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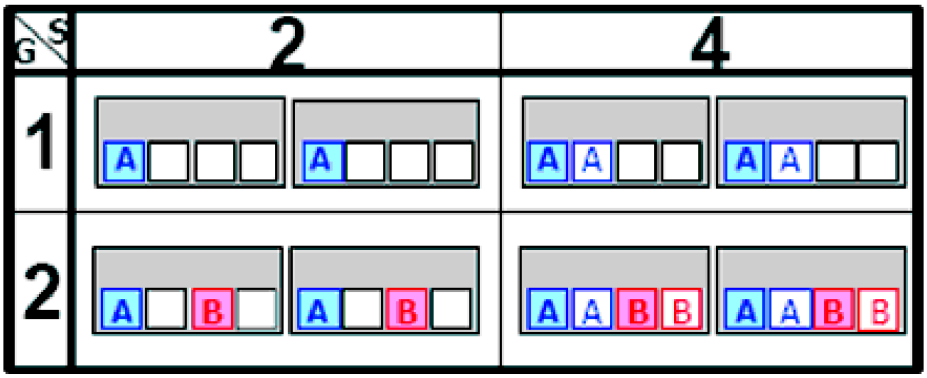
Figure 6-13. 1+0 cross plug-in L1 LAG configurations—Update



G = number of Link Aggregation Groups
S = LAG Size (Number of Radio Protection Groups in the LAG)
Links with the same letter (A or B) belong to the same group
Diagram shows two MSS Slots on the same row. SFP Ports represented only (from EAS Port5 to Port8)
Master Ports indicated in bold

22892

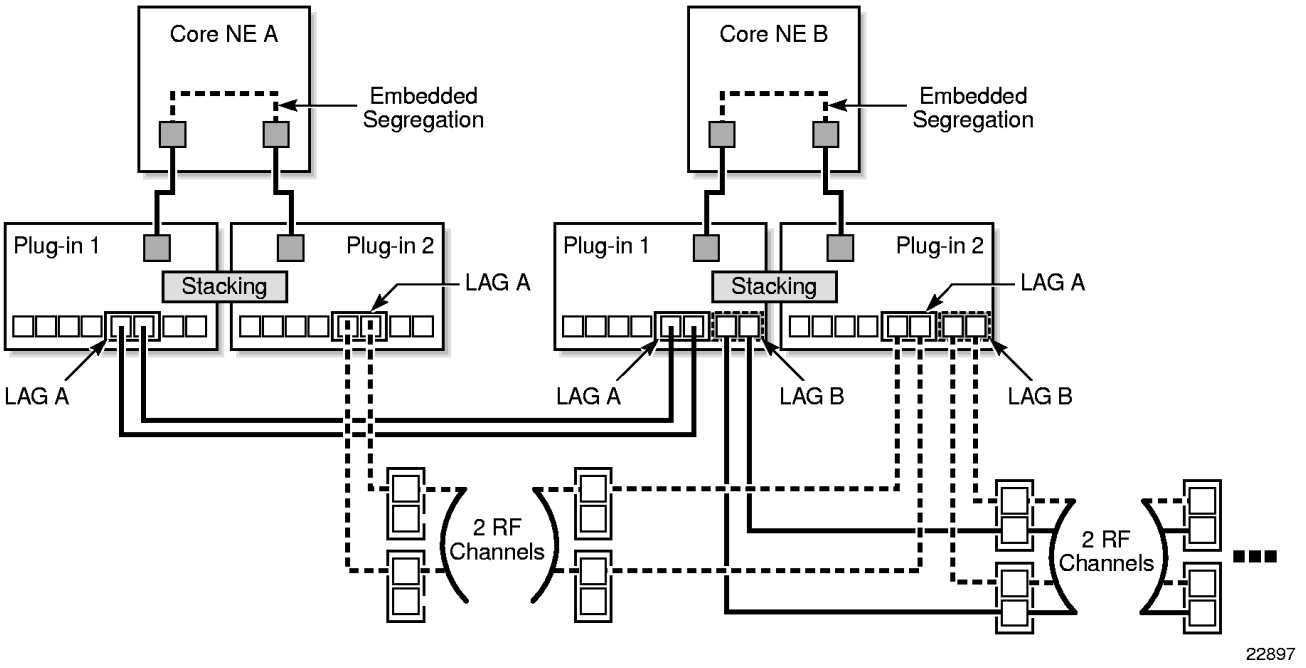
Protected cross plug-in L1 LAG sceneries

6.83 In the Protected Cross Plug-in LAG configuration, the 1+1 protection group is seen as a single radio interface. The protected 1+1 HSB/SD radio configuration is created using the same SFP port on the left and right Plug-in, i.e. port 5 of the left P8ETH card (main) is protected by port 5 of the right P8ETH card (spare).

6.84 Protected L1 LAG configurations are only supported using MPT-HL radio interfaces.

6.85 An example of Protected Cross Plug-in LAG implementation is shown in Figure 6-14. Site A is configured with two 1+1 HSB/SD protected radio links in a Protected Cross Plug-in LAG. Site B is configured with two Protected Cross Plug-in LAGs to implement a radio repeater configuration.

Figure 6-14. Protected 1+1 cross plug-in L1 link aggregation scenario Update



6.86 In this configuration, radio protection handles a failure of a single radio hop belonging to the 1+1 HSB/SD protection group. LAG capacity is not affected by a single radio hop failure belonging to the protection group.

6.87 Supported Protected Cross Plug-in L1 LAG 2x(1+1) configurations are shown in Figure 6-15.

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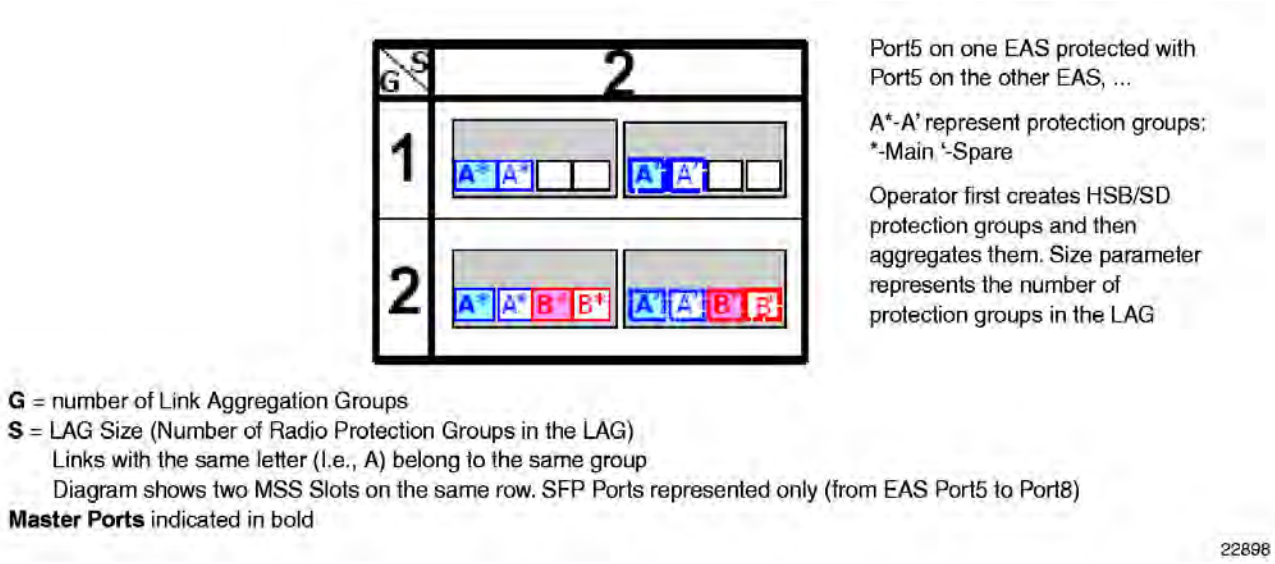
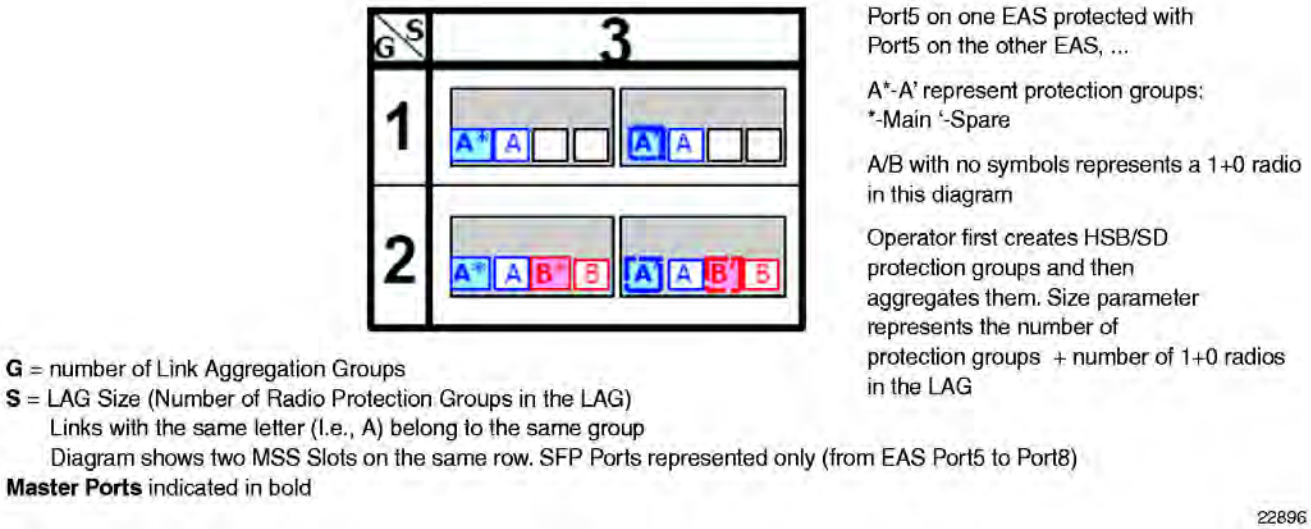
Figure 6-15. Protected 2x(1+1) cross plug-in L1 LAG configurations—Update



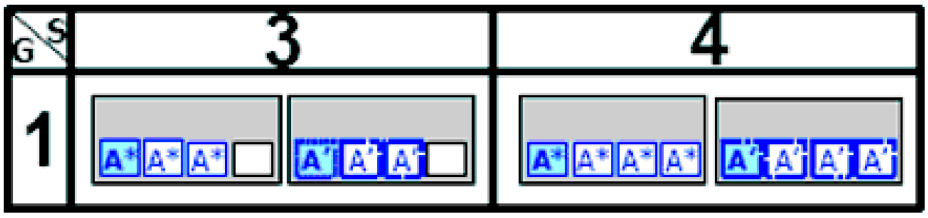
6.88 A mixture of protected and not protected L1 LAGs are supported. The protected pair can reside in any of the available P8ETH port pairs. Shown in Figure 6-16 the protected pairs reside in ports 5 and 7.

Figure 6-16. Mix 1+0 and 1+1 protected cross plug-in L1 LAG configurations—Update



6.89 An extension of the supported protected Cross Plug-in configuration supports 3x(1+1) and 4x(1+1) as shown in Figure 6-17.

Figure 6-17. Protected 3x(1+1)/4x(1+1) cross plug-in L1 LAG configurations—Update



Port5 on one EAS protected with Port5 on the other EAS, ...

A*-A' represent protection groups: *-Main '-Spare

Operator first creates HSB/SD protection groups and then aggregates them. Size parameter represents the number of protection groups in the LAG

G = number of Link Aggregation Groups
S = LAG Size (Number of Radio Protection Groups in the LAG)
Links with the same letter (I.e., A) belong to the same group
Diagram shows two MSS Slots on the same row. SFP Ports represented only (from EAS Port5 to Port8)
Master Ports indicated in bold

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L1 LAG creation

6.90 L1 LAG is created using the following parameters:

- LAG ID (LAG Identifier): is mandatory parameter that identifies the LAG in the NE
- LAG Name: is an optional parameter which assist the operator to identify the virtual radio direction. LAG Name is up to 32 characters in length.
- LAG Type: is a mandatory parameter that defines the LAG type (i.e., L1 Radio, L2 Radio, L2 Ethernet).
- LAG Size: is a mandatory parameter that configures the maximum number of radio links included in the L1 LAG. LAG Size cannot be lower than the number of radio links belonging to the LAG.
- Administrative Status: indicates the operational status of the LAG and is configured by the operator

6.91 LAG ID is selected with the following restrictions:

- integer from 1 to 14
- cannot be same as LAG ID of an existing L1/L2 LAG ID
- cannot be equal to the Administrative Key of an existing L2 LAG

6.92 When the administrative state of the LAG is disabled, no traffic is sent out the LAG. No LAG alarms are reported to the WebEML.

6.93 When the administrative state of the LAG is enabled, the LAG is available for the following:

- cross-connections
- 802.1Q port membership
- selected as synchronization reference

6.94 A LAG cannot be disabled when involved in any of the following:

- cross-connections
- 802.1Q port membership
- selected as synchronization reference

6.95 The following features are supported at the L1 LAG level:

- Wait-To-Restore (WTR)
- PPP RF
- SSM

6.96 A Wait-To-Restore timer provides a mechanism to minimize the impact to LAG capacity by fast/intermittent failures on a radio link member of the LAG. WTR time is configurable from 100 milliseconds to 8 seconds. The default value is 1 second.

6.97 When a radio link member of a LAG declares a traffic affecting condition, that member is removed from the available radio links and the capacity of the LAG is reduced accordingly. Once the failure condition is cleared, the WTR period is applied. Upon expiration of the WTR period, if the radio link remains condition free, the radio link is restored as a member of the LAG and becomes available to carry traffic. The capacity of the LAG is increased accordingly.

6.98 The following LAG parameters can be modified after creation:

- Port membership
- LAG Name

- LAG Size
- Wait to Restore time

L1 LAG lowest index port

6.99 A LAG Lowest Index Port is defined for each LAG. The Lowest index Port is responsible to transmit traffic from the Distributor (near end) towards the Collector (far end) and vice versa.

6.100 Lowest index Port is selected from P8ETH SFP ports 5 or 7 depending on LAG configuration scenario.

6.101 Lowest index Port is configured using the following:

- Intra Plug-in
  - Port 5 or Port 7
  - Lowest index Port shall have the lowest index in the LAG port membership (i.e., if Lowest index Port is Port 7, Port 5 and/or Port 6 cannot be added to the LAG).
  - one Lowest index Port per LAG
- Cross Plug-in
  - port 5 or port 7 on both P8ETH configured in LAG
  - Lowest index Ports shall have the lowest index in the LAG port membership (i.e., if Lowest Index Port is port 7, port 5 or port 6 cannot be added to the LAG).
  - one lowest index port is main (active)
  - one lowest index port is spare (standby)

6.102 For Intra Plug-in LAG, the active lowest index port is configured on the P8ETH hosting LAG.

6.103 For Cross Plug-in LAG, the active lowest index port is configured:

  - left P8ETH (slots 3, 5, or 7) port 5 when available
  - right P8ETH (slots 4, 6, or 8) port 7 when available

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6.104 When a mixture of Intra/Cross Plug-in LAGs are configured on the same row, the active lowest index port of the Cross Plug-in LAG is configured on a different plug-in used by the Intra Plug-in LAG.

Port provisioning rules

6.105 During port membership add/remove operation, the following rules apply:

- Lowest index Port(s) must always be present in the set of ports attached to the LAG
- considering the slot, lowest index port shall have the lowest index in the LAG port membership.
  - Port 5 or Port 7
  - one Lowest index Port per Intra Plug-in L1 LAG
  - two Lowest index Ports per Cross Plug-in L1 LAG
- Set of ports added to the LAG shall be adjacent considering the slot. No holes are allowed in the L1 LAG port membership filtered by slot (i.e., ports 5, 7, and 8 are not an allowed configuration).
- For Cross Plug-in configuration, the maximum number of ports per slot is two. It is not supported to aggregate 3 ports on one Plug-in and 1 port on the other Plug-in.
- Lowest index Port cannot be changed. If lowest index port is Port 7, Port 5 and Port 6 cannot be added to the L1 LAG.
- Port add/remove operation rules are applied for all port add and port remove operation. Checks are performed on the entire set of ports.
- radio port is eligible to be a member of only one L1 LAG

Intra plug-in port membership

6.106 Table 6-A provides a list of supported 1+0 Intra Plug-in L1 LAG configurations. L1 LAG group lowest index port is indicated in bold, "**X**".

Table 6-A. Intra plug-in L1 LAG supported 1+0 configurations: single LAG group

CONFIG	LAG SIZE	LEFT P8ETH (SLOTS 3, 5, 7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
		P5	P6	P7	P8	P5	P6	P7	P8
I1	1	**X**	—	—	—	—	—	—	—
I2	2	**X**	X	—	—	—	—	—	—
I3	3	**X**	X	X	—	—	—	—	—
I4	4	**X**	X	X	X	—	—	—	—
I5	1	—	—	—	—	**X**	—	—	—
I6	2	—	—	—	—	**X**	X	—	—
I7	3	—	—	—	—	**X**	X	X	—
I8	4	—	—	—	—	**X**	X	X	X
I9	1	—	—	**X**	—	—	—	—	—
I10	2	—	—	**X**	X	—	—	—	—
I11	1	—	—	—	—	—	—	**X**	—
I12	2	—	—	—	—	—	—	**X**	X

Cross plug-in port membership configurations

6.107 Table 6-B provides a list of supported 1+0 Cross Plug-in L1 LAG configurations. L1 LAG group lowest index ports (active and standby) are indicated in bold, "**X**".

Table 6-B. Cross plug-in L1 LAG supported 1+0 configurations: single LAG group

CONFIG	LAG SIZE	LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
		P5	P6	P7	P8	P5	P6	P7	P8
C1	2	**X**	—	—	—	**X**	—	—	—
C2	3	**X**	X	—	—	**X**	—	—	—
C3	3	**X**	—	—	—	**X**	X	—	—
C4	4	**X**	X	—	—	**X**	X	—	—
C5	2	—	—	**X**	—	—	—	**X**	—
C6	3	—	—	**X**	X	—	—	**X**	—
C7	3	—	—	**X**	—	—	—	**X**	X
C8	4	—	—	**X**	X	—	—	**X**	X

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Protected cross plug-in port membership configurations

6.108 Table 6-C provides a list of supported protected Cross Plug-in L1 LAG configurations. Supported configurations contain a mixture of 1+1 and 1+0 radio directions. The L1 LAG group lowest index ports (active and standby) are indicated in bold, "**X**" (1+0 port), "**M**" (1+1 main port), and "**S**" (1+1 spare port).

Table 6-C. Cross plug-in L1 LAG supported 1+1 configurations: single L1 LAG group

CONFIG	LAG SIZE	LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
		P5	P6	P7	P8	P5	P6	P7	P8
C1	1	**M**	—	—	—	**S**	—	—	—
C2	2	**M**	X	—	—	**S**	—	—	—
C3	2	**M**	—	—	—	**S**	X	—	—
C4	3	**M**	X	—	—	**S**	X	—	—
	3	**X**	M	—	—	**X**	S	—	—
	2	**M**	M	—	—	**S**	S	—	—
C5	1	—	—	**M**	—	—	—	**S**	—
C6	2	—	—	**M**	X	—	—	**S**	—
C7	2	—	—	**M**	—	—	—	**S**	X
C8	3	—	—	**M**	X	—	—	**S**	X
	3	—	—	**X**	M	—	—	**X**	S
	2	—	—	**M**	M	—	—	**S**	S
C9	3	**M**	M	M	—	**S**	S	S	—
C10	4	**M**	M	M	M	**S**	S	S	S

Dual L1 LAG port membership configurations

6.109 Up to two L1 LAGs are supported on a horizontal row of the MSS-4/8 shelf.

6.110 When two L1 LAGs are located on the same horizontal row, the system locates the master LAG port on different Plug-in cards when possible. This optimizes throughput and re-order capabilities for both LAGs.

6.111 When a mixture of Intra/Cross Plug-in LAGs are configured on the same row, the active lowest index port of the Cross Plug-in LAG is configured on a different plug-in used by the Intra Plug-in LAG.

6.112 Table 6-D provides a list of supported dual 1+0 L1 LAG configurations. L1 LAG group master ports (active and standby) are indicated in bold, "**A**" (LAG A) and "**B**" (LAG B).

Table 6-D. Dual L1 LAG Groups, Supported Mixed Plug-in 1+0 Configurations:

LAG GROUP A		LAG GROUP B		LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
CONFIG	LAG SIZE	CONFIG	LAG SIZE	P5	P6	P7	P8	P5	P6	P7	P8
I1	1	I5	1	**A**	—	—	—	**B**	—	—	—
		I6	2	**A**	—	—	—	**B**	B	—	—
		I7	3	**A**	—	—	—	**B**	B	B	—
		I8	4	**A**	—	—	—	**B**	B	B	B
		I9	1	**A**	—	**B**	—	—	—	—	—
		I10	2	**A**	—	**B**	B	—	—	—	—
		I11	1	**A**	—	—	—	—	—	**B**	—
		I12	2	**A**	—	—	—	—	—	**B**	B
		C5	2	**A**	—	**B**	—	—	—	**B**	—
		C6	3	**A**	—	**B**	B	—	—	**B**	—
		C7	3	**A**	—	**B**	—	—	—	**B**	B
		C8	4	**A**	—	**B**	B	—	—	**B**	B
I2	2	I5	1	**A**	A	—	—	**B**	—	—	—
		I6	2	**A**	A	—	—	**B**	B	—	—
		I7	3	**A**	A	—	—	**B**	B	B	—
		I8	4	**A**	A	—	—	**B**	B	B	B
		I9	1	**A**	A	**B**	—	—	—	—	—
		I10	2	**A**	A	**B**	B	—	—	—	—
		I11	1	**A**	A	—	—	—	—	**B**	—
		I12	2	**A**	A	—	—	—	—	**B**	B
		C5	2	**A**	A	**B**	—	—	—	**B**	—
		C6	3	**A**	A	**B**	B	—	—	**B**	—
		C7	3	**A**	A	**B**	—	—	—	**B**	B
		C8	4	**A**	A	**B**	B	—	—	**B**	B
I3	3	I5	1	**A**	A	A	—	**B**	—	—	—
		I6	2	**A**	A	A	—	**B**	B	—	—
		I7	3	**A**	A	A	—	**B**	B	B	—
		I8	4	**A**	A	A	—	**B**	B	B	B
		I11	1	**A**	A	A	—	—	—	**B**	—
		I12	2	**A**	A	A	—	—	—	**B**	B

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Table 6-D. Dual L1 LAG Groups, Supported Mixed Plug-in 1+0 Configurations: (cont.)

LAG GROUP A		LAG GROUP B		LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
CONFIG	LAG SIZE	CONFIG	LAG SIZE	P5	P6	P7	P8	P5	P6	P7	P8
I4	4	I5	1	**A**	A	A	A	**B**	—	—	—
		I6	2	**A**	A	A	A	**B**	B	—	—
		I7	3	**A**	A	A	A	**B**	B	B	—
		I8	4	**A**	A	A	A	**B**	B	B	B
		I11	1	**A**	A	A	A	—	—	**B**	—
		I12	2	**A**	A	A	A	—	—	**B**	B
I5	1	I9	1	—	—	**B**	—	**A**	—	—	—
		I10	2	—	—	**B**	B	**A**	—	—	—
		I11	1	—	—	—	—	**A**	—	**B**	—
		I12	2	—	—	—	—	**A**	—	**B**	B
		C5	2	—	—	**B**	—	**A**	—	**B**	—
		C6	3	—	—	**B**	B	**A**	—	**B**	—
		C7	3	—	—	**B**	—	**A**	—	**B**	B
		C8	4	—	—	**B**	B	**A**	—	**B**	B
I6	2	I9	1	—	—	**B**	—	**A**	A	—	—
		I10	2	—	—	**B**	B	**A**	A	—	—
		I11	1	—	—	—	—	**A**	A	**B**	—
		I12	2	—	—	—	—	**A**	A	**B**	B
		C5	2	—	—	**B**	—	**A**	A	**B**	—
		C6	3	—	—	**B**	B	**A**	A	**B**	—
		C7	3	—	—	**B**	—	**A**	A	**B**	B
		C8	4	—	—	**B**	B	**A**	A	**B**	B
I7	3	I9	1	—	—	**B**	—	**A**	A	A	—
		I10	2	—	—	**B**	B	**A**	A	A	—
I8	4	I9	1	—	—	**B**	—	**A**	A	A	A
		I10	2	—	—	**B**	B	**A**	A	A	A
I9	1	I11	1	—	—	**A**	—	—	—	**B**	—
		I12	2	—	—	**A**	—	—	—	**B**	B
		C1	2	**B**	—	**A**	—	**B**	—	—	—
		C2	3	**B**	B	**A**	—	**B**	—	—	—
		C3	3	**B**	—	**A**	—	**B**	B	—	—
		C4	4	**B**	B	**A**	—	**B**	B	—	—

Table 6-D. Dual L1 LAG Groups, Supported Mixed Plug-in 1+0 Configurations: (cont.)

LAG GROUP A		LAG GROUP B		LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
CONFIG	**LAG SIZE**	**CONFIG**	**LAG SIZE**	**P5**	**P6**	**P7**	**P8**	**P5**	**P6**	**P7**	**P8**
I10	2	I11	1	—	—	**A**	A	—	—	**B**	—
		I12	2	—	—	**A**	A	—	—	**B**	B
		C1	2	**B**	—	**A**	A	**B**	—	—	—
		C2	3	**B**	B	**A**	A	**B**	—	—	—
		C3	3	**B**	—	**A**	A	**B**	B	—	—
		C4	4	**B**	B	**A**	A	**B**	B	—	—
I11	1	C1	2	**B**	—	—	—	**B**	—	**A**	—
		C2	3	**B**	B	—	—	**B**	—	**A**	—
		C3	3	**B**	—	—	—	**B**	B	**A**	—
		C4	4	**B**	B	—	—	**B**	B	**A**	—
I12	2	C1	2	**B**	—	—	—	**B**	—	**A**	A
		C2	3	**B**	B	—	—	**B**	—	**A**	A
		C3	3	**B**	—	—	—	**B**	B	**A**	A
		C4	4	**B**	B	—	—	**B**	B	**A**	A
C1	2	C5	2	**A**	—	**B**	—	**A**	—	**B**	—
		C6	3	**A**	—	**B**	B	**A**	—	**B**	—
		C7	3	**A**	—	**B**	—	**A**	—	**B**	B
		C8	4	**A**	—	**B**	B	**A**	—	**B**	B
C2	3	C5	2	**A**	A	**B**	—	**A**	—	**B**	—
		C6	3	**A**	A	**B**	B	**A**	—	**B**	—
		C7	3	**A**	A	**B**	—	**A**	—	**B**	B
		C8	4	**A**	A	**B**	B	**A**	—	**B**	B
C3	3	C5	2	**A**	—	**B**	—	**A**	A	**B**	—
		C6	3	**A**	—	**B**	B	**A**	A	**B**	—
		C7	3	**A**	—	**B**	—	**A**	A	**B**	B
		C8	4	**A**	—	**B**	B	**A**	A	**B**	B
C4	4	C5	2	**A**	A	**B**	—	**A**	A	**B**	—
		C6	3	**A**	A	**B**	B	**A**	A	**B**	—
		C7	3	**A**	A	**B**	—	**A**	A	**B**	B
		C8	4	**A**	A	**B**	B	**A**	A	**B**	B

PRELIMINARY

Protected dual L1 LAG port membership configurations

6.113 Up to two protected L1 LAGs are supported on a horizontal row of the MSS-4/8 shelf. Supported configurations contain a mixture of 1+1 and 1+0 radio directions.

6.114 When two protected L1 LAGs are located on the same horizontal row, the system locates the master LAG port on different Plug-in cards when possible. This optimizes throughput and re-order capabilities for both LAGs.

6.115 Table 6-E provides a list of supported dual protected 1+1/1+0 L1 LAG configurations. Members of LAG group A are indicated with an "A". Members of LAG group B are indicated with a "B". L1 LAG group lowest index ports (active and standby) are indicated in bold, "**A**" (LAG group A) and "**B**" (LAG group B). Main 1+1 ports are indicated with an "M". Spare 1+1 ports are indicated with an "S".

Table 6-E. Cross plug-in L1 LAG supported 1+1 configurations: dual L1 LAG groups

GROUP A		GROUP B		LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
CONFIG	LAG SIZE	CONFIG	LAG SIZE	P5	P6	P7	P8	P5	P6	P7	P8
C1	1	C5	1	**A** M	—	**B** M	—	**A** S	—	**B** S	—
		C6	2	**A** M	—	**B** M	B	**A** S	—	**B** S	—
		C7	2	**A** M	—	**B** M	—	**A** S	—	**B** S	B
		C8	3	**A** M	—	**B** M	B	**A** S	—	**B** S	B
		C8	3	**A** M	—	**B**	B M	**A** S	—	**B**	B S
		C8	2	**A** M	—	**B** M	B M	**A** S	—	**B** S	B S
C2	2	C5	1	**A** M	A	**B** M	—	**A** S	—	**B** S	—
		C6	2	**A** M	A	**B** M	B	**A** S	—	**B** S	—
		C7	2	**A** M	A	**B** M	—	**A** S	—	**B** S	B
		C8	3	**A** M	A	**B** M	B	**A** S	—	**B** S	B
		C8	3	**A** M	A	**B**	B M	**A** S	—	**B**	B S
		C8	2	**A** M	A	**B** M	B M	**A** S	—	**B** S	B S
C3	2	C5	1	**A** M	—	**B** M	—	**A** S	A	**B** S	—
		C6	2	**A** M	—	**B** M	B	**A** S	A	**B** S	—
		C7	2	**A** M	—	**B** M	—	**A** S	A	**B** S	B
		C8	3	**A** M	—	**B** M	B	**A** S	A	**B** S	B
		C8	3	**A** M	—	**B**	B M	**A** S	A	**B**	B
		C8	2	**A** M	—	**B** M	B M	**A** S	A	**B** S	B S

Table 6-E. Cross plug-in L1 LAG supported 1+1 configurations: dual L1 LAG groups (cont.)

GROUP A		GROUP B		LEFT P8ETH (SLOTS 3, 5,7)				RIGHT P8ETH (SLOTS 4, 6, 8)			
CONFIG	LAG SIZE	CONFIG	LAG SIZE	P5	P6	P7	P8	P5	P6	P7	P8
C4	3	C5	1	**A** M	A	**B** M	—	**A** S	A	**B** S	—
		C6	2	**A** M	A	**B** M	B	**A** S	A	**B** S	—
		C7	2	**A** M	A	**B** M	—	**A** S	A	**B** S	B
		C8	3	**A** M	A	**B** M	B	**A** S	A	**B** S	B
		C8	3	**A** M	A	**B**	B M	**A** S	A	**B**	B S
		C8	2	**A** M	A	**B** M	B M	**A** S	A	**B** S	B S
C4	3	C5	1	**A**	A M	**B** M	—	**A**	A S	**B** S	—
		C6	2	**A**	A M	**B** M	B	**A**	A S	**B** S	—
		C7	2	**A**	A M	**B** M	—	**A**	A S	**B** S	B
		C8	3	**A**	A M	**B** M	B	**A**	A S	**B** S	B
		C8	3	**A**	A M	**B**	B M	**A**	A S	**B**	B S
		C8	2	**A**	A M	**B** M	B M	**A**	A S	**B** S	B S
C4	2	C5	1	**A** M	A M	**B** M	—	**A** S	A S	**B** S	—
		C6	2	**A** M	A M	**B** M	B	**A** S	A S	**B** S	—
		C7	2	**A** M	A M	**B** M	—	**A** S	A S	**B** S	B
		C8	3	**A** M	A M	**B** M	B	**A** S	A S	**B** S	B
		C8	3	**A** M	A M	**B**	B M	**A** S	A S	**B**	B S
		C8	2	**A** M	A M	**B** M	B M	**A** S	A S	**B** S	B S

Port add restrictions

6.116 To add a radio direction to a Radio L1 LAG port, the radio direction must NOT be provisioned as a member to any of the following:

- cross-connection
- VLAN
- port segregation
- PPP RF enabled on the radio channel
- Synchronization reference
- SSM

6.117 ALL cross-connections, VLANs, and port segregation provisioning must be removed before adding a Radio direction to a Radio LAG port.

6.118 TX Mute must be provisioned enabled to add a radio direction to an enabled L1 LAG port. TX Mute should not be disabled until both sides of the radio direction are ready to carry traffic through the LAG port.

6.119 When adding an MPT-HL, Lowest index Port to L1 LAG, the port add restrictions does not apply. During this operation, the following actions are performed by the NE:

- is denied if radio direction:
  - is configured with more than 254 cross-connections
  - is member of 1+1 protection group
  - is MPT-HC/XP
- LAG administrative state is set to Enabled
- WebEML/Craft Terminal is automatically shutdown
- operation results in an impact to traffic

Port removal restrictions

6.120 To remove a radio direction from an L1 LAG port, TX Mute must be provisioned enabled on both sides of the LAG direction.

6.121 ALL cross-connections, VLANs, and port segregation provisioning must be removed from the L1 LAG port before removing the lowest index port.

6.122 To remove the Lowest index Port from a L1 LAG port, the following conditions must exist on the L1 LAG port:

- all other radio ports must be removed from the L1 LAG port
- L1 LAG port must be disabled
- no cross-connections are configured on L1 LAG
- L1 LAG is member of no 802.1Q VLANs (except default VLAN 1)
- L1 LAG is member of no port segregation
- L1 LAG is not provisioned as a synchronization reference

- PPP RF is disabled on the L1 LAG port
- SSM is disabled on the L1 LAG port

Provisionable radio parameters for members of L1 LAG

6.123 After a radio port has been added to an L1 Radio LAG port, the following radio interface parameters may be modified:

- Link Identifier
- Tx Power/ATPC
- Remote Switching Threshold (in Adaptive Modulation)
- Tx Mute
- Loopback (Note)
- Performance Monitoring
- Alarm Profile

Note: When the MPT-HC/MPT-HL/MPT-XP is configured in a Radio L1 LAG, the loopback of a single radio is not forbidden, but is not supported.

L1 radio LAG deletion

6.124 A L1 LAG can be deleted if:

- Administrative state is Disabled
- no ports are members of the L1 LAG

L1 radio LAG QoS configuration

6.125 NE QoS and queue size settings are applied to the L1 Radio LAG port.

- QoS Scheduler settings
- QoS Mapping
- Radio Queue size

6.126 When a radio port is added to the L1 LAG port all custom QoS and queue size configuration is lost.

6.127 When a radio port is removed from a L1 LAG port, the NE QoS settings are applied to the radio port. The queue sizes are set to the default values.

L1 radio LAG rate

6.128 L1 LAG rate represents the total capacity of the L1 LAG port. The LAG rate is determined by multiplying the capacity of the master LAG port by the number of links in the LAG membership.

Admission control

6.129 Admission control is not performed on L1 LAG.

6.130 Bandwidth of cross-connected traffic should not exceed the capacity of a single LAG port member.

Available P8ETH user ports

6.131 Electrical and optical P8ETH ports which are not members of a L1 LAG may be used for user Ethernet or radio interface ports.

Maximum ethernet frame length

6.132 The maximum Ethernet frame length is:

- 1540 bytes for mixed TDM and Ethernet traffic
- 9728 bytes for pure Ethernet traffic

Maximum number of cross-connections

6.133 The maximum number of cross-connections supported by L1 LAG is 254.

Maximum number of cross-connections

6.134 The maximum number of cross-connections supported by L1 LAG is 254.

Performance monitoring

6.135 Ethernet statistics related to the L1 Radio LAG direction monitors all the TDM and Ethernet traffic passing through the Lowest Index Port.

6.136 To facilitate commissioning, remote maintenance, and troubleshooting the following L1 radio LAG PM counters are supported:

- Total Number of Tx Packets
- Total Number of Tx Bytes
- Total Number of Tx Discarded Packets
- Available Capacity
- TTO Throughput
- TDF Ratio

6.137 For a detailed description of radio PM, refer to **Performance monitoring** in this manual.

Port segregation

6.138 Port segregation involving the L1 LAG is supported.

6.139 The following port segregation involving an L1 LAG are supported:

- segregation to user Ethernet or radio ports belonging to same P8ETH
- segregation to user Ethernet ports or radio ports belonging to an P8ETH on the same MSS row
- segregation of P8ETH card involved in Intra Plug-in L1 LAG to user Ethernet port connected to CSM-E or other P8ETH cards
- segregation of P8ETH card involved in Intra Plug-in L1 LAG to radio ports connected to CSM-E, MOD300, MPTACC, or other P8ETH cards
- segregation of both P8ETH cards involved in Cross Plug-in L1 LAG to user Ethernet port connected to CSM-E or other P8ETH cards
- segregation of both P8ETH cards involved in Cross Plug-in L1 LAG to radio ports connected to CSM-E, MOD300, MPTACC, or other P8ETH cards

PPP-RF configuration

6.140 PPP-RF is configured at the L1 LAG level.

SSM

6.141 SSM is configured at the L1 LAG level.

Synchronization

6.142 An enabled L1 LAG port can be selected as synchronization reference. The L1 LAG port is managed as a single logical synchronization reference.

6.143 System selects L1 LAG radio link as synchronization reference based upon alarm status of the individual radio links.

6.144 For a synchronization failure, the system selects a new reference from the non-faulted members of the L1 LAG.

6.145 Detection of synchronization degrade on selected reference is consider synchronization degrade condition against entire L1 LAG because the quality of the reference clock is supplied by the remote NE.

6.146 Synchronization selection is not revertive.

Radio L2 LAG

6.147 Radio Link Aggregation (Radio L2 LAG) groups a set of radio ports so that the network nodes can be interconnected using multiple links to increase link capacity and availability.

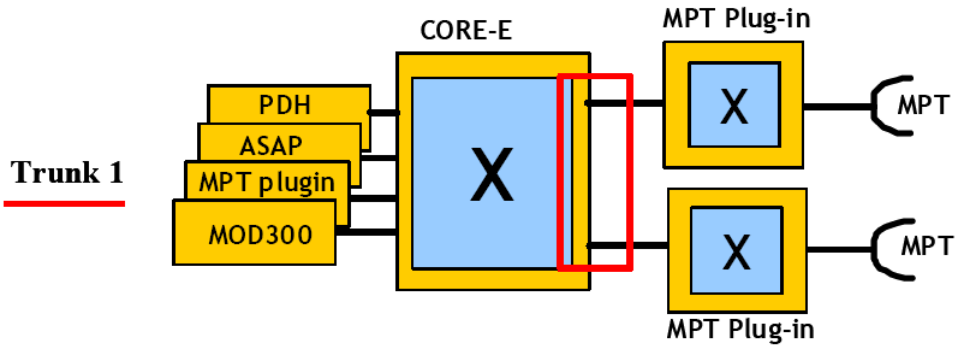
Figure 6-18. Radio L2 LAG

6.148 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 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 traffic with lower priority, high priority traffic is still running on the remaining active channels.

Figure 6-19. Radio L2 LAG block diagram



6.149 Radio L2 LAG ports are supported on MOD300/ODU300, MPT-HC, MPT-HL, and MPT-XP radio interfaces.

6.150 Radio L2 LAG is supported on radio interfaces in both static and adaptive modulation.

6.151 Members of a radio L2 LAG port must be configured:

- All the same radio interface type
- MPT-HC/XP radio interface must be configured with MPT Access card, one radio interface per MPT Access card
- MPT-HL radio interface must be configured with P8ETH card, one radio interface per P8ETH card
- 1+0 unprotected

6.152 Radio L2 LAG ports configured in Active/Standby mode are NOT recommended in this release of the 9500 MPR-A.

6.153 Radio LAG size is restricted to the following:

- up to eight Radio L2 LAG ports per NE
- up to six MOD300/ODU300 ports per Radio L2 LAG port

- up to six MPT-HC/XP ports per Radio L2 LAG port
- up to four MPT-HL ports per Radio L2 LAG port

6.154 PPP RF should be disabled on ALL radio interfaces of a Radio L2 LAG port.

6.155 TMN In-Band should be cross-connected with only one radio interface of a Radio L2 LAG port.

6.156 To add a radio port to a Radio L2 LAG port, the radio port must NOT be provisioned as a member to any of the following:

- cross-connection
- VLAN
- port segregation
- PPP RF enabled on the radio channel

6.157 ALL cross-connections, VLANs, and port segregation provisioning must be removed before adding the Radio port to a Radio L2 LAG port.

6.158 After a radio port has been added to a Radio L2 LAG port, the following radio interface parameters may be modified:

- Mode (Static, Adaptive Modulation)
- Reference Channel Spacing
- Modulation Scheme
- Options
- Link Identifier
- Tx Power/ATPC
- Modulation Range (in Adaptive Modulation)
- Driving MSE (in Adaptive Modulation)
- Remote Switching Threshold (in Adaptive Modulation)
- Manual Operation (in Adaptive Modulation)
- Tx Mute

- Loopback
- Performance Monitoring
- Alarm Profile

6.159 After a radio port has been added to a Radio L2 LAG port, the following radio interface parameters may NOT be modified:

- Tx and Rx Frequency
- Shifter
- SSM support

Transmit power control

6.160 Transmit power control is controlled using one of two modalities:

- Automatic Transmit Power Control (ATPC)
- Remote Transmit Power Control (RTPC)

ATPC

6.161 ATPC function automatically increases or decreases the transmit output power upon request from the downstream receiver. The downstream receiver constantly monitors Receive Signal Level (RSL), receive signal quality, and aggregate Bit Error Rate (BER) of the receive signal.

6.162 When ATPC is enabled, the transmit output power will remain at it's lowest level until a fade occurs (or a receive circuit alarm is detected). When a change in RSL is detected at the receive end, a command is sent to the transmit end to increase power in 0.5 dB steps, up to the maximum level if required. After the fade is over, the receive end commands the transmit power to decrease in 0.5 dB steps to the lowest level.

6.163 The ATPC range (minimum and maximum limits) is variable, determined by link distance, link location, and link frequency. When ATPC is enabled, the range values (minimum and maximum) are user provisionable within the supported ATPC Range.

RTPC

6.164 RTPC manages the output power level in a static or fixed mode. RTPC may be preferred to ATPC when hop length or interface problems present a condition that a fixed transmit power level is preferred.

6.165 The range of output power supported is band and modulation dependent.

Tx mute

6.166 Radio interfaces supports manual and automatic Tx Mute.

6.167 When Tx Mute command is activated, the RF signal output of the radio interface is squelched.

6.168 Tx Mute supports the following states:

- Off: Transmitter not squelched
- Manual: transmitter squelched due to manual operation
- Auto: transmitter squelched due to an automatic operation

6.169 Refer to Table 6-F for Tx Mute of Radio interface characteristics.

Table 6-F. Tx Mute characteristics

	Automatic	**Manual using Craft Terminal**	**Manual using Front Panel**
Supported Radio Interface	MPT-HC, MPT-HL, MPT-XP, ODU300	MPT-HC, MPT-HL, MPT-XP, ODU300	MPT-HL
Radio Main View, Tx Mute Field	Auto	Manual	Manual
Radio Main View Measurements tab	-100 dBm[1]	-100 dBm[1]	-100 dBm[1]
Abnormal Condition	N/A	Tx Mute	N/A
Alarm condition	N/A	N/A	Replaceable Unit Problem

[1] Radio Main View Measurement tab power level equal to "-100 dBm" indicates the transmitter is in Tx Mute.

XPIC

6.170 Cross-Polarized Interference Cancellation (XPIC) provides the ability two operate two links on the same radio channel frequency, one using vertical polarization and the other using the horizontal polarization. XPIC typically provides 20 dB improvement in polarization discrimination. The actual improvement will depend on the native discrimination provided by the antenna alignment and any reduction of this discrimination caused by atmospheric effects (fading).

6.171 XPIC feature supports the following radio configurations:

- Single 2x(1+0) XPIC
- Double 2x(1+1) HSB XPIC
- 4x(1+0) XPIC

6.172 Refer to Figure 6-20 for an example of the single 2x(1+0) XPIC configuration.

6.173 Refer to Figure 6-21 for an example of the double 2x(1+1) HSB co-channel XPIC configuration.

6.174 Refer to Figure 6-22 for an example of the quadruple 4x(1+0) co-channel XPIC configuration.

Figure 6-20. Single 2+0 XPIC

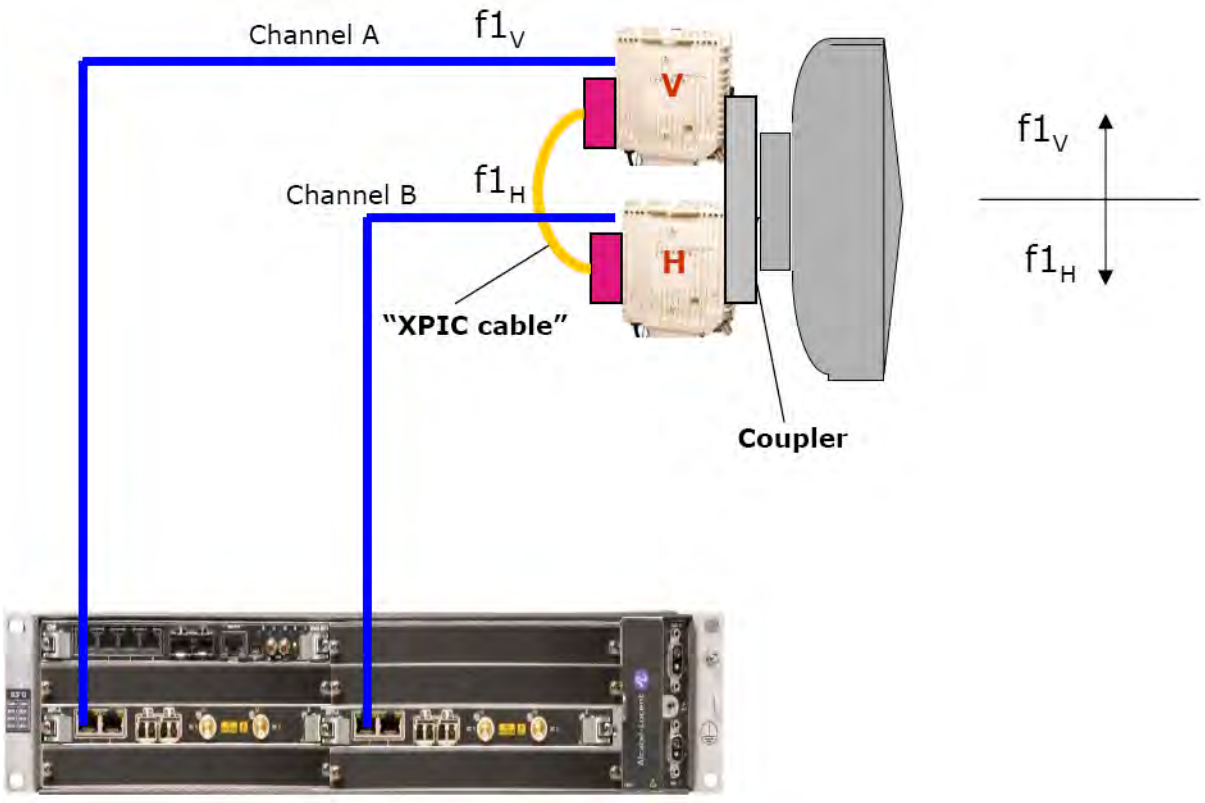


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Figure 6-21. Double 2x(1+1) HSB co-channel XPIC

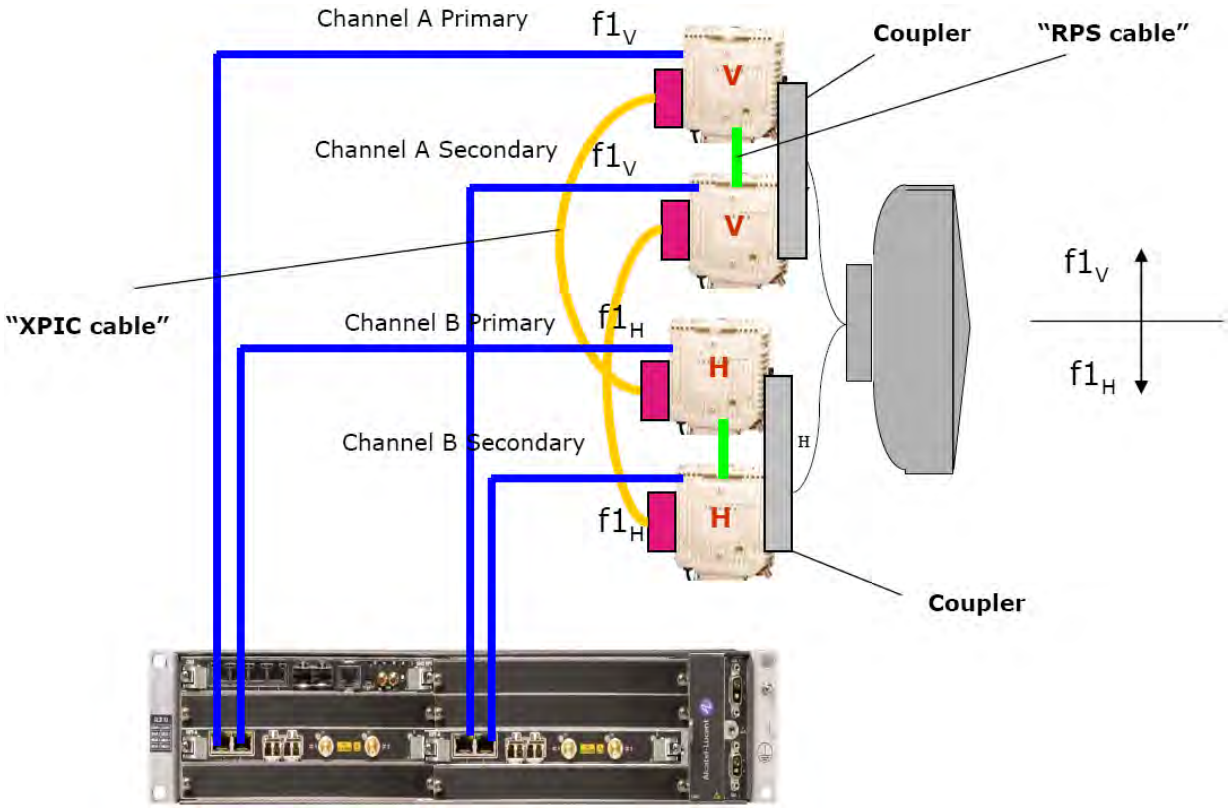


Figure 6-22. Quadruple 4x(1+0) XPIC LEVERAGE from ETSI?

6.175 XPIC is supported on the MPT-HC/XP only.

6.176 XPIC functionality is implemented by installing the XPIC+RPS external module onto the MPT-HC/XP.

6.177 XPIC functionality is supported by MPT-HC/XP radio ports connected to the following interface card types:

- MPT Access
- Core-E

6.178 The following radio features are supported on channels configured with XPIC:

- Adaptive modulation

- ATPC
- Radio L2 LAG

6.179 The following radio parameters must be configured the same on both MPT-HC/XP radio channels configured with XPIC:

- Modulation/Capacity
- Tx Frequency
- Rx Frequency
- Shifter Value
- Modulation mode (static/adaptive)

6.180 XPIC is supported using the following radio features:

- Radio Channels:
  - Lower 6 GHz
  - Upper 6 GHz
  - 7 GHz
  - 8 GHz
  - 11 GHz
  - 15 GHz
  - 18 GHz
  - 23 GHz
  - 38 GHz
- Modulation Schemes:
  - 64 QAM
  - 128 QAM
  - 256 QAM
- Radio Channel Spacing:
  - 30 MHz

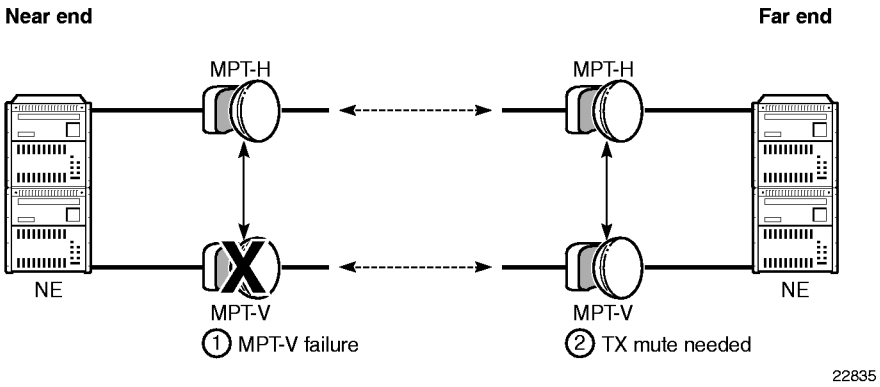
  - 40 MHz
  - 50 MHz
- Radio L2 LAG

XPIC automatic remote TX mute

6.181 Automatic remote TX mute is an automatic procedure, which starts in a receiver failure condition to continue ensuring the working of the remaining link. This procedure is automatically disabled when at least one of the radio directions involved in the XPIC association is configured in a protected scheme.

6.182 In case of double failure conditions, for example, two MPT cards fail or XPIC module card fail alarms affecting both channels having the same polarization, it is acceptable to lose all traffic for both polarizations, because the cancellation function may not work. Under some specific conditions (see Root causes), the remote transmitter signal on the failed link is muted to prevent unwanted interference on the remaining receiver. Figure 6-23 explains this occurrence.

Figure 6-23. Automatic remote TX mute



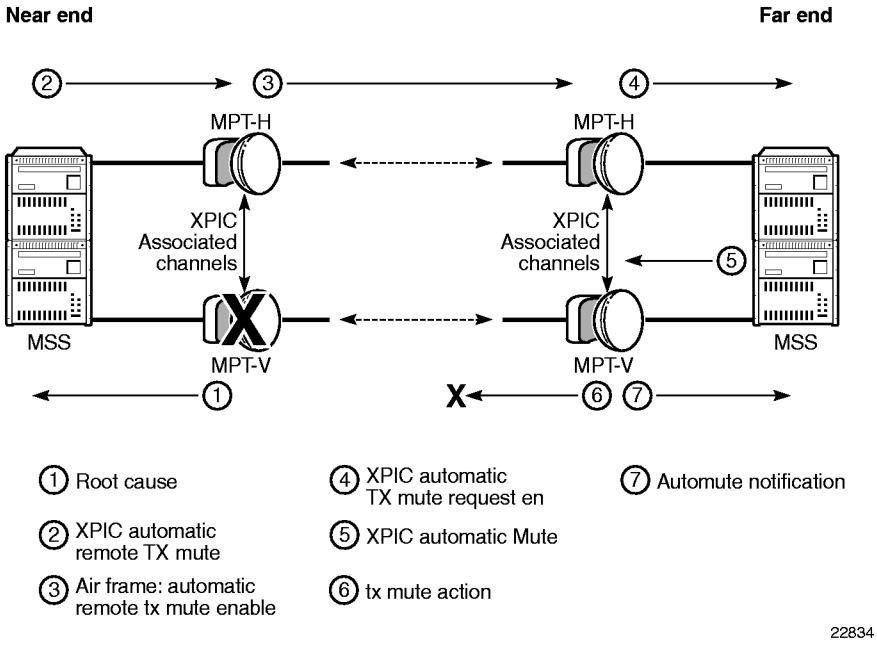
6.183 The MPT-V on the Far end is squelched, because the MPT-HC/XP on the Near end could not correctly cancel the V component from the co-polar signal.

6.184 Upon specific conditions occurrence on one MPT, the MSS (near end) redirects the automatic remote transmitter mute request over the correct radio direction, that is, over its associated channel. When these specific conditions are no longer present and the related alarms are cleared, then the MSS (near end) redirects the automatic remote transmitter unmute request over the same link.

6.185 As soon as the MPT (far end) receives an automatic mute/unmute remote request, it communicates this information to the MSS. The MSS mutes/unmutes the MPT corresponding to the associated channel, which is the radio direction associated to the one from which the command has been received.

6.186 Figure 6-24 explains the complete loop.

Figure 6-24. Automatic remote TX mute complete loop



Root causes

6.187 The procedure of automatic remote transmitter mute is activated (sending message number 2 in Figure 6-24) on the radio interface associated in XPIC mode to the other if one of the following alarms (listed in priority order, starting from higher priority one) is activated:

- MPT Power Supply Failure alarm (used only if MPT is connected to MPT Access unit)
- MPT/EAS access card fail (used only if the two MPTs associated in XPIC mode are connected to two different EAS/MPT access peripherals)
- ICP
- MPT card fail
- XPIC module card fail

6.188 The procedure is automatically activated when both radio directions involved in XPIC mode raise XPIC cable loss alarms. In case of monodirectional XPIC cable loss (alarm associated to only one radio direction involved in XPIC mode), the procedure does not start.

6.189 If an associated alarm is active in both radio directions involved in XPIC mode (indicated by the "Associated channel" parameter), then the procedure is performed considering the higher priority alarm. This means that the procedure is activated on the radio interface associated in XPIC mode to the one raising the higher priority alarm.

6.190 If the same alarm (including XPIC cable loss) is active in both radio directions involved in XPIC mode, then the procedure is activated only on one channel. Automatic remote transmitter mute request is directed toward the V polarization channel to mute the H channel.

6.191 If the XPIC cable loss alarm and another alarm, from the root causes list, is present in both radio directions involved in XPIC mode, then the procedure is activated considering this other alarm. This means that the procedure is activated on the radio interface associated in XPIC mode to the one raising this alarm.

6.192 The same procedure is applied for the automatic remote transmitter mute disable, when alarms above are cleared.

6.193 In case the alarm priority changes, then a procedure is activated to disable the previous remote transmitter mute and another one to enable a new remote transmitter mute for the other polarization.

6.194 Root alarms are considered valid only if the corresponding MPT is considered in service condition, in order to avoid spurious requests during the startup/configuration phase.

Radio transceivers

6.195 Four types of RF transceiver types are available:

- Microwave Packet Transport - Gigabit Capacity (MPT-GC) ODU
- Microwave Packet Transport - High Capacity (MPT-HC/XP/9558HC) ODU
- Microwave Packet Transport - Long Haul (MPT-HL) IDU
- OutDoor Unit 300 (ODU300) ODU

MPT-GC

6.196 MPT-GC is a multipurpose split mount ODU to address 80 GHz microwave applications. Extremely compact in size providing 1185 Mbps maximum capacity.

6.197 For a detailed description of the MPT-GC, see the MPT-GC User Manual, PN 3DB19025AA.

MPT-HC/XP/9558HC

6.198 MPT-HC/XP/9558HC is a multipurpose split mount ODU to address any microwave application. The unit is optimal for urban links: it is extremely compact in size providing 314 Mbps maximum capacity.

6.199 MPT-HC/XP/9558HC can be deployed in stand-alone configuration (MPR-e) or it can be deployed in split mount solution connected to MSS-1c/4/8 IDU.

- Up to eighteen MPT-HC/XP connected to MSS-8
- Up to fourteen MPT-HC/XP connected to MSS-4
- Up to one MPT-HC/XP connected to MSS-1c

6.200 9558HC supports the 5.8 GHz Unlicensed frequency band.

6.201 MPT-HC supports L6, U6, 7, 8, 11, 15, 18, 23, and 38 GHz frequency bands.

6.202 MPT-XP supports L6, U6, and 8 GHz frequency bands.

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6.203 MPT-HC/XP/9558HC supports 64 QAM, 128 QAM, and 256 QAM static modulation techniques.

6.204 MPT-HC/XP/9558HC supports 4/16/32/64/128/256 QAM adaptive modulation techniques.

6.205 MPT-HC/XP/9558HC supports 10, 30, 40, and 50 MHz channel bandwidths.

6.206 MPT-HC/XP/9558HC supports standard and high system gain profiles.

6.207 MPT-HC/XP/9558HC supports 1+0 Unprotected, 1+1 HSB, 1+1 SD, 1+1 FD, 2x(1+0) XPIC, 4x(1+0) XPIC, and 2x(1+1) HSB XPIC radio configurations.

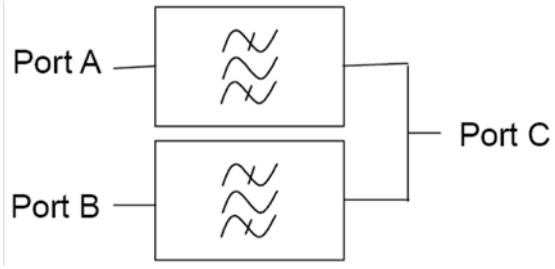
6.208 Two mechanical solutions are adopted:

- with embedded diplexer for cost optimization (L6, 11 to 38 GHz)
- with external diplexer (5.8 unlicensed, L6, U6, 7, and 8 GHz)

6.209 The external diplexer included in the available branching assemblies refers to ITU–R F.385, 386 and RF special customers channelling with Tx/Rx separation.

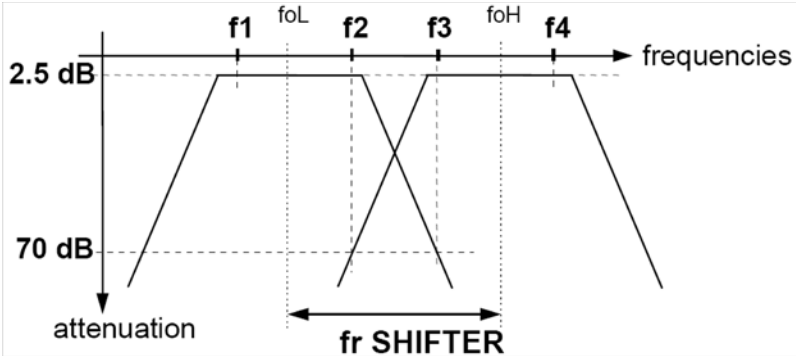
6.210 Each branching box diplexer is a 3-port passive device with two band–pass filters as described in Figure 6-7.

Figure 6-7. Branching box block diagram



6.211 The arrangement between filters on the same branching device is described in Figure 6-8.

Figure 6-8. Branching box band-pass detail



NOTE: 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.

6.212 MPT-HC/XP is deployable in three hardware configurations to optimize radio configuration growth scenarios. Hardware configurations are as follows including their supported configurations:

- MPT-HC/XP w/o external module: supports 1+0 Not protected, 1+1 HSB, 1+1 SD, and 1+1 FD radio configurations (using Virtual 1+1 RPS configuration)
- MPT-HC/XP w/1+1 RPS module: supports 1+0 Not protected, 1+1 HSB, 1+1 SD, and 1+1 FD radio configurations
- MPT-HC/XP w/XPIC/RPS module: supports 1+0 Not protected, 1+1 HSB, 1+1 SD, 1+1 FD, 2x(1+0) XPIC, 4x(1+0) XPIC, and 2x(1+1) XPIC radio configurations

6.213 1+1 RPS is configurable using one of two methods as follows:

- Cabled 1+1 RPS: RPS module and RPS cable required between main and spare MPT-HC/XPs
- Virtual 1+1 RPS: RPS module and RPS cable are not required between main and spare MPT-HC/XPs

6.214 Supports Ethernet ring protection Switching connected to MPT Access and Core-E.

6.215 Integrated antenna mounts, Ethernet (electrical and optical) connectivity, and power connectivity to MSS-1c/4/8 shelves simplify installation.

6.216 MPT-HC/XP supports FEC including Reed Solomon Decoding and TCM 2D/4D. The FEC configuration is a direct consequence of the modem profile provisioned and is not configurable.

MPT-XP

6.217 MPT-XP is very high power version of MPT-HC/XP. The unit provides an additional 7 dB of transmit power when compared with MPT-HC.

6.218 Supports L6, U6, 7, and 8 GHz frequency bands.

6.219 Mechanical solution using external diplexer.

MPR-e (standalone MPT-HC/XP)

6.220 MPR-e is the stand alone, full outdoor application of the MPT-HC/XP to address full Ethernet site backhauling (fix or mobile) and to address converged MPLS metro networks reducing the number of deployed equipment.

6.221 For a detailed description of the MPR-e, refer to MPR-e User Manual, PN 3DB19901EB.

MPT-HL

6.222 MPT-HL is an IDU transceiver to address long haul microwave applications providing 245 Mbps maximum capacity.

6.223 MPT-HL is deployed in an all indoor mount solution. Connects to the Ethernet Access Switch (P8ETH) housed in the MSS-4/8 shelf.

- Up to eighteen MPT-HL connected to MSS-8
- Up to eight MPT-HL connected to MSS-4

6.224 Supports 5.8 Unlicensed, L6, U6, 7, 8, 10.5, and 11 GHz frequency bands.

6.225 Supports 32 QAM, 128 QAM, and 256 QAM static modulation techniques.

6.226 Supports 4/16/64/128/256 QAM adaptive modulation techniques.

6.227 Supports Bandwidths: 5, 10, 30, and 40 MHz

6.228 Supports standard and high system gain support

6.229 Supports 1+0 Unprotected, 1+1 HSB, 1+1 SD, and 1+1 FD radio configurations.

6.230 MPT-HL supports FEC including Reed Solomon Decoding and TCM 2D/4D. The FEC configuration is a direct consequence of the modem profile provisioned and is not configurable.

Lower 6 GHz frequency plan

6.231 Refer to 9500 MPR-A Engineering Support Documentation manual (PN 3EM23957AL) and see drawing 3EM227840000BJZZA, Equipping Options Drawing for lower 6 GHz radio configurations and equipping options.

Figure 6-25. Lower 6 GHz Frequency Plan: 5.925 to 6.425 GHz

PRELIMINARY

Table 6-I. Lower 6 GHz 10 MHZ channel plan

GO		RETURN	
CHANNEL FREQUENCY	**DESIGNATOR**	**CHANNEL FREQUENCY**	**DESIGNATOR**
5935.320	L6.D1.L	6187.360	L6.D1.H
5945.200	L6.D2.L	6197.240	L6.D2.H
5955.080	L6.D3.L	6207.120	L6.D3.H
5964.970	L6.D4.L	6217.010	L6.D4.H
5974.850	L6.D5.L	6226.890	L6.D5.H
5974.730	L6.D6.L	6236.770	L6.D6.H
5994.620	L6.D7.L	6246.660	L6.D7.H
6004.500	L6.D8.L	6256.540	L6.D8.H
6014.380	L6.D9.L	6266.420	L6.D9.H
6024.270	L6.D10.L	6276.310	L6.D10.H
6034.150	L6.D11.L	6286.190	L6.D11.H
6044.030	L6.D12.L	6296.070	L6.D12.H
6053.920	L6.D13.L	6305.960	L6.D13.H
6063.800	L6.D14.L	6315.840	L6.D14.H
6073.680	L6.D15.L	6325.720	L6.D15.H
6083.570	L6.D16.L	6335.610	L6.D16.H
6093.450	L6.D17.L	6345.490	L6.D17.H
6103.330	L6.D18.L	6355.370	L6.D18.H
6113.220	L6.D19.L	6365.260	L6.D19.H
6123.100	L6.D20.L	6375.140	L6.D20.H
6132.980	L6.D21.L	6385.020	L6.D21.H
6142.870	L6.D22.L	6394.910	L6.D22.H
6152.750	L6.D23.L	6404.790	L6.D23.H
6162.630	L6.D24.L	6414.670	L6.D24.H

ODU300

6.232 ODU300 is a multipurpose ODU to address any microwave application and is optimal for urban links. The ODU is extremely compact in size providing 306 Mbps maximum capacity.

6.233 ODU300 is deployed in split mount solution connected to the Radio Interface (MOD300) card housed in the MSS-4/8 shelf.

- Up to six ODU300s connected to an MSS-8

- Up to two ODU300s connected to an MSS-4

6.234 Supports 6L, 6U, 7, 8, 11, 15, 18, 23, and 38 GHz frequency bands.

6.235 Supports 4 QAM, 16 QAM, 32 QAM, and 64 QAM, 128 QAM, and 256 QAM static modulation techniques.

6.236 Supports 4/16 QAM, 4/16/64 QAM, 4/16/64/128 QAM and 4/16/64/128/256 QAM Adaptive modulation techniques.

6.237 Supports 10, 30, 40, and 50 MHz channel bandwidths.

6.238 Supports standard and high system gain profiles.

6.239 Supports 1+0 Unprotected, 1+1 HSB, 1+1 SD, and 1+1 FD radio configurations.

6.240 Supports Ethernet ring protection Switching.

6.241 Integrated antenna mounts and coaxial connection to the MSS-4/8 shelf simplify installation.

6.242 ODU300 is available with and without lightning surge suppressor.

6.243 ODU300 Supports FEC including Reed Solomon Decoding and TCM 2D/4D. The FEC configuration is a direct consequence of the modem profile provisioned and is not configurable.

Unlicensed radio for MPT-HL and 9558HC

6.244 The JF6-9558H/6933B-9500MPT (MPT-HL) unlicensed radio provide fast deployment of service with microwave radio. No license and small antennas (no FCC and Industry Canada (IC) requirements) allow immediate Turn-Up. After the license is received, the unlicensed MPT-HL radio can be easily converted to the lower 6 GHz licensed band.

6.245 The JF6-9558HC/6933B-9558HC (9558HC) unlicensed radio provide fast deployment of service with microwave radio. No license and small antennas (no FCC and Industry Canada (IC) requirements) allow immediate Turn-Up. The 9558HC unlicensed radio can not be upgraded to licensed operation.

PRELIMINARY

CAUTION Possibility of service interruption. Changes or modifications not expressly approved by Alcatel-Lucent could void the authority to operate the JF6-9558H/6933B-9500MPT and JF6-9558HC/6933B-9558HC (unlicensed) radio.

CAUTION Possibility of service interruption. Installation, Turn-Up, Maintenance, and Operation Instruction supplied with the JF6-9558H/6933B-9500MPT and JF6-9558HC/6933B-9558HC (unlicensed) radio require strict adherence for continued part 15 of the FCC Rules and IC RSS-210 compliance.

Table 6-J. Unlicensed radio

Transceiver	FCC ID	Industry Canada ID
9558HC	JF6-9558HC	6933B-9558HC
MPT-HL	JF6-9558H	6933B-9500MPT

6.246 Refer to 9500 MPR-A Engineering Support Documentation manual (PN 3EM23957AL) and see drawing 3EM227840000BJZZA, Equipping Options Drawing for unlicensed radio configurations and equipping options.

6.247 The MPT-HL and 9558HC unlicensed radio operate in the 5725-5850 Information, Scientific, and Medical (ISM) band in accordance with FCC Part 15.247 and IC RSS-210. This unlicensed radio, although operating in the same band as a spread spectrum radio, operates using narrower bandwidths than spread spectrum. Advantages, disadvantages, and antenna recommendations for the unlicensed radio follow:

6.248 Advantages:

- Fast installation and Turn-Up
- Between 6.6 — 185 Mb/s user configurable data payload capacity consisting of a combination of DS1, DS3, OC-3, and/or Ethernet traffic
- Field convertible to lower 6 GHz licensed band (MPT-HL)
- Field expandable to higher capacities.
- Common network management with licensed radios.
- Common spares and training with licensed radios
- Adaptive Modulation - automatic interference countermeasures

6.249 Disadvantages:

- Interference from other 5725-5850 ISM band transmissions are possible
- Operating restrictions
- 5.725 to 5.850 GHz band
- Performance could deteriorate due to interference as the frequency band becomes congested.

6.250 Antenna Recommendations:

- Frequency – 5.8 GHz
- Size and Type – 2, 4, 6, 8, or 10 foot parabolic; 1 or 2 foot flat panel.
  - Parabolic antennas, See Table 6-K.
  - Flat antennas, See Table 6-K.
- Gain and 3 dB Beamwidth

6.251 This device has been designed to operate with the antennas listed below, and having a maximum gain of 42.5 dB. Antennas not included in this list or having a gain greater than 42.5 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Table 6-K. 5.8 GHz unlicensed antenna options

PARABOLIC	FLAT
MPT-HL/9558HC	**MPT-HL/9558HC**
2 ft parabolic – 29 dB/6°	1 ft flat panel – 23 dB/9°
4 ft parabolic – 35 dB/3°	2 ft flat panel – 28 dB/3.5°
6 ft parabolic – 38 dB/2°	—
8 ft parabolic – 41 dB/1.5°	—
10 ft parabolic – 42.5 dB/1.2°	—

6.252 These antennas can only be used in a fixed point-to-point configuration.

6.253 To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

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6.254 The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 12 meters from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

DANGER **Possibility of personal injury. Danger of public exposure to long term RF radiated energy. When using a 1 ft flat panel antenna with a 1 watt (+30 dBm) output power, the antenna must be located in an area that does not allow the general population access to within 12 meters (5.8 Ghz) of the antenna.**

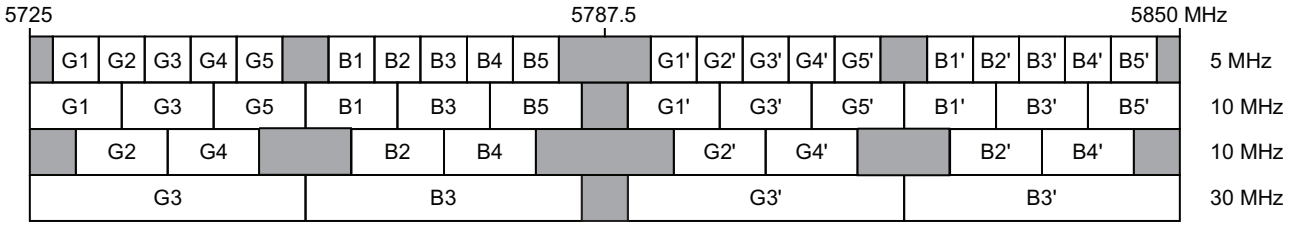
6.255 Frequency Plan:

- For MPT-HL frequency plan for the 5.725 and 5.850 GHz unlicensed band, refer to Figure 6-26.
- For 9558HC frequency plan for the 5.725 and 5.850 GHz unlicensed band, refer to Figure 6-27.

6.256 Output Power: A requirement of operating in the unlicensed band is to limit transmit output power to not more than +30.0 dBm at the antenna port. It is the responsibility of the user to transmit not more than +30.0 dBm.

NOTE: To meet FCC part 15 requirements, output power for 9558HC 30 MHz 4QAM and 8QAM channels must not be provisioned greater than 24 dBm. This is not enforced by the user interface and is the responsibility of the operator to guarantee provisioning of the radio transmit power. For transmit power specification, refer to the 9500 MPR-A Engineering Support Documentation manual (PN 3EM23957AL), System Application Rules document, 3EM227840000BGZZA.

Figure 6-26. Frequency plan MPT-HL: 5.725 to 5.850 GHz unlicensed band (FCC Part 15 and IC RSS-210)



Transmit Channel	Frequency MHz	Receive Channel	Frequency MHz
G1	5730	G1'	5795
G2	5735	G2'	5800
G3	5740	G3'	5805
G4	5745	G4'	5810
G5	5750	G5'	5815
B1	5760	B1'	5825
B2	5765	B2'	5830
B3	5770	B3'	5835
B4	5775	B4'	5840
B5	5780	B5'	5845

Notes:

1. The drawing above shows the 5 MHz bandwidth channels used by the JF6-9558H/6933B-9500MPT radio. Gray channels are designated "G". Blue channels are designated "B". Transmit and receive channels have a 65 MHz frequency separation.
2. RF filters are centered on channels G3, B3, G3', and B3'.
3. The flexability of the JF6-9558H/6933B-9500MPT allows any radio to grow to 183 Mb/s without a hardware upgrade.

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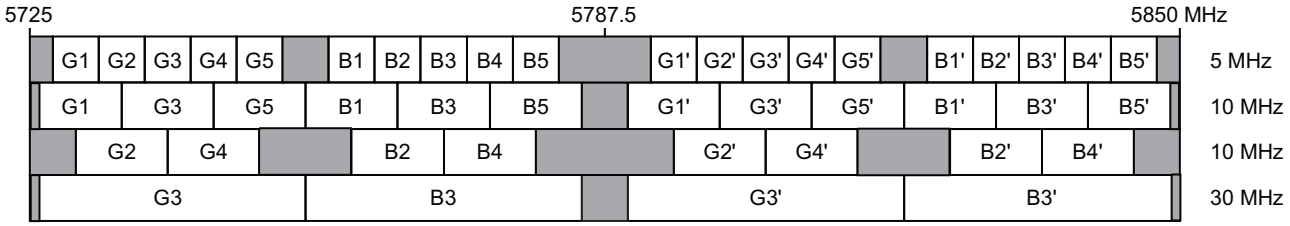
041612

Figure 6-27. Frequency plan 9558HC: 5.725 to 5.850 GHz unlicensed band (FCC Part 15 and IC RSS-210)



Transmit Channel	Frequency MHz	Receive Channel	Frequency MHz
G1	5730.5	G1'	5794.5
G2	5735.5	G2'	5799.5
G3	5740.5	G3'	5804.5
G4	5745.5	G4'	5809.5
G5	5750.5	G5'	5814.5
B1	5760.5	B1'	5824.5
B2	5765.5	B2'	5829.5
B3	5770.5	B3'	5834.5
B4	5775.5	B4'	5839.5
B5	5780.5	B5'	5844.5

Notes:

1. The drawing above shows the 5 MHz bandwidth channels used by the JF6-9558HC/6933B-9558HC radio. Gray channels are designated "G". Blue channels are designated "B". Transmit and receive channels have a 64 MHz frequency separation.
2. RF filters are centered on channels G3, B3, G3', and B3'.
3. The flexability of the JF6-9558HC/6933B-9558HC allows any radio to grow to 185 Mb/s without a hardware upgrade.

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041612

Ethernet

6.257 The system supports the following Ethernet functionality:

Ethernet traffic management

6.258 Ethernet traffic is all the traffic entering the MPR-A network from user Ethernet ports.

6.259 Ethernet traffic is switch using either 802.1D MAC Address Bridge or 802.1Q Virtual Bridge.

802.1D

6.260 When the system is configured in 802.1D mode all Ethernet traffic is routed according to the destination MAC address without regard to VLAN ID.

802.1Q

6.261 When the system is configured in 802.1Q mode all Ethernet traffic is routed according to the VLAN IDs.

6.262 When 802.1Q mode is enable, VLAN 1 is automatically created. All user Ethernet ports and all radio ports are members of VLAN 1. VLAN 1 is not editable. In egress VLAN 1 is always removed from all ports.

6.263 The default configuration is 802.1Q.

Bridge type change

6.264 To change bridge type from 802.1Q to 802.1D, the content of the VLAN table and the VLAN assigned to the user Ethernet ports must be deleted by the operator prior to a change of bridge type.

Frame type

6.265 The system supports the following Ethernet Frame types:

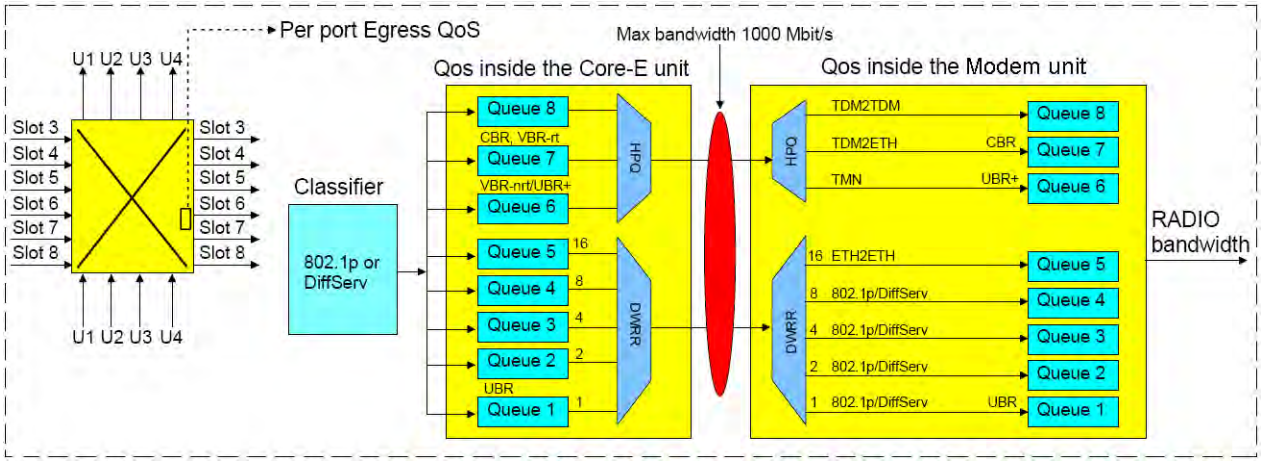
- Ethernet v2
- 802.3
- 802.1Q

PRELIMINARY

Quality of service (QoS)

6.266 The QoS feature assigns the priority for Ethernet packets according to the selected QoS mode. See Figure 6-28 for an overview of the QoS implementation.

Figure 6-28. QoS configuration



6.267 QoS feature provides eight internal queues to support different traffic priorities. The QoS function assigns Ethernet packets to one of the eight egress traffic queues.

QoS classification

6.268 QoS classification determines the method the system uses to assign packet priority.

6.269 QoS classification criterion is assigned at the NE level and applied to all radio and Ethernet ports.

6.270 The system supports the following QoS classification modes:

- Disabled
- DiffServ
- IEEE 802.1p

Disabled

6.271 All Ethernet traffic has the same priority (FIFO).

6.272 All packets are assigned the lowest priority queue.

6.273 Disabled is the default QoS classification mode.

DiffServ

6.274 Default Ethernet traffic QoS classification is per RFC2474.

6.275 Each packet is classified based on Differentiated Service Code Point (DSCP) field in the IPv4 or IPv6 packet header to determine packet priority.

6.276 DSCP values are mapped to one of five internal Forwarding Classes.

6.277 DSCP values apply to the following VLAN bridge modes:

- 802.1Q Virtual Bridge
- 802.1D MAC Address Bridge

6.278 When incoming packets are not IPv4 or IPv6, the packets are assigned to Q1.

IPv4 traffic class management

6.279 The system supports IPv4 Traffic class management. IPv4 Traffic management provides customization of DiffServ priority to Queue for IPv4 frames for queuing/delivery purposes.

6.280 IPv4 Traffic class management is supported on all P8ETH and CSM-E user Ethernet ports and all radio ports except MPT-HL radio ports.

IPv6 traffic class management

6.281 The system supports IPv6 Traffic class management. IPv6 Traffic class management is used to identify and distinguish between different classes and priorities of IPv6 packets for queuing/delivery purposes.

6.282 IPv6 Traffic class management is supported on all P8ETH and CSM-E user Ethernet ports and all radio ports except MPT-HL radio ports.

IEEE 802.1p

6.283 Default Ethernet traffic QoS classification is per IEEE 802.1Q.

6.284 Priority value is carried by Priority Code Point (PCP) field.

6.285 PCP values are mapped to one of five internal forwarding classes.

6.286 PCP values apply to the following VLAN bridge modes:

- 802.1Q Virtual Bridge
- 802.1D MAC Address Bridge

6.287 When incoming packets do not carry a valid 802.1p priority tag (untagged frame), priority is assigned according to the following:

- 802.1Q Virtual Bridge: port priority
- 802.1D MAC Address Bridge: priority 1

Priority queue mapping

6.288 The system supports priority queue mapping. Priority queue mapping allows a user to provision the priority queue management of Diffserv, 802.1p, and MEF-8 external traffic flows.

6.289 Priority queue mapping is supported on all P8ETH and CSM-E user Ethernet ports and all radio ports except MPT-HL radio ports.

QoS priority value to internal forwarding class

6.290 The QoS feature allows the user to customize QoS priority values (PCP or DSCP) to internal forwarding class on a per priority value basis.

6.291 QoS priority values to internal forwarding classes are provisionable using the following:

- Internal forwarding classes FC0 through FC4 are provisionable
- Internal forwarding classes FC5 through FC7 are NOT provisionable
- Provisioned at the NE level and applied to all radio and Ethernet ports
- QoS priority to internal forwarding classes are provisionable for the following QoS classification criterion:

– IEEE 802.1p

– DiffServ

IEEE 802.1p

6.292 802.1p priority values to internal forwarding classes are provisionable using the following:

- each PCP value can be mapped to only one internal forwarding class
- multiple PCP values can be mapped to the same internal forwarding class
- each time 802.1 p QoS classification criterion is provisioned, the default mapping between PCP values and internal forwarding classes is applied
- default internal forwarding class values may be retrieved
- provisioned internal forwarding class values may be restored

6.293 Refer to Table 6-A for default 802.1p to internal forwarding class mapping.

Table 6-A. Default 802.1p QoS classification criteria to internal forwarding class

PCP	Internal Forwarding Class	Default Egress Queue	Traffic Type
N/A	7 (Highest)	Q8	TDM2TDM
N/A	6	Q7	TDM2ETH
N/A	5	Q6	TMN
111 (7)	4	Q5	Generic Ethernet
110 (6)	3	Q4	
101 (5)	2	Q3	
100 (4)	2	Q3	
011 (3)	1	Q2	
010 (2)	1	Q2	
001 (1)	0	Q1	
000 (0)	0 (Lowest)	Q1	

DiffServ

6.294 DiffServ priority values to internal forwarding classes are provisionable using the following:

- each DSCP value can be mapped to only one internal forwarding class
- multiple DSCP values can be mapped to the same internal forwarding class
- when DiffServ classification criterion is provisioned, the default mapping between DSCP values and internal forwarding classes are applied
- default internal forwarding class values may be retrieved
- provisioned internal forwarding class values may be restored

6.295 Refer to Table 6-B for default DiffServ to internal forwarding class mapping.

Table 6-B. Default DiffServ QoS classification criteria to internal forwarding class

PCP	Internal Forwarding Class	Default Egress Queue	Traffic Type
N/A	7 (Highest)	Q8	TDM2TDM
N/A	6	Q7	TDM2ETH
N/A	5	Q6	TMN

Table 6-B. Default DiffServ QoS classification criteria to internal forwarding class (cont.)

PCP	Internal Forwarding Class	Default Egress Queue	Traffic Type
111000 (56) Class Selector 7	4	Q5	Generic Ethernet
110000 (48) Class Selector 6	4	Q5	
1011100 (46) EF	4	Q5	
101000 (40) Class Selector 5	4	Q5	
100110 (38) AF4 High	3	Q4	
100100 (36) AF4 Medium	3	Q4	
100010 (34) AF4 Low	3	Q4	
100000 (32) Class Selector 4	3	Q4	
011110 (30) AF3 High	2	Q3	
011100 (28) AF3 Medium	2	Q3	
011010 (26) AF3 Low	2	Q3	
011000 (24) Class Selector 3	2	Q3	
010110 (22) AF2 High	1	Q2	
010100 (20) AF2 Medium	1	Q2	
010010 (18) AF2 Low	1	Q2	
010000 (16) Class Selector 2	1	Q2	
001110 (14) AF1 High	1	Q2	
001100 (12) AF1 Medium	1	Q2	
001010 (10) AF1 Low	1	Q2	
001000 (8) Class Selector 1	1	Q2	
000000 (0) Class Selector 0	1	Q2	
All Remaining Values	0 (Lowest)	Q1	

Internal forwarding class to queue mapping

6.296 The QoS feature does not support customizing the mapping from internal forwarding class the egress queue. The QoS configuration tool does allow the user to view internal forwarding classes to Ethernet output queues mapping.

Scheduler type queue mapping

6.297 The system supports scheduler type queue mapping. Scheduler type queue mapping allows a user to provision the scheduler of Diffserv, 802.1p, and MEF-8 external traffic flows as either High Queue Preempt (HQP) or Deficit Weighted Round Robin (DWRR) scheduling.

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6.298 Priority queue mapping is supported on all P8ETH and CSM-E user Ethernet ports and all radio ports except MPT-HL radio ports.

Queue scheduler algorithm

6.299 The QoS queue scheduler algorithm determines the method queues are serviced.

6.300 The QoS queue scheduler algorithm maybe customized using the following:

- Provisioned at the NE level and applied to all radio QoS
- Queues Q6 through Q8 are NOT provisionable
- Queues Q1 through Q5 are provisionable
- Supported scheduling algorithms:
  - Deficit Weighted Round Robin (DWRR) (supported weight range: 1 to 32)
  - Strict Priority (SP)
- Provisioned continuos with SP always applied to the highest priority queues
- Default values may be retrieved
- Provisioned values may be restored

6.301 Refer to Table 6-C for the default queue scheduling algorithm.

Table 6-C. Default queue scheduling algorithm

Queue	Default Scheduling Algorithm	Default Weight	Traffic Type
Q8 (Highest)	SP	N/A	TDM2TDM
Q7	SP	N/A	TDM2ETH
Q6	SP	N/A	TMN
Q5	DWRR	16	Generic Ethernet
Q4	DWRR	8	
Q3	DWRR	4	
Q2	DWRR	2	
Q1 (Lowest)	DWRR	1	

Queue size

6.302 The QoS feature allows the user to customize queue size on a per queue, per radio direction basis.

6.303 Queue sizes are provisionable using the following:

- Queues Q1 through Q5 are provisionable
- Queues Q6 through Q8 are NOT provisionable
- Provisioned at the radio direction level and applied to radio QoS
- Supported radio configurations:
  - 1+0 not protected
  - 1+1 FD
  - 1+1 HSB/SD
  - L2 Radio LAG
- Queue size supported range:
  - maximum: 4034836 bytes
  - minimum: 2480 bytes
- Modem profile change to one of the following parameters restores the default queue size values:
  - channel spacing
  - modulation
  - adaptive modulation reference modulation
- Protection configuration change:
  - for 1+0 to 1+1:

    the spare radio channel takes the queue sizes of the main radio channel

– for 1+1 to 1+0:

main radio channel maintains the queue sizes of the main radio channel

spare radio channel takes the default queue sizes according to the configured modem profile

- Default values may be retrieved using QoS Configuration tool
- Provisioned values may be restored using QoS Configuration tool

6.304 An estimated maximum delay for an Ethernet frame is displayed by the QoS Configuration tool based upon the provisioned QoS values.

6.305 The estimated maximum delay is calculated according to the following provisioned parameters:

- Queue size in bytes
- Ethernet available bandwidth of the radio channel
- Scheduling algorithm applied to the queue
- Weight (for scheduling algorithm DWRR)

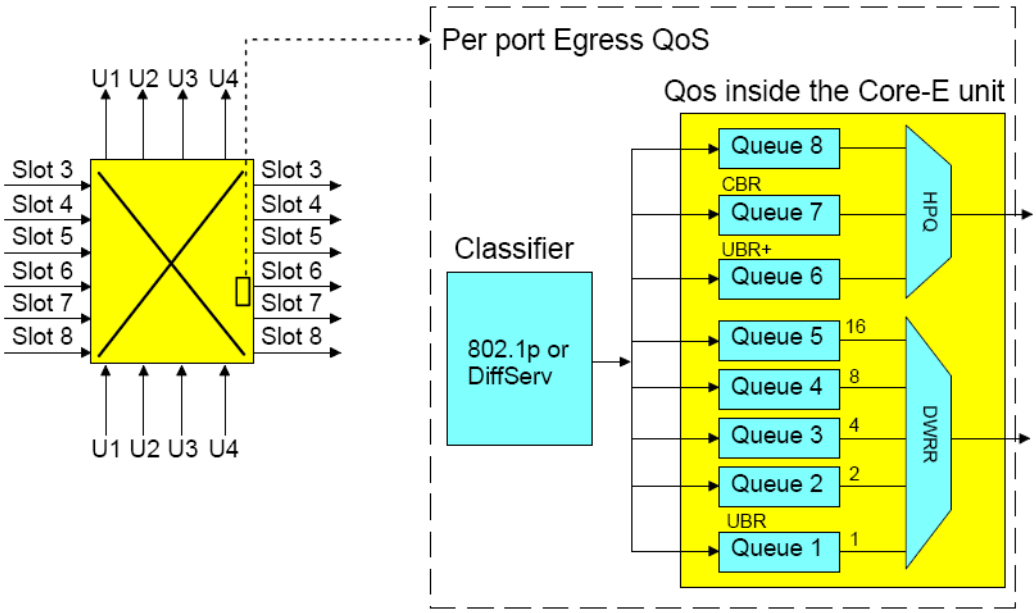
QoS with jumbo frame

6.306 While there is no physical limitation to the number of ports that can receive jumbo frames. If jumbo flows are transmitted toward the same port into two different queues, the QoS could adversely affect the jumbo frames sent to the lowest priority queue. It is recommended to forward jumbo frame only to queue Q1 (lowest priority).

QoS in the Core-E card

6.307 Figure 6-29 shows an overview of the QoS implementation inside the switch.

Figure 6-29. QoS in the Core-E unit Update from ETSI Figure 100



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

6.309 According to QoS mode configured in the switch, packets are mapped to the appropriate egress queue on each Ethernet/radio port.

6.310 Packets are not mapped directly to egress queues. Instead packet are first mapped to one of eight internal forwarding classes according to the QoS mode selected. These internal forwarding classes are then mapped to one of eight egress queues.

6.311 The eight egress queues are as follows:

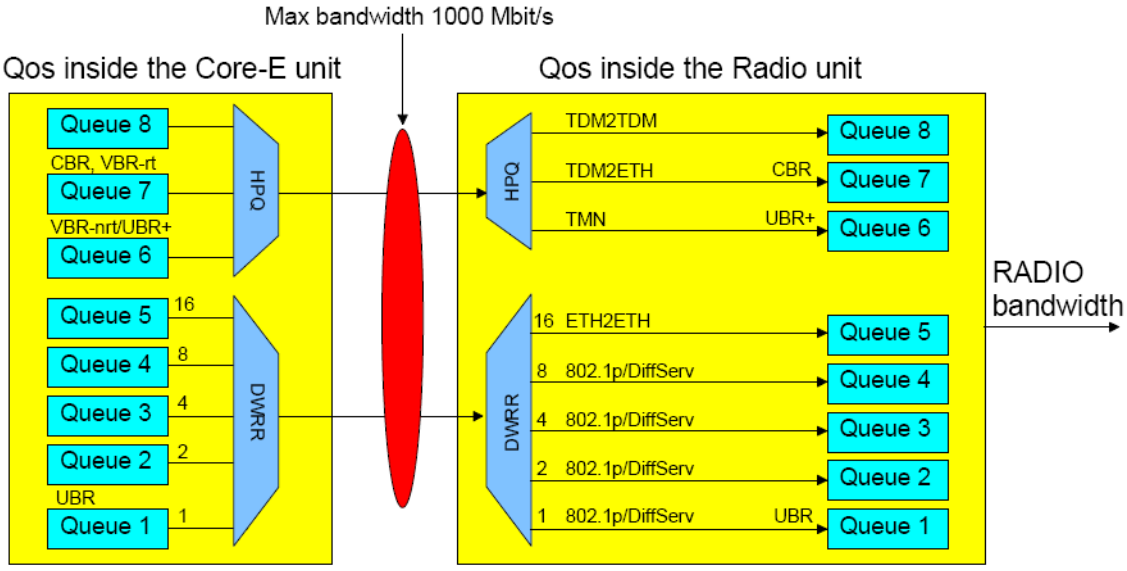
- Queue 8: TDM2TDM traffic (highest priority)
- Queue 7: TDM2ETH traffic
- Queue 6: TMN traffic
- Queues 1 to 5: generic Ethernet traffic

PRELIMINARY

QoS in the modem MOD300 card

6.312 Figure 6-29 shows an overview of the QoS implementation inside the Modem card which is used to interface the ODU300.

Figure 6-30. QoS in the modem card



6.313 The QoS feature provides eight internal queues to support different traffic priorities. The QoS function assigns packets to one of the eight egress transmit queues as defined by Ethernet flow classification.

QoS in the MPT-HC/XP

6.314 The Radio QoS is implemented on the MPT-HC/XP (not on the MPT Access Card).

6.315 The MPT-HC/XP radio QoS features are identical to the QoS in the modem MOD300 card.

QoS in the MPT-HL

6.316 The Radio QoS is implemented on the MPT-HL (not on the Ethernet Access Card).

6.317 The MPT-HL radio QoS features are identical to the QoS in the modem MOD300 card.

6.318 The QoS function inside the system is the result of a distributed implementation in the switch and Radio Interface modules. Both of these QoS functions must be properly configured in order to get the desired behavior on Ethernet flows that will be transmitted on the Radios.

Ethernet features provisioned by craft terminal

6.319 The following Ethernet features are supported provisioned using the Craft Terminal.

C-VLAN translation

6.320 The system supports C-VLAN Translation on user Ethernet interfaces, the translation is applied bi-directional.

6.321 Tagged ingress frames entering the User Ethernet interface, C-VLAN ID (From), are changed to a new C-VLAN ID (To). At the same time, tagged egress frames, C-VLAN ID (To) are changed to C-VLAN ID (From) exiting the User Ethernet interface.

6.322 The PCP field and CFI field are left unchanged.

6.323 The available set of C-VLAN IDs (To) is the list of VLAN IDs which have the User Ethernet interface as a member of the VLAN port set and which have at most two ports (User Ethernet interface and another Ethernet or Radio port) as members of the VLAN port set.

6.324 C-VLAN Translation is supported:

- in 802.1Q Virtual Bridge mode
- on Core-E user Ethernet interfaces
- on P8ETH user Ethernet interfaces
- up to eight C-VLAN IDs (from) can be translated to C-VLAN IDs (to) per user Ethernet interface

6.325 A User Ethernet interface can not be disabled when the C-VLAN Translation feature is enabled on the interface.

6.326 When a C-VLAN ID is selected as C-VLAN ID (To), the following actions are not permitted:

- modification of the C-VLAN parameters

- deletion of the C-VLAN ID

6.327 C-VLAN Translation is provisioned using the Craft Terminal.

6.328 The VLAN ID selected as C-VLAN ID (From) does not require VLAN creation using the VLAN Configuration Tool.

6.329 When a VLAN ID is selected as C-VLAN ID (From), the creation/modification of that VLAN in the VLAN Configuration Tool is not supported.

6.330 C-VLAN Translation feature is not supported with the following features:

- Ethernet Ring Protection Switching (ERPS)
- L2 Radio Link Aggregation
- VLAN Rate Limiter
- ECFM

Port based rate limiting

6.331 The system supports Port based Rate Limiting on user Ethernet interfaces. Port based Rate Limiting allows a user to provision on a per user Ethernet port basis the maximum data rate on ingress and egress directions.

6.332 The Rate Limiter is managed according to a Leaky Bucket algorithm, Ethernet frames that do not find room in the Bucket are dropped.

6.333 The parameters of Rate Limiter are:

- Committed Information Rate (CIR): Ethernet throughput not taking into account Preamble and IFG frames.
- Committed Burst Size (CBS)

6.334 CIR is configured in the range from 64 Kbit/s to 1,000,000 Kbit/s in step of 64 Kbit/s. The default value for CIR is 64 Kbit/s.

6.335 CBS is configured in the range from 4 Kbytes (4096 bytes) to 16 MBytes in steps of 4 Kbytes. The default value for CBS is 12 Kbytes.

6.336 Ingress Rate Limiter and Egress Rate Limiter can be enabled/disabled independently.

6.337 Port based Rate Limiting is supported:

- in 802.1D MAC Bridge mode
- in 802.1Q Virtual Bridge mode
- on Core-E user Ethernet interfaces
- on P8ETH user Ethernet interfaces

6.338 A User Ethernet interface can not be disabled when the Port based Rate Limiting feature is enabled on the interface.

6.339 Port based Rate Limiting is provisioned using the Craft Terminal.

6.340 In cases were Port based Rate Limiting was provisioned using file based configuration, it is required to remove the file based Port based Rate Limiting configuration prior to provisioning using the Craft Terminal.

Storm control (broadcast, multicast, and unknown unicast)

6.341 The system supports traffic Storm Control for the following Ethernet traffic frame types:

- Broadcast
- Multicast
- Unknown Unicast

6.342 Storm Control provides a mechanism to control the effects of broadcast, multicast, and unknown unicast storms on physical user Ethernet interfaces. This helps prevent traffic storms from being disruptive and degrading network performance.

6.343 When storm control is enabled, and in a 1 second time interval, the number of broadcast, multicast, and/or unknown unicast Ethernet frames exceeds the configured threshold, a dropping mechanism is applied.

6.344 Frame rate thresholds are provisionable for broadcast, multicast, and unknown unicast traffic. Frame rate thresholds are configured from 0 Frame/s to 16,777,215 Frame/s. The default threshold for all frame types is 100 Frame/s.

6.345 Storm Control is supported:

- in 802.1D MAC Bridge mode
- in 802.1Q Virtual Bridge mode
- on Core-E user Ethernet interfaces
- on P8ETH user Ethernet interfaces

6.346 Storm Control is enabled/disabled for all supported frame types at one time.

6.347 A User Ethernet interface can not be disabled when the Storm Control feature is enabled on the interface.

6.348 Storm Control is provisioned using the Craft Terminal.

6.349 In cases were the Storm Control feature was provisioned using file based configuration, it is required to remove the file based Storm Control configuration prior to provisioning using the Craft Terminal.

VLAN based rate limiter

6.350 The system supports a VLAN based Rate Limiter on user Ethernet interfaces for the ingress direction. VLAN based Rate Limiter allows a user to provision, on a per VLAN ID basis, the maximum data rate for the ingress direction.

6.351 The VLAN IDs available for VLAN based Rate Limiter are those which include the User Ethernet interface as a member of the VLAN port set.

6.352 The Rate Limiter is managed according to a Token Bucket algorithm, Ethernet frames that do not find available tokens are dropped.

6.353 The parameters of VLAN Rate Limiter are:

- Committed Information Rate (CIR): Ethernet throughput not taking into account Preamble and IFG frames.
- Committed Burst Size (CBS)

6.354 CIR is configured in the range from 64 Kbit/s to 32 Gbit/s in step of 64 Kbit/s. The default value for CIR is 64 Kbit/s.

6.355 CBS is configured in the range from 4 Kbytes (4096 bytes) to 2 MBytes. The default value for CBS is 16 Kbytes.

6.356 VLAN based Rate Limiter is supported:

- in 802.1Q Virtual Bridge mode
- on Core-E user Ethernet interfaces
- on P8ETH user Ethernet interfaces
- up to eight VLAN IDs per user Ethernet interface

6.357 A User Ethernet interface can not be disabled when the VLAN based Rate Limiter feature is enabled on the interface.

6.358 When a VLAN based Rate Limiter is enabled on a VLAN ID, the following actions are not permitted:

- modification of the VLAN parameters
- deletion of the VLAN ID

6.359 VLAN Rate Limiter should not be activated in conjunction with Port based Rate Limiter

6.360 VLAN based Rate Limiter is provisioned using the Craft Terminal.

6.361 In cases where a VLAN based Rate Limiter was provisioned using file based configuration, it is required to remove the file based VLAN based Rate Limiter configuration prior to provisioning using the Craft Terminal.

Per-VLAN per-COS rate limiter

6.362 The system supports a per-VLAN per-COS Rate Limiter on user Ethernet interfaces for the ingress direction.

6.363 The rate limiter is applied to a tagged Ethernet flow classified according to the VLAN ID and PCP fields of the VLAN tag. The flow is identified by one VLAN ID value and one PCP value.

6.364 The VLAN IDs available for per-VLAN per-COS Rate Limiter are those which include the User Ethernet interface as a member of the VLAN port set.

6.365 The Rate Limiter is managed according to a Token Bucket algorithm, Ethernet frames that do not find available tokens are dropped.

6.366 The parameters of per-VLAN per-COS Rate Limiter are:

- Committed Information Rate (CIR): Ethernet throughput not taking into account Preamble and IFG frames.
- Committed Burst Size (CBS)

6.367 CIR is configured in the range from 0 Kbit/s to 1 Gbit/s in step of 64 Kbit/s. The default value for CIR is 64 Kbit/s. A value of 0 Kbit/s indicates a drop of the Ethernet flow.

6.368 CBS is configured in the range from 4 Kbytes (4096 bytes) to 16 MBytes. The default value for CBS is 16 Kbytes. The allowed values for CBS are:

- 4 Kbytes
- 8 Kbytes
- 16 Kbytes
- 32 Kbytes
- 64 Kbytes
- 128 Kbytes
- 256 Kbytes
- 512 Kbytes
- 1 Mbytes
- 2 Mbytes
- 4 Mbytes
- 8 Mbytes
- 16 Mbytes

6.369 Per-VLAN Per-COS Rate Limiter is supported:

- in 802.1Q Virtual Bridge mode
- on Core-E user Ethernet interfaces
- on P8ETH user Ethernet interfaces

- Up to 16 Rate Limiters can be activated per User Ethernet interface, up to 32 Rate Limiters can be activated on a Core-E card and up to 32 Rate Limiters can be activated on each P8ETH card.

6.370 A User Ethernet interface can not be disabled when the per-VLAN per-COS Rate Limiter feature is enabled on the interface.

6.371 When a per-VLAN per-COS Rate Limiter is enabled on a VLAN ID, the following actions are not permitted:

- modification of the VLAN parameters
- deletion of the VLAN ID

6.372 Per-VLAN per-COS Rate Limiter should not be activated in conjunction with VLAN based Rate Limiter.

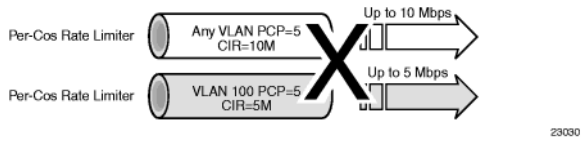
CAUTION Possibility of service interruption. When a Per-VLAN Per-CoS Rate Limiter is activated in conjunction with a Port Rate Limiter, the Per-VLAN Per-CoS Rate Limiter must apply to Ethernet frames that meet the Port Rate Limiter parameters.

6.373 Per-VLAN per-COS Rate Limiter is provisioned using the Craft Terminal.

6.374 In cases where a VLAN based Rate Limiter was provisioned using file based configuration, it is required to remove the file based VLAN based Rate Limiter configuration prior to provisioning using the Craft Terminal.

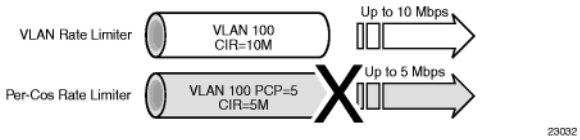
6.375 The value Any can be used as the VLAN ID: the tagged Ethernet flow will be classified according to the value of the PCP field only. The CT and the NE perform a check to verify that two Per-VLAN Per-CoS rate limiters do not exist on the same port where one is identified by PCP value only and another is identified by a specific VLAN ID and the same PCP value as shown in Figure 6-31.

Figure 6-31. Per-VLAN Per-COS rate limiters with duplicate PCP values



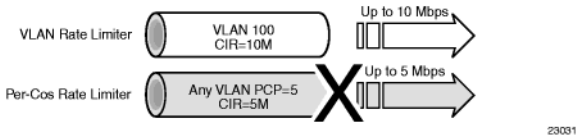
6.376 A check is also performed to verify that a Per-VLAN Per-CoS rate limiter is not created on the same port with a VLAN ID that is already in use to perform a VLAN Rate Limiter, as shown in Figure 6-32.

Figure 6-32. Per-VLAN Per-CoS Rate Limiter and VLAN Rate Limiter with the same VLAN ID



6.377 A check is performed to verify that a Per-VLAN Per-CoS Rate Limiter identified by PCP value only (VLAN ID = Any) is not created when there is already a VLAN Rate Limiter on the same port, as shown in Figure 6-33.

Figure 6-33. Per-VLAN Per-CoS Rate Limiter with VLAN ID = Any and a VLAN Rate Limiter



Ethernet features configured by enhanced configuration file

6.378 The following Ethernet features can be configured using an Enhanced Configuration File.

Access control list

6.379 The system supports Access Control List. Access Control List allows a user to restrict MAC addresses allowed in the network.

Enabling Access Control List feature automatically drops ALL MAC addresses which are not specifically provisioned by the user.

Out of range VLAN swap

6.380 The system supports Out of Range VLAN swap. Out of Range VLAN swap allows transport of VLANs outside the supported range (4081-4094). The out of range VLAN ID is swapped to one supported by the system on ingress and vice versa.

6.381 VLAN swapping is supported on all P8ETH and Core-E user Ethernet ports and all radio ports except MPT-HL radio ports.

Per-flow policer

6.382 The system supports scheduler type queue mapping. Scheduler type queue mapping allows a user to provision the scheduler for Diffserv, 802.1p, and MEF-8 external traffic flows as either High Queue Preempt (HQP) or Deficit Weighted Round Robin (DWRR) scheduling.

6.383 Priority queue mapping is configured via configuration file. Supported on all P8ETH and Core-E user Ethernet ports.

Stacked VLAN (Q-in-Q) tagging

6.384 The system supports Stacked VLAN (Q-in-Q) Tagging. VLAN stacking allows all traffic from a single customer (which could be multiple VLANs) into a single VLAN simplifying management across the network.

6.385 Stacked VLAN (Q-in-Q) Tagging is supported on all P8ETH and Core-E user Ethernet ports and all radio ports except MPT-HL radio ports.

VLAN remarking

6.386 The system supports 802.1p remarking. VLAN remarking allows packets to be remarked specifying a different priority level in the packet header.

6.387 VLAN swapping is configured via configuration file. Supported on all P8ETH and Core-E user Ethernet ports and all radio ports except MPT-HL radio ports.

VLAN swap

6.388 The system supports VLAN swap. VLAN swap allows the inner and outer tags to be swapped on double tagged packets. The inner tag becomes the outer tag and vice versa.

6.389 VLAN remarking is supported on all P8ETH and Core-E user Ethernet ports and all radio ports except MPT-HL radio ports.

2xE1DS1 SFP Support

6.390 The system supports up to two DS1 MEF-8 compliant circuit emulation signals using the 2xE1DS1 SFP.

6.391 2xE1DS1 SFP is supported on CSM-E user SFP Ethernet ports.

Input/output flow control

6.392 The system support for 802.3x asymmetric pause frame towards the link partner.

Input pause feature

6.393 This feature makes the auto-negotiation function willing to stop receiving traffic. When the radio input buffers approach overflow, the function sends a pause message to the link partner that is transmitting data to the radio, telling the device to temporarily stop sending data. The link partner will stop sending data if the device has and is provisioned with the Allow Option Pause function. See Figure 6-34.

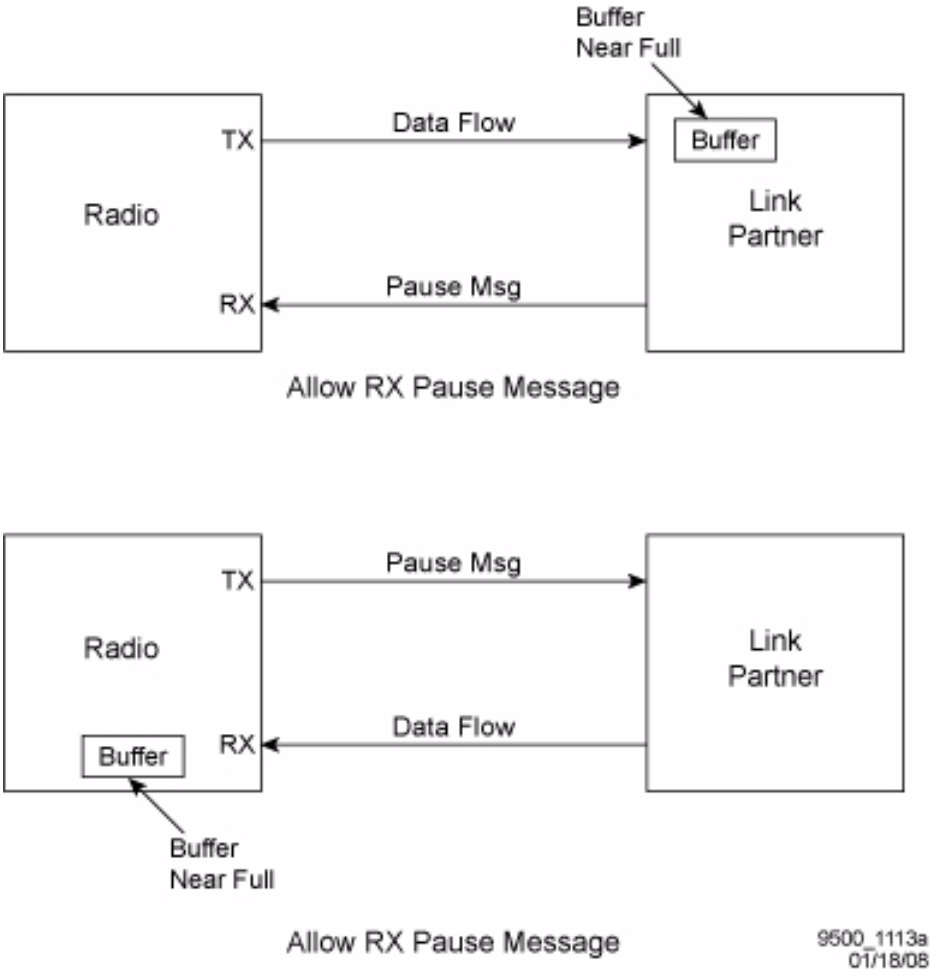
6.394 If the link partner is either not equipped with or is not provisioned for input pause, data overflowing the registers in the radio will be lost, regardless of the provisioning for input pause in the radio. Any time there is an overflow, the radio will alarm and indicate Dropped Frames on the Performance Monitor screens.

Output pause feature

6.395 The system does not support 802.3x receive pause frames. When the system receives a pause frame, the pause frame will be dropped.

6.396 Data overflowing the registers in the link partner will be lost regardless of the provisioning for output pause.

Figure 6-34. Input/output flow control block diagram



Reserved multicast addresses

6.397 The system handles reserved multicast addresses uniquely since they are designed for layer 2 control protocols. The following actions are supported by the system:

- **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.

Table 6-L. Reserved multicast addresses

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), Clause 57 (OAM) of IEEE 802.3, and ITU-T G.8264 (ESMC)	Peer for Link Aggregation and ESMC Discard for OAM
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
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

Traffic mode

6.398 The user Ethernet traffic ports can be configured in either manual or automatic mode. In manual mode auto-negotiations is disabled. In automatic mode auto-negotiations is enabled. Speed, capability and flow control are negotiated between the link partners.

6.399 Electrical Ethernet ports support the following parameters on a per port basis:

- Speed: 10, 100, or 1000 Mb/s
- Capability: Full-duplex or half-duplex
- Flow control: enable or disabled
- Master-Slave: PHY Master or PHY Slave (SyