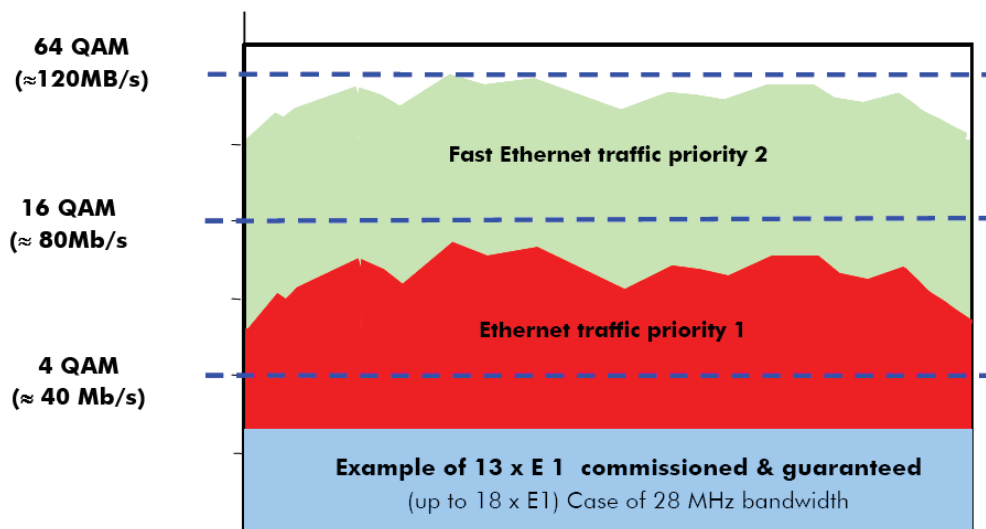


Figure 81. Example of traffic in case of 28MHz bandwidth and Admission Control Enabled

In this case, the operator has commissioned 13xE1's and enabled the Admission Control. There are two other kinds of traffic provisioned, Ethernet traffic #1 and Fast Ethernet traffic #2. Furthermore, Ethernet traffic #1 has a higher priority than Fast Ethernet traffic #2.

The 13xE1's are saved even in the case of a degradation of the modulation down to 4QAM. Remaining available capacity is used to transmit other kinds of traffic.

When the modulation is degraded from 64QAM to 16QAM (Figure 82.), the E1 flows are kept whilst the Ethernet traffic with lowest priority (Fast Ethernet traffic #2) is reduced.

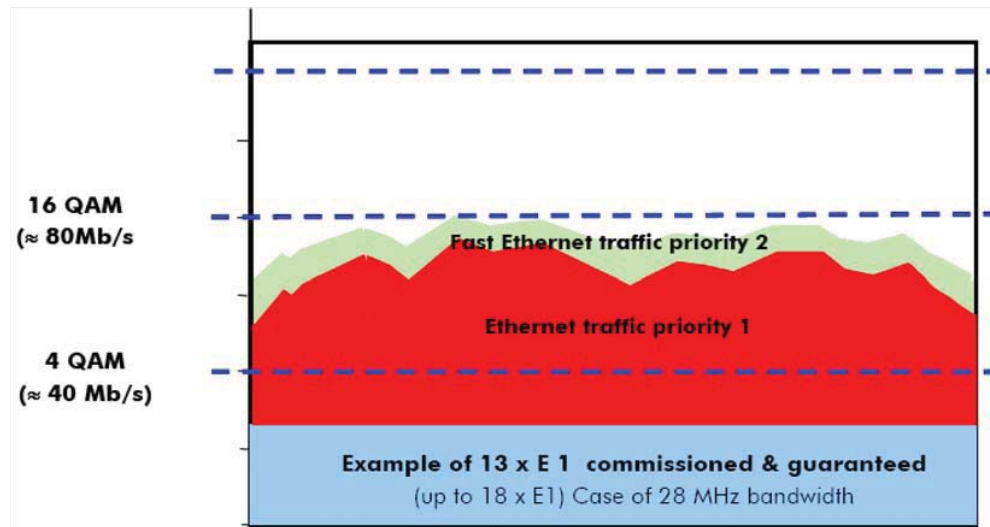


Figure 82. Example of traffic in case of 28MHz bandwidth and modulation downgraded to 16QAM

When the modulation is further degraded to 4QAM (Figure 83.), the E1 flows are still kept whilst the Ethernet traffic with the lowest priority is dropped (Fast Ethernet traffic #2) and the Ethernet traffic with the highest priority is reduced (Ethernet traffic #1) to fit the remaining available bandwidth.

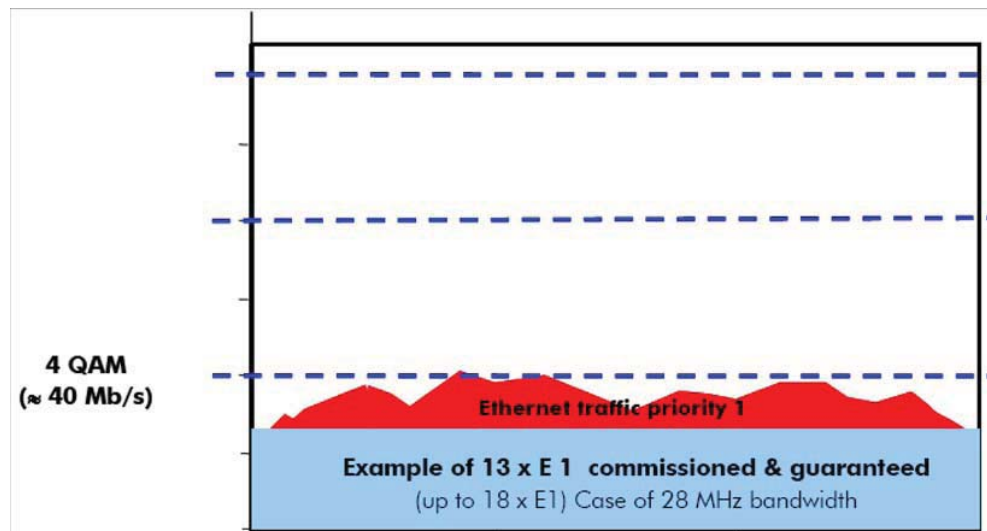


Figure 83. Example of traffic in case of 28MHz bandwidth and modulation downgraded to 4QAM

2.8.14.4 Adaptive modulation and admission control disabled

The E1 flows are no more guaranteed traffic when the operators disable the admission control. The maximum number of E1 links that can be cross-connected into a given radio direction is the one that is fitting with 16QAM capacity but without any survival when the modulation scheme is degraded.

N.B. As all the E1 links have the same priority, it is not possible, from a system point of view, to decide "which" E1's should be dropped when the modulation scheme is degraded from 16QAM to 4QAM. To secure provisioning and commissioning operations, the **admission control** check at WebEML level has been inserted, avoiding a possible mistake from the user to provision a number of E1's that are not fitting inside 16QAM bandwidth.

Depending on the channel spacing value, the maximum number of E1's that can be provisioned is (refer to Table 2.):

- Channel spacing of 7 MHz: 8 x E1
- Channel spacing of 14 MHz: 18 x E1
- Channel spacing of 28 MHz: 37 x E1

The remaining capacity is devoted to other types of traffic such as Ethernet best effort.

When RSL (received signal level) value decreases, the modulation scheme is downgraded first from 64QAM to 16QAM and all E1 flows are kept because there is enough bandwidth to transmit them. When the modulation further degrades to 4QAM, all E1 flows are dropped because there is no way to define any kind of priority among them. The remaining bandwidth is filled with other traffics.

N.B. It might happen that some E1(s) are temporarily up and transmitting, but this is a random behaviour without any predefined mechanism, there is no control at all performed on the E1 links.

This feature addresses the need of transmitting a high number of E1's, without giving up the benefits of adaptive modulation for Ethernet traffic.

Figure 84., Figure 85. and Figure 86. show how the system operates in case of modulation changes when admission control is disabled (case of 28 MHz bandwidth).

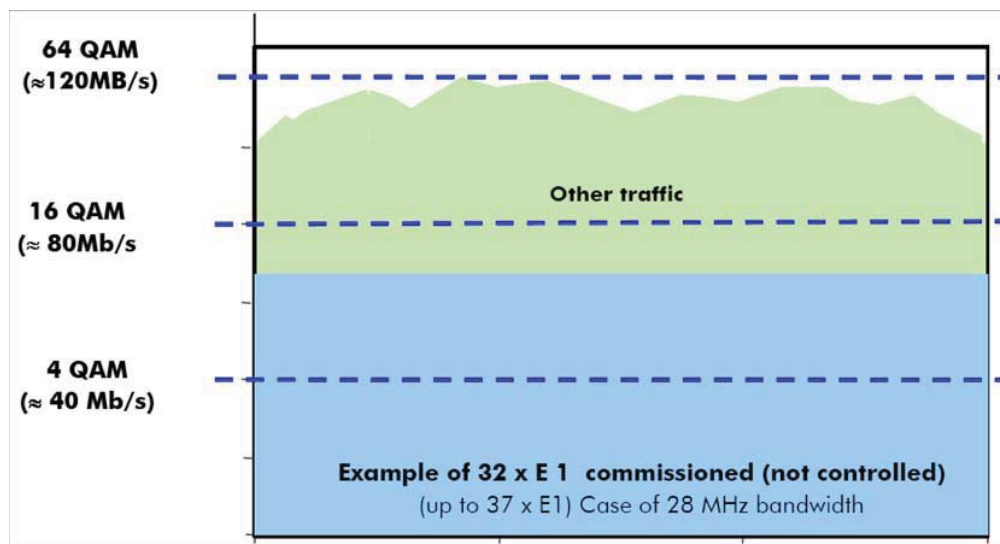


Figure 84. Example of traffic in case of 28MHz bandwidth and Admission Control Disabled

In this case, the operator has commissioned 32xE1's and chosen to disable the Admission Control. These 32 xE1's are kept as long as the modulation scheme is degraded down to 16QAM.

Other kinds of traffic are transmitted according to the available capacity and the priority defined beyond them.

When the modulation is downgraded to 16QAM, all E1 flows are kept whilst the other traffic is reduced.

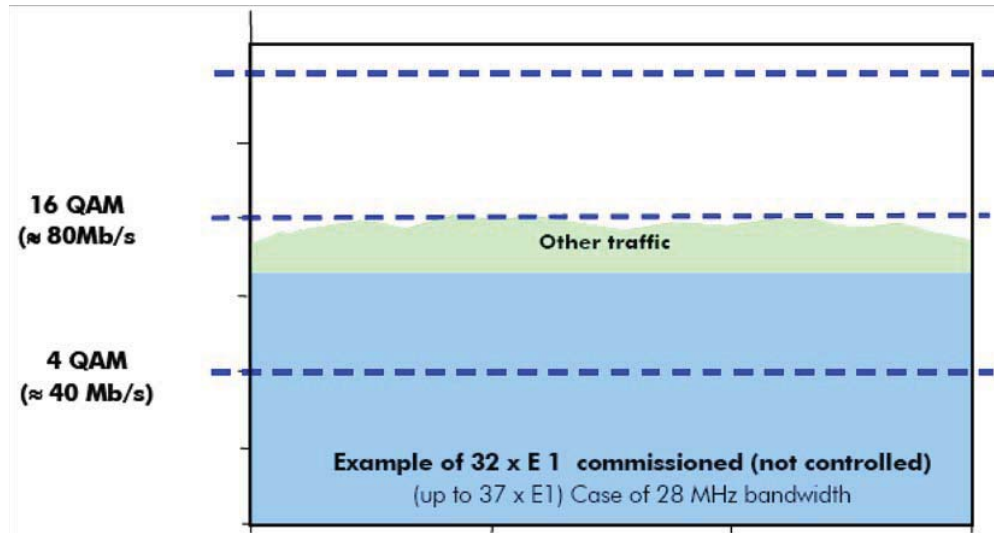


Figure 85. Example of traffic in case of 28MHz bandwidth and modulation downgraded to 16QAM

When the modulation is further degraded to 4QAM, all E1 flows are dropped whilst the other traffic is reduced to fit the remaining available bandwidth.

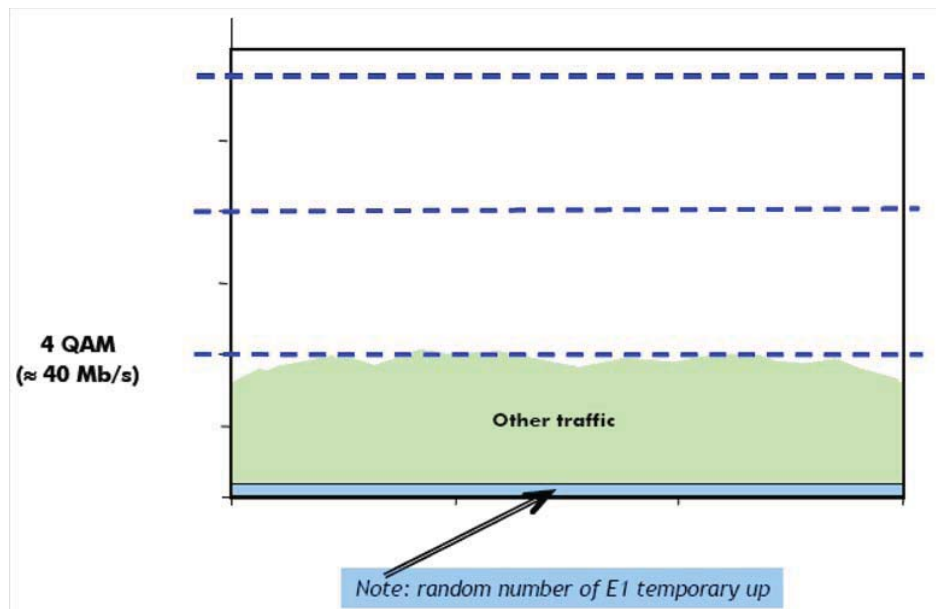


Figure 86. Example of traffic in case of 28MHz bandwidth and modulation downgraded to 4QAM

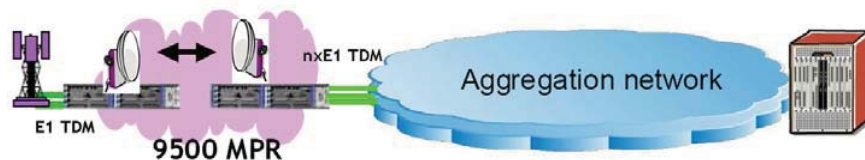
2.8.15 Managed Services and profiles

Here below the association of managed services and profiles:

- **TDM to TDM** – This is the typical service associated to a traditional TDM network in which E1 traffic is transported, switched and terminated inside a MPR network.
- **TDM to ETH** – This is the service allowing the TDM traffic to be aggregated and output in a single ETH stream. On this service specific algorithms are applied in order the E1 is transported, switched and provided to an external ETH network in standard format (MEF-8).
- **SDH to SDH** – This is the typical service associated to a traditional SDH transport network. STM-1 traffic is transparently transported, switched and terminated inside a MPR network.
- **ETH to ETH** – This is not a real CES due to the native IP architecture of MPR. Ethernet traffic is directly managed by the L2 switch on the Core board, thanks to the auto-learning algorithm, VLANs etc.
- **ATM to ATM** – This profile allows the management of the ATM services inside a 9500 MPR network. E1s IMA/ATM are terminated/reconstructed at the borders of the 9500 MPR cloud; encapsulation/extraction of ATM streams into/from ATM PW packets is performed according to RFC 4717.
- **ATM to ETH** – This profile allows the ATM service to be terminated and encapsulated into an Ethernet stream towards an IP/MPLS Core Network.

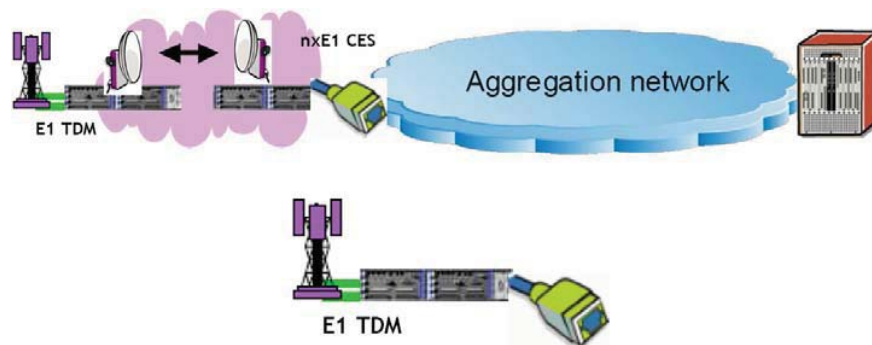
[1] TDM to TDM flow

- **Definition:** This service identifies a flow inside MPR network, in which E1 is transported, switched and terminated.
- **Application:** Typical microwave 2G backhauling application, in which E1s are terminated before entering into aggregation network.



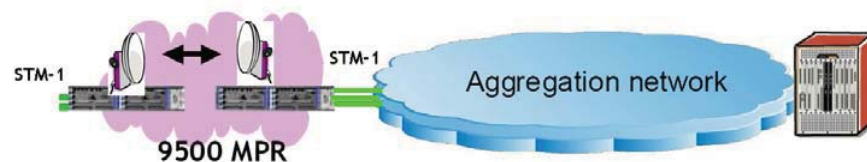
[2] TDM to ETH flow

- **Definition:** E1 TDM input signals are packetized according to MEF8 standard; E1s are transported, switched and provided to an external ETH network in standard format (MEF-8).
- **Application:**
 - **a)** Typical microwave 2G backhauling application, in which E1s are terminated before entering into aggregation network, where aggregation network is a packet network. E1s are not terminated at the end of the microwave backhauling and an end-to-end circuit emulation services could be established between 9500 MPR and the service router in front of BSC/RNC
 - **b)** 9500 MPR without ODU (MSS-8 or MSS-4 stand alone) provides the same level of feature of a site aggregator box, grooming together different services (in this particular case E1 TDM) into the common Ethernet layer.



[3] TDM to TDM flow

- **Definition:** This service identifies a flow inside MPR network, in which STM-1 is transparently transported, switched and terminated.
- **Application:** Typical microwave transport application.



[4] ETH to ETH flow

- **Definition:** Ethernet traffic is transported and switched automatically by the standard auto-learning algorithm of the built-in MPR 10 Gbit Ethernet switch.
- **Application:** Typical microwave 3G backhauling/WiMax application, in which transport of Ethernet packets coming from basestations is requested.



[5] “ATM2ATM” flow

- **Definition:** 9500 MPR terminates the native IMA/ATM and performs encapsulation/extraction of those ATM flows into/from ATM PW packets according to RFC 4717. The 9500MPR facing the aggregation network, the original ATM flows are re-built on ASAP board.
- **Application:** Typical microwave 3G backhauling application, in which transport of Ethernet packets coming from 3G base station is requested.

[6] “ATM2ETH” flow

- **Definition:** 9500 MPR terminates the native IMA/ATM and ATM traffic, encapsulated in Ethernet frames, is transported into IP/MPLS Core Network.
- **Application:** Typical microwave 3G backhauling application, in which transport of Ethernet packets coming from 3G basestation is requested.

2.8.16 TDM and Ethernet traffic management

Three kinds of traffic management have been identified:

- TDM2TDM (9500 MPR-E ↔ 9500 MPR-E, internal to the MPR network)
- TDM2Eth (9500 MPR-E ↔ TDM to Ethernet)
- SDH2SDH (9500 MPR-E ↔ 9500 MPR-E, internal to the MPR network)
- DATA (Ethernet to Ethernet)

The first two profiles meet MEF8 standard.

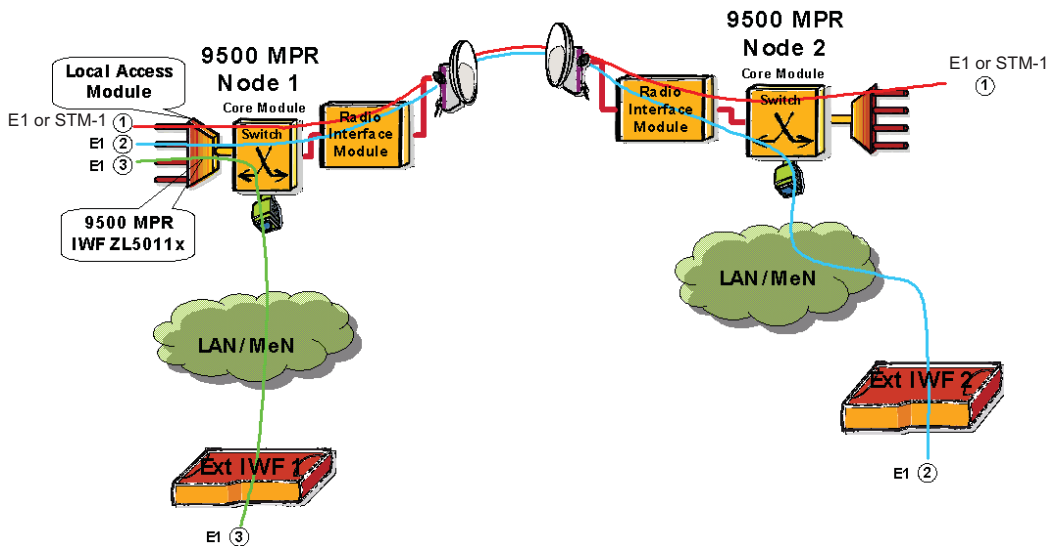


Figure 87. Traffic profiles

Case ① for E1

The E1 stream is inserted in Node 1 and extracted in Node 2. In this case the two IWFs used to packetize the traffic for the Ethernet switch in the Core-E module are both internal to the 9500 MPR-E network. The Circuit Emulation Service is TDM2TDM in Node 1 and Node 2. The Cross connections to be implemented are PDH-Radio type.

Case ① for STM-1

The STM-1 stream is inserted in Node 1 and extracted in Node 2. In this case the two IWFs used to packetize the traffic for the Ethernet switch in the Core-E module are both internal to the 9500 MPR-E network. The Circuit Emulation Service is SDH2SDH in Node 1 and Node 2. The Cross connections to be implemented are SDH-Radio type.

Case ②

The E1 stream is inserted in Node 1 and extracted in Node 2. One IWF is inside the 9500 MPR-E, but the second IWF is external to the 9500 MPR-E network. The Circuit Emulation Service is TDM2ETH in Node 1 and Node 2. The Cross connections to be implemented are PDH-Radio type in Node 1 and Radio-Eth type in Node 2.

Case ③

The E1 stream is inserted/extracted in Node 1. One IWF is inside the 9500 MPR-E, but the second IWF is external to the 9500 MPR-E network. The Circuit Emulation Service is TDM2ETH in Node 1 and Node 2. The Cross connections to be implemented are PDH-Eth type in Node 1.

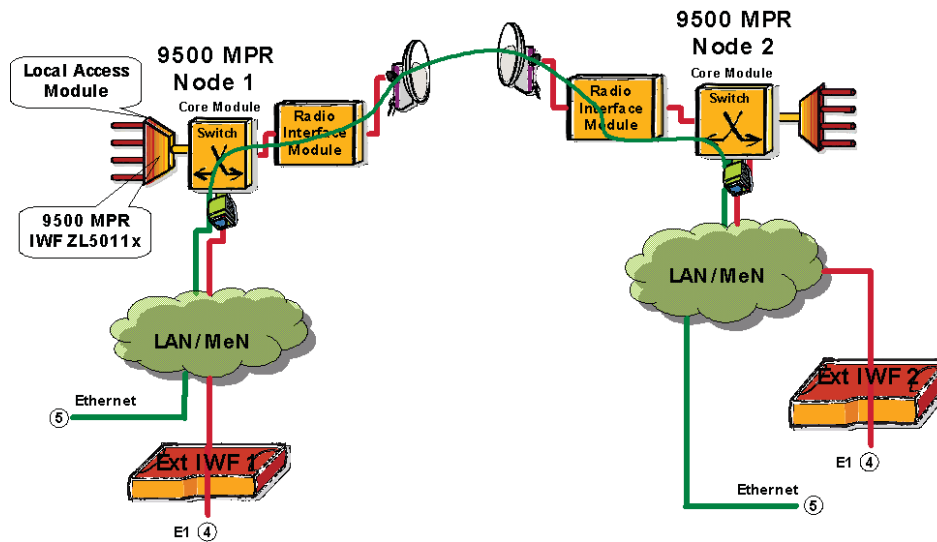


Figure 88. Traffic profiles

Case ④ and ⑤

In these cases Ethernet packets enter Node 1 and are extracted in Node 2. In case 4 the Ethernet packets encapsulate the E1 stream; in case 5 the packets are native Ethernet packets. None of the IWFs belongs to the 9500 MPR-E network. The Circuit Emulation Service is ETH2ETH in Node 1 and Node 2. No Cross connections must be implemented. The path is automatically implemented with the standard auto-learning algorithm of the 9500 MPR-E Ethernet switch.

2.8.16.1 TDM2TDM

E1 traffic packetized only internally to 9500 MPR-E equipment.

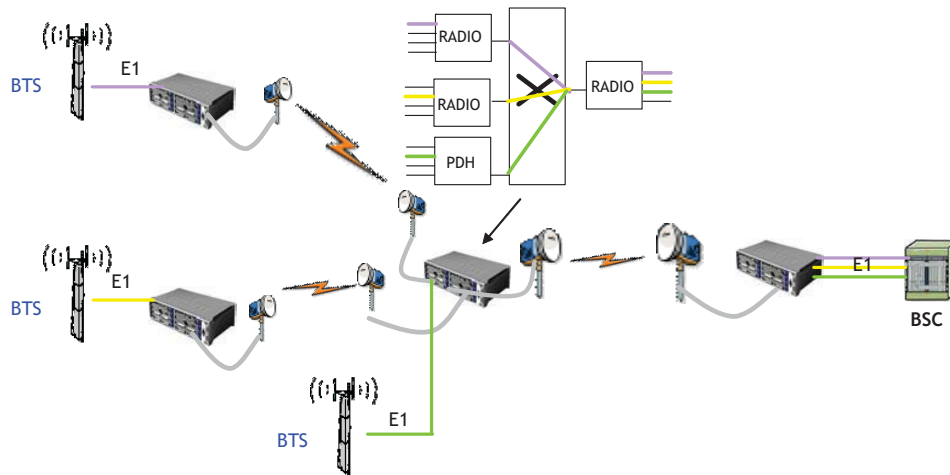


Figure 89. E1 Traffic

Flow Id present (user defined)

Intermediate node configuration (E1 provisioning):

- node by node (building Cross-connection tables based on Flow Id)

Bandwidth guaranteed (according to QoS → Highest Queue Priority association)

No flooding-autolearning necessary

Both the IWFs belong to 9500 MPR-E and the packets are not supposed to exit the 9500 MPR-E network.

The IWF parameters listed above, have predetermined values and don't need to be provisioned.

- Mac addresses are determined as consequences of the cross connections.
- Payload size is fixed to 121 bytes
- ECID will be the same value as Flow Id (ECID = Emulated Circuit Identifier)
- TDM clock source: clock recovery differential,
- Flow Id provisioned by ECT/NMS

2.8.16.2 TDM2Eth

E1 traffic both internal and external to 9500 MPR-E equipment.

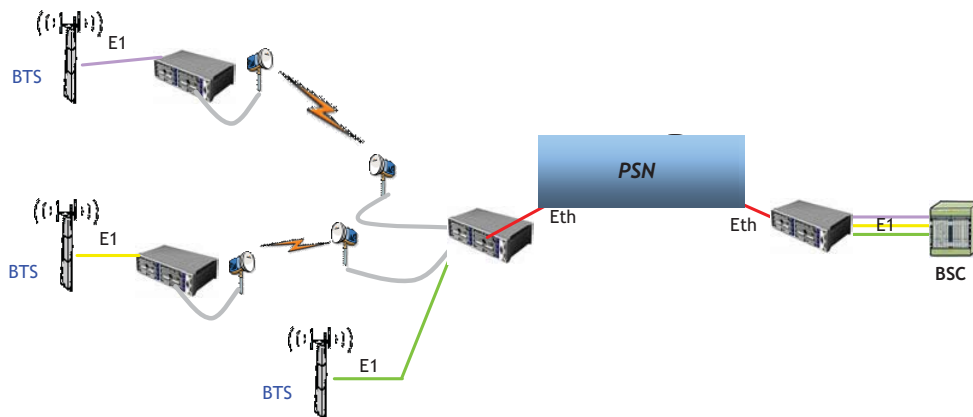


Figure 90. E1 Traffic

Flow Id present (user defined)

All the parameters must be configured compliant with the MEF8 standard

Adaptive or differential clock recovery supported

Bandwidth guaranteed (according to QoS → Highest Queue Priority association)

Destination MAC added before going into whole network (MEF8 compliant)

Only one of the IWFs belongs to 9500 MPR-E and the packets are supposed to exit the 9500 MPR-E network.

- MAC addresses: in all involved nodes are determined as consequences of the cross connections; the only exception is the Ethernet Terminal Node (the node where the TDM2ETH traffic goes through an user Ethernet port). In such ETN the source address is the node Mac address, the destination Mac address will be provisioned by ECT/NMS.
- Payload size: is fixed to 256 bytes
- ECID: provisioned by ECT/NMS, 2 different values may be used for each direction (ECID = Emulated Circuit Identifier)
- TDM clock source is provisioned by ECT/NMS: clock recovery adaptive, clock recovery differential, clock loopback (TDM line in)
- Flow Id is provisioned by ECT/NMS (One Vlan is assigned to each bi-directional circuit emulated E1 flow)

For this case the expected latency for 1 hop is 3.5 msec for 256 bytes.

2.8.16.3 SDH2SDH

STM-1 traffic packetized only internally to 9500 MPR-E equipment.



Figure 91. STM-1 Traffic

Flow Id present (user defined)

If there are intermediate nodes in each node build the Cross-connection tables based on Flow Id.

Bandwidth guaranteed (according to QoS → Highest Queue Priority association)

No flooding-autolearning necessary

Both the IWFs belong to 9500 MPR-E and the packets are not supposed to exit the 9500 MPR-E network.

The IWF parameters listed above, have predetermined values and don't need to be provisioned.

- Mac addresses are determined as consequences of the cross connections.
- Payload size is fixed
- Clock source: clock recovery differential/node timing
- Flow Id provisioned by ECT/NMS

2.8.16.4 ETH2ETH

None of the IWFs belongs to 9500 MPR-E.

None of the parameters listed in the previous slide has to be configured (the 9500 MPR-E is transparent).

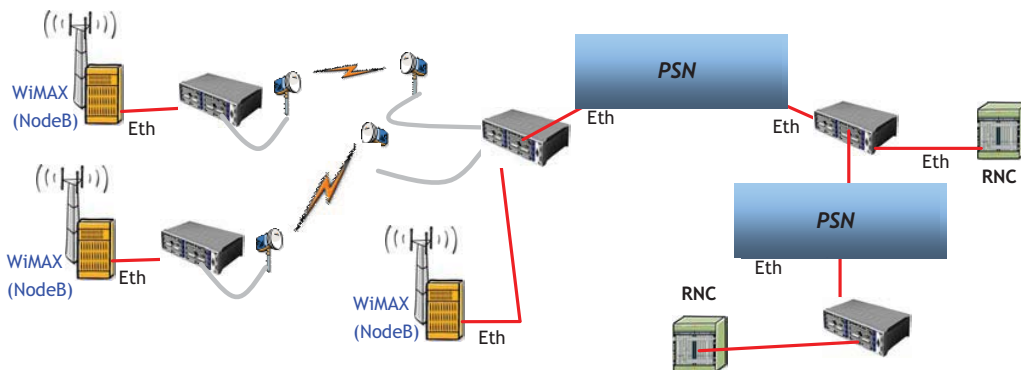


Figure 92. E1 Traffic

Any packet belonging to an Eth2Eth TDM flow is treated as any other Ethernet packet with the only exception of giving it an higher priority based on the MEF 8 Ethertype.

2.8.17 ATM Traffic Management

- Three Ethernet CoS are foreseen for ATM PW flows, derived from ATM Service Category configured for the related VP/VC at ATM layer (by ATM Traffic Descriptor):
 - CBR
 - UBR+ (MDCR > 0)
 - UBR
- By proper mapping of these CoSs to Core Switch and Modem Switch (refer to Figure 93.), the native ATM QoS can be emulated.
- ATM PW flow-based packet queueing is performed inside the ASAP unit, its Ethernet flow CIR/PIR/MBS/EBS parameters are also derived from configured ATM TD.
- ATM PW flows that have been classified as CBR and UBR+ will be subjected to admission control and then have guaranteed bandwidth; the required bandwidth will be derived from Ethernet flow CIR, taking in account the ATM PW encapsulation and air frame structure.

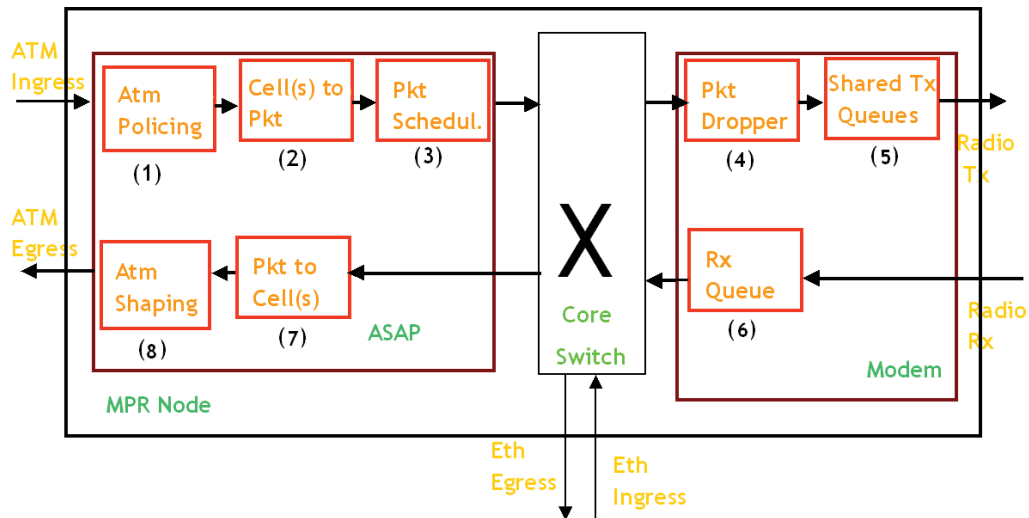


Figure 93. ATM Traffic Management - General block diagram

In Figure 94 is shown a more detailed block diagram of the ASAP unit in Ingress.

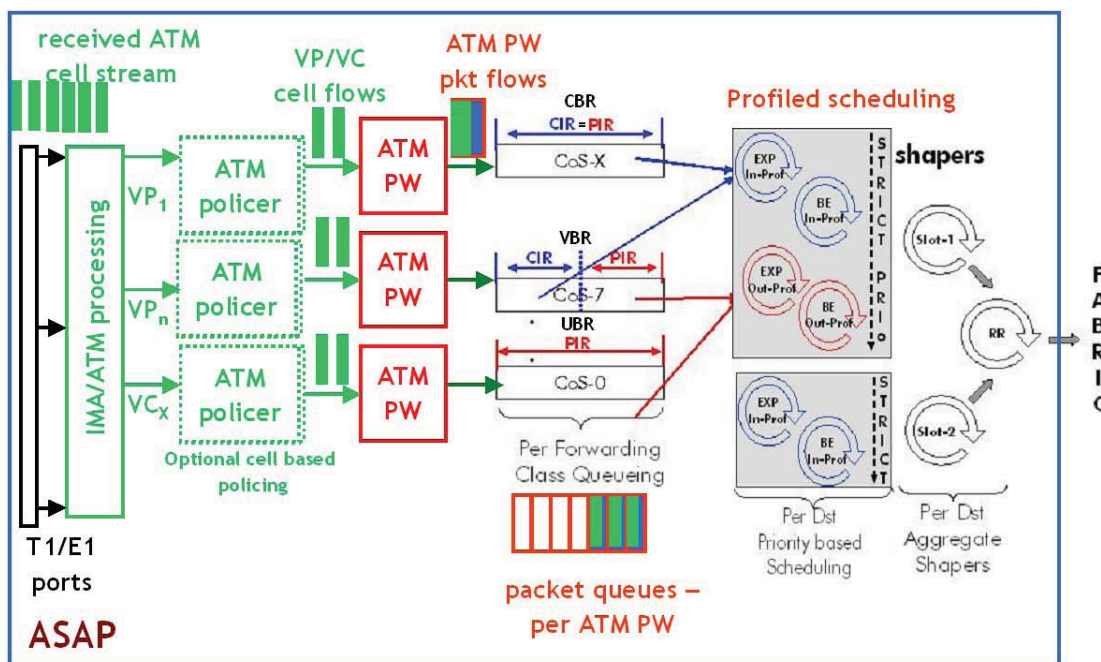


Figure 94. Block diagram for ATM Ingress (ATM -> Packet) direction

[1] ATM Ingress Policing

- ATM Policing (cell-based) can be enabled/disabled, on provisioning base, for each VP/VC configured on ATM interface, according to its Ingress Traffic Descriptor (PCR,SCR,CDVT,MCDR) as defined by ATM Traffic Management AF-TM-0121.000
 - Service Category: CBR, UBR+ and UBR
 - Conformance Definition: CBR.1

[2] Cells to packet

The ATM cells are encapsulated in PWE3 packet.

[3] Packet Profiled Scheduling

- ATM cell(s) are put into a packet, as result of provisioned value of max concat. number or elapsed timeout; an Ethernet flow is therefore created (identified by ATM PW Label/VLAN pair), whose CoS and CIR/PIR are automatically assigned by MPR based on ATM Ingress Traffic Descriptor and previous encaps params.
- This packet is then put in a dedicated queue where:
 - it is scheduled for transmission towards Core switch, with a constant rate given by assigned CIR/PIR (depending on CoS):
 - if the actual flow rate is < CIR:
 - 802.1p bits are marked as "GREEN", if $CIR < \text{actual flow rate} < PIR$,
 - 802.1p bits are marked as "YELLOW", (the packet is discarded on the Modem unit in case of congestion on radio i/f);
 - if the actual flow rate is > PIR, congestion on this queue happens and the next PWE3 packets will be dropped directly in ASAP card.

In/out profile is a dynamic assignment, based on CIR/PIR conformance for packet queue, and FC type (expedited vs best effort). The mapping of the 802.1p bits is shown in Table 31.

It is mapped to 802.1p bits in the following manner:

802.1p bits	Usage	Color
000	Best Effort, Out-of-Profile	YELLOW
001	unused	-
010	Expedited, Out-of-Profile	YELLOW
011	unused	-
100	Best Effort, In-Profile	GREEN
101	unused	-
110	Expedited, In-Profile	GREEN
111	Contro - egress only	-

Table 31. 802.1p mapping

[4] Packet Dropper

The packets marked with yellow are discarded in case of congestion, when the buffer in the Modem unit exceed a specific threshold.

Dropping mechanism:

- if a configurable queue fill level is overcame, then ATM PW packets that have been marked by ASAP as out of profile (within 802.1p bits) are discarded.

The dropping mechanism applyies to queues with guaranteed Traffic:

- It applies to queue 7 and 6.
- To avoid delay on queue 7, shared among TDM2ETH, ATM CBR, the fill level to start discarding is configured according to max acceptable delay (about 1 ms).

[5] Shared Tx queues

The packet according to its service category is send to one of the output queues.

[6] Rx Queues

Flows of the same type are reassembled in different queues.

[7] Packet to cells

The ATM cells are extracted from the PWE3 packet.

[8] ATM Egress Shaping

- A four-queue scheduling is used for for ATM traffic egressing MPR system.
- The higher priority queues are reserved for ATM shaped traffic, while the lowest one is reserved to not shaped traffic.
- Cell-based ATM Shaping is applied for a VP/VC that has been configured with CBR and VBR Service Category on the basis of its configured egress ATM Traffic Descriptor, general referene for this feature is ATM standards.
- A Weighted Round Robin is instead applied for all VPs/VCs that are not shaped. The weights are based on the value of configured MDCR in the egress ATM Traffic Descriptor value according to below table:

MDCR [cell/s]	RR Weight
<= 149	1
<= 300	2
<= 602	3
<= 1206	4
<= 2413	5
<= 3621	6
<= 4529	7
>= 4530	8

e.g. MDCR = 1000 [cell/s] -> Weight = 4
An UBR has MDCR=0 -> weight = 1

Table 32. RR weights

N.B. ATM "Light" Service

With MPT-HC or MPT-MC there is no full support of ATM Traffic as with ODU300, but the so-called ATM "Light" Service applies.

In this release, ATM PW traffic will be transported as native Ethernet traffic over radio directions with MPT ODU.

Radio QoS applied to ATM PW traffic will be the one for native Ethernet traffic, but since bandwidth cannot be guaranteed, admission control will not be applied.

Transport of ATM PW traffic within an MPR network must be done with radio links using all the same type of ODU, either ODU300 or MPT ODU.

To avoid NE reconfiguration in migration towards future release fully supporting ATM PW Service on radio directions with MPT ODU, a complete provisioning is applied since this release (including declaration of traffic descriptors).

However, configurations where ATM PW flows are cross-connected between a Radio-Ethernet terminal and an ATM-Ethernet terminal will require NE reconfiguration, as different MAC Address need to be provisioned.

2.8.17.1 ATM Traffic Management on ASAP - PW Label Exp bits and scheduling type

The scheduling is performed by using the EXP bit in the PW label. The assignment is according to ATM PW Cos as reported in the following table.

ATM Service category	EXP bits	Scheduling type
CBR	110	Expedited
UBR+	010	Best Effort
UBR	000	Best Effort

Table 33. PW label EXP bits

2.8.17.2 ATM Traffic Management on Modem card - Block diagram for ATM PW Flow policer

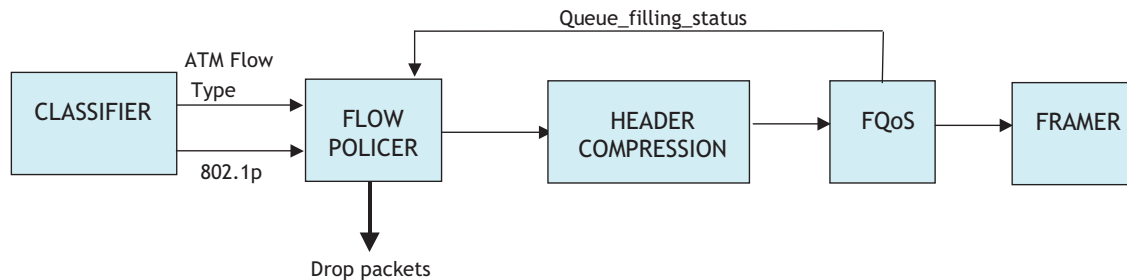


Figure 95. ATM Traffic Management on Modem card - Block diagram

- The CLASSIFIER provides to FLOW POLICER, for each ATM PW flow ((VLAN&MAC classification), the 802.1p bits with the indication if the packet is in/out profile.
- FLOW POLICER, looking at the packet type, 802.1p bits and the filling status of queue, discards or sends the ATM PW packet to HEADR COMPRESSION.

2.8.17.3 Support of ATMoMPLS Protocol Stack (with or without MPLS Tunnel Label)

2.8.17.3.1 ATM PW over MPLS (ATMoMPLS)

In order to support inter-working of ATM PW Service with IP/MPLS network at least at datapath level, in this release it will be supported the ATMoMPLS protocol stack referenced by RFC 4717, with the characteristics/limitation described in this paragraph.

For network deployment where both terminations of ATM traffic is carried out by MPR NEs, in order to save radio bandwidth it will be possible to have the ATM PW Service using the ATMoMPLS protocol stack without the MPLS Tunnel Label.

2.8.17.3.2 Protocol Stack Termination

In this release the ATMoMPLS protocol stack is terminated directly by the MPR NE where native ATM interface is present (i.e. MPLS Tunnel Label, if present, is added by ASAP Card).

That implies all MPR NEs must be aware of MPLS Tunnel Label presence, i.e. to apply ATM PW Header Compression.

2.8.17.3.3 802.1q VLAN Tag

ATMoMPLS protocol stack used by MPR foresees to have the 802.1q VLAN Tag.

VLAN is used, within MPR network, to define for ATM PW frames:

- forwarding plane
- colour marking consequent to profiled scheduling
- specific processing (ATM PW Header Compression) and QoS (queue assignment and colour-based policing) on radio interfaces

The same VLAN ID can be used by several ATM PW flows only if they share the same CoS and forwarding plane. Thinking to future releases, to use the same VLAN ID, the ATM PW flows must also share the same encapsulation format (i.e. N-1 cell mode with or without Control Word, AAL5 SDU or PDU modes)

A VLAN ID that is used by ATM PW flow(s) can never be used for TDM flows.

The fields of the 802.1Q VLAN Tag to be inserted into ATM PW flow frames are assigned in the following manner:

- 12-bit VLAN ID will be provisioned by ECT/NMS
- 3-bit PCP field is assigned according to the ATM PW flow COS and packet profiled scheduling
- 1-bit CFI field is set to 0

2.8.17.3.4 VLAN Swap

VLAN Swap feature is foreseen on "hand-off" MPR NE, i.e. the NE connected to IP/MPLS network.

VLAN Swap means that ATM PW flows ingressing/egressing the "hand-off" MPR will have the same common "external" VLAN ID, while within MPR network each ATM PW flow will use its own "internal" VLAN ID (may be shared among several ATM PW flows with same path and CoS).

To avoid possible configuration clashing, the above "external" VLAN ID should belong to the allowed range. Moreover, the "external" VLAN ID should be different from each "internal" VLAN ID.

VLAN Swap performed by the "hand-off" MPR NE is based on:

- for ingress, IP/MPLS network -> MPR network direction: the Inbound PW Label value
- for egress, MPR network -> IP/MPLS network direction: ATM PW CoS (to reduce numbers of "rules" used for such mapping).

2.8.17.3.5 802.1p remarking

In addition to VLAN Swap, 802.1p bits remarking are also applied by "hand-off" MPR NE to ATM PW frames:

- for ingress, IP/MPLS network -> MPR network direction: all frames will be declared as "green"
- for egress, MPR network -> IP/MPLS network direction: 802.1p bits will copy ATM PW Exp Bits

2.8.17.3.6 Tunnel Label

The MPLS Tunnel Label for ATM PW frames is foreseen only for compatibility with ATMoMPLS protocol stack.

MPR network is actually not using information from MPLS Tunnel Label value in ATM PW frames, for example:

- forwarding is based on VLAN/MAC DA
- CoS assignment of such frames will be always based on PW Label Exp bits

Tunnel Label fields to be inserted into ATM PW frames generated by MPR are assigned as below reported:

- 20-bit Tunnel Label will be provisioned by ECT/NMS
- EXP bits are copied from PW Label Exp bits
- BoS bit is set to 0
- TTL field is set to 255

2.8.18 Ethernet Traffic Management

The Ethernet traffic is all the traffic entered the MPR network from user Ethernet ports.

By ECT/NMS it is possible to define the way to manage the Ethernet traffic according to one of the following options:

- 802.1D (MAC Address bridge)
- 802.1Q (Virtual Bridge).

2.8.18.1 Bridge type change

In case of change of the bridge type from 802.1Q to 802.1D, the content of the VLAN table and the VLAN assigned to the user Ethernet ports (refer to par. 2.8.18.2) has to be deleted by the Operator before to change the bridge type.

2.8.18.2 Reserved Multicast Addresses

The following table summarizes the actions taken for specific reserved multicast addresses. Frames identified with these destination addresses are handled uniquely since they are designed for Layer 2 Control Protocols.

The actions taken by the system can be:

- **Discard** - The system discards all ingress Ethernet frames and must not generate any egress Ethernet Frame carrying the reserved multicast address.
- **Forward** - The system accepts all ingress Ethernet frames as standard multicast frames and forwards them accordingly.
- **Peer** - The system acts as a peer of the connected device in the operation of the relevant Layer 2 Control Protocol.

Reserved Multicast Address	Function	Action
01-80-C2-00-00-00	Bridge Group Address	Forward
01-80-C2-00-00-01	Clause 31 (MAC Control) of IEEE 802.3	Flow-Control enabled: Peer Flow-Control disabled: Discard
01-80-C2-00-00-02	Clause 43 (Link Aggregation) and Clause 57 (OAM) of IEEE 802.3	Peer for Link Aggregation and ESMC Discard for QAM
01-80-C2-00-00-03	IEEE 802.1X PAE address	Discard
01-80-C2-00-00-04 - 01-80-C2-00-00-0D	Reserved for future standardization	Discard
01-80-C2-00-00-0E	IEEE 802.1AB LLDP multicast address	Discard
01-80-C2-00-00-0F	Reserved for future standardization	Discard

Reserved Multicast Address	Function	Action
01-80-C2-00-00-10	All LANs Bridge Management Group Address	Forward
01-80-C2-00-00-11 - 01-80-C2-00-00-1F	Reserved	Forward
01-80-C2-00-00-20	GMRP Address (Clause 10 of IEEE 802.1D)	Forward
01-80-C2-00-00-21	GVRP Address (IEEE 802.1Q)	Forward
01-80-C2-00-00-22 - 01-80-C2-00-00-2F	Reserved for GARP Application	Forward
01-80-C2-00-00-30 - 01-80-C2-00-00-3F	CCM and LTM Group Destination MAC Addresses (IEEE 802.1ag)	Peer/Forward

2.8.19 LAG (Link Aggregation Group)

2.8.19.1 LAG overview

Link Aggregation groups a set of ports so that two network nodes can be interconnected using multiple links to increase link capacity and availability between them.

When aggregated, two or more physical links operate as a single logical link with a traffic capacity that is the sum of the individual link capacities.

This doubling, tripling or quadrupling of capacity is relevant where more capacity is required than can be provided on one physical link.

Link aggregation also provides redundancy between the aggregated links. If a link fails, its traffic is redirected onto the remaining link, or links.

If the remaining link or links do not have the capacity needed to avoid a traffic bottleneck, appropriate QoS settings are used to prioritize traffic so that all high priority traffic continues to get through.

The Link Aggregation is performed according to 802.3ad and can be applied to Radio ports and to User Ethernet ports.

2.8.19.1.1 Link aggregation on Radio ports (Radio LAG)

Link aggregation can be applied to radio ports (in this case it is named Radio Link Aggregation).

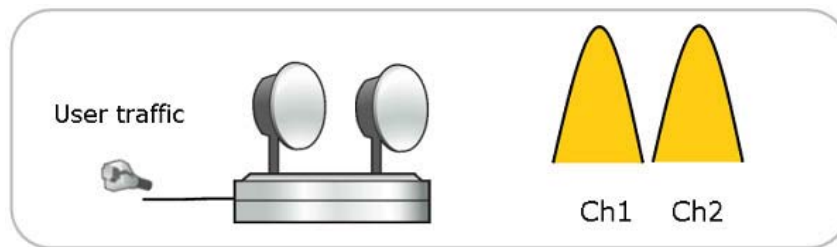


Figure 96. Radio LAG overview

In this example, user traffic is split up into radio channels. Main advantages:

- **Throughput.** The overall radio Ethernet throughput is more than 1 Gbit/sec (4 x 350 Mbit/s, being this the value for 256QAM@56 MHz)
- **Protection.** In case of a failure of one of the three channels, all the traffic is redirected on the remaining link (with a throughput of around 0.35 Gbit/sec). The discarded or dropped traffic is the one with lower priority: high priority traffic is still running on the remaining active channels.

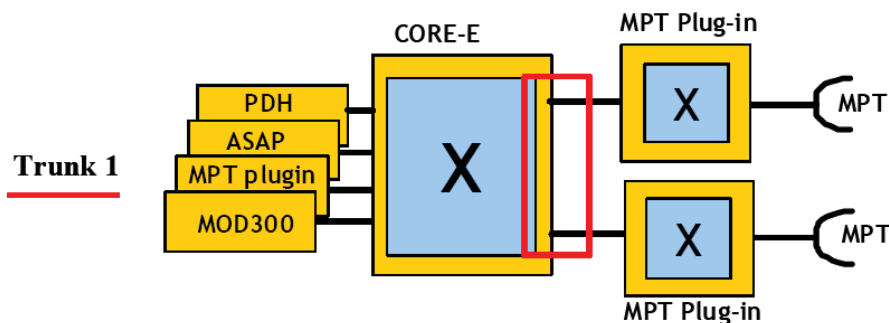


Figure 97. Radio LAG

One MPT per MPT plug-in.

2.8.19.1.2 Link aggregation on User Ethernet ports (Ethernet LAG)

Link aggregation can be applied to Ethernet user ports (electrical or optical) on the same Core-E unit.

The LACP protocol is supported.

Note 1: the Ethernet ports involved in a LAG cannot be used as TMN In-band interface.

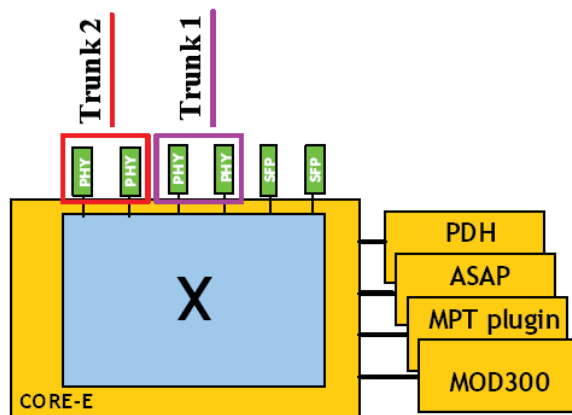


Figure 98. Ethernet LAG

2.8.19.1.3 Rules to be followed for the LAG creation

- Max number of Ethernet LAGs: 3 - each LAG with max 4 electrical Ethernet ports or 2 optical Ethernet ports.
- Max number of Radio LAGs: 3 - each with max four MPT-HC/MPT-HC V2 or four MPT-MC (no ODU300 can be used).
- The two MPT, grouped in a radio LAG, must be connected to two different MPT Access units (the other port of the MPT Access unit must be EMPTY). The ports of the two MPT Access units can have also a different port number.

Warning: the other port of the MPT Access unit must be DISABLED.

- The identifying number a LAG must be in the range 1-14.

2.8.20 Quality Of Services (QoS)

The QoS function inside 9500 MPR-E is the result of a distributed implementation in the switch and Radio Interface module. Both those QoS functions are properly configured in order to get the wished behavior on Ethernet flows that will be transmitted towards the Radio.

N.B. Configurations files

To obtain a specific behavior (not obtainable with the WebEML) the configuration files can be used. The configuration files configure the Ethernet switch inside the Core-E and the FPGA inside the Modem unit for ODU300 and inside the MPT Access unit for MPT-HC/MPT-MC.

The configuration files are written by using a set of low level commands provisioning in the proper way different devices of different MPR cards. After an NE reset, the configuration file is applied, provisioning the Ethernet switch and other devices to implement the desired feature.

The configuration file must be put in the compact flash plugged in Main Core, inside a specific directory, via FTP.

The application of a new configuration file could cause traffic hits.

The use of the Configuration files is explained in the relevant document "Configuration File Management".

2.8.20.1 QoS in the Core-E unit

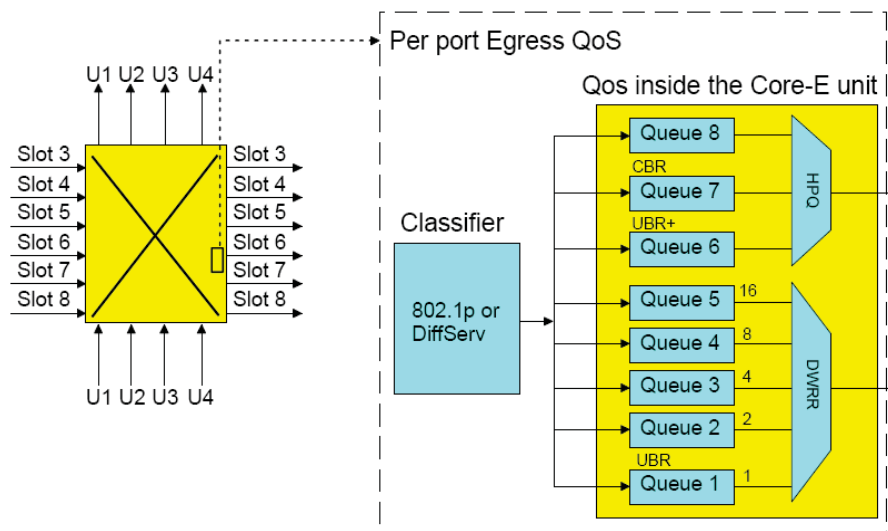


Figure 99. QoS in the Core-E unit

The figure shows an overview of the QoS implementation inside the switch.

The Quality of Service feature of the Ethernet switch provides four internal queues per port to support four different traffic priorities. Typically the high-priority traffic experiences less delay than that low-priority in the switch under congested conditions.

For each egress port according to method of QoS classification configured in the switch, the packets are assigned to each queue.

TDM flows classification

All the TDM2TDM traffic flows will be assigned to the highest egress priority queue (Q8). All the TDM2ETH traffic flows will be assigned to the Q7 egress priority queue. All the MEF-8 ETH2ETH traffic flows will be assigned to the Q5 egress priority queue.

Ethernet flows classification

For generic Ethernet flows in the switch the priority of each packet can be assigned according to the information in:

- **IEEE 802.1p**: the packet is examined for the presence of a valid 802.1P user-priority tag. If the tag is present the correspondent priority is assigned to the packet

802.1P priority	Queue
111, 110	Q5 (higher priority)
101	Q4
100	Q3
011, 000	Q2
010, 001	Q1

- **DiffServ**: each packet is classified based on DSCP field in the IP header to determine the priority.

DiffServ priority	Queue
111000, 110000, 101110, 101000	Q5 (higher priority)
100110, 100100, 100010, 100000	Q4
011110, 011100, 011010, 011000	Q3
010110, 010100, 010010, 010000 001110, 001100, 001010, 001000 000000	Q2
All remaining values	Q1

ATM PW flows classification

ATM PW flows will be assigned to Ethernet switch egress priority queues according to their CoS, as below reported:

ATM PW CoS	Switch Egress Queue
Guaranteed (CBR)	Q7 (higher priority)
Best Effort (UBR+)	Q6
BackGround (UBR)	Q1

Scheduler

The scheduler algorithm cannot be configured. HQP scheduler algorithm is used on queues Q8, Q7 and Q6.

Deficit Weighted Round Robin (DWRR) is used on the other queues with the following weights:

QUEUE	WEIGHT
Q5 (higher priority)	16
Q4	8
Q3	4
Q2	2
Q1	1

QoS with jumbo frame

While there is no physical limitation to the number of ports that can receive jumbo frame, if more jumbo flows are transmitted toward the same port into two different queues the QoS could work in wrong way. It is recommended to forward jumbo frame only in the queue Q1 (lower priority).

2.8.20.2 QoS in the Modem unit

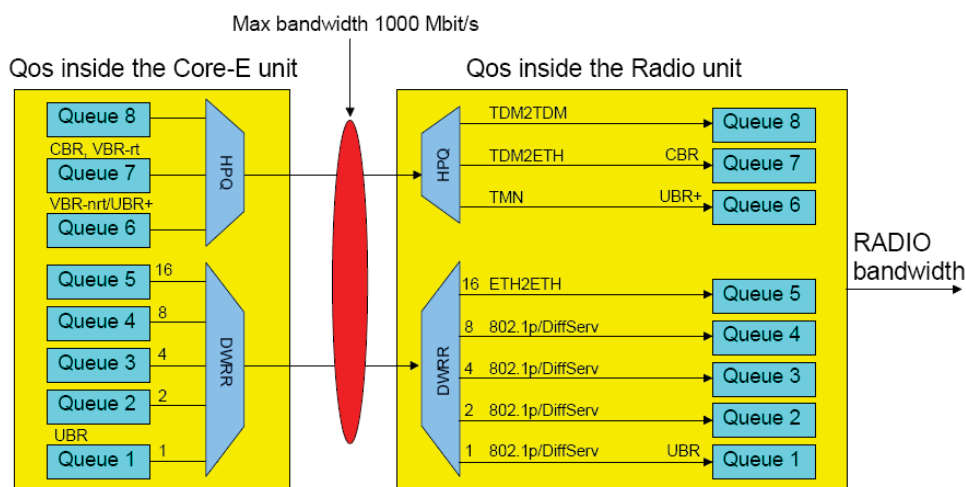


Figure 100. QoS in the Modem unit

In the figure is shown an overview of the QoS implementation inside the Modem unit which is used to interface the ODU300.

The QoS feature provides eight internal queues to support different traffic priorities. The QoS function can assign the packet to one of the eight egress transmit queues.

- Queue 8 is assigned to TDM2TDM traffic
- Queue 7 is assigned to TDM2Eth traffic
- Queue 6 is assigned to TMN

Queues 1 to 4 are assigned to Ethernet traffic according to the information inside the packet as 802.1p field, DiffServ field, Ethertype or 802.1Q VLAN_ID.

TDM flows classification

All the TDM2TDM traffic flows are assigned to the highest egress priority queue (Q8). All the TDM2ETH traffic flows are assigned to the Q7 egress priority queue. All the MEF-8 ETH2ETH traffic flows are assigned to the Q5 egress priority queue.

TMN flows classification

All TMN traffic flows are assigned to the Q6 egress priority queue.

QoS based on IEEE std. 802.1p

When 802.1p QoS mechanism is adopted, the reference is the standard "IEEE 802.1D-2004 Annex G User priorities and traffic classes" that defines 7 traffic types and the corresponding user priority values.

Considering that in the Radio Interface module for generic Ethernet traffic there are five egress queues the mapping 802.1p value to queue is the following:

802.1p priority	Queue
111, 110	Q5 (higher priority)
101	Q4
100	Q3
011, 000	Q2
010, 001	Q1

QoS based on DiffServ

DiffServ priority	Queue
111000, 110000, 101110, 101000	Q5 (higher priority)
100110, 100100, 100010, 100000	Q4
011110, 011100, 011010, 011000	Q3
010110, 010100, 010010, 010000 001010, 001100, 001010, 001000, 000000	Q2
All remaining values	Q1

ATM PW flows classification

ATM PW flows will be assigned to radio queues according to below table:

ATM PW CoS	Radio Queue
Guaranteed (CBR)	Q7 (higher priority)
Best Effort (UBR+)	Q6
BackGround (UBR)	Q1

Scheduler

HQP scheduler algorithm will be used on Q8, Q7 and Q6.

Deficit Weighted Round Robin (DWRR) algorithm will be used for the other five queues.

By default, the DWRR algorithm is used with the following weights:

Queue	Weight
Q5 (higher priority)	16
Q4	8
Q3	4
Q2	2
Q1	1

2.8.20.3 QoS in the MPT-HC/MPT-MC

The Radio QoS is implemented by MPT-HC/MPT-MC itself (not in the MPT Access unit).

The set of MPT Radio QoS features is the same of the one specified for the Modem unit (refer to par. 2.8.20.2) with the **exception** of the ATM CBR and UBR+ CoS: in MPT-HC/PT-MC they are sent to queue #5 and queue #4 respectively (and not to queue #7 and queue #6).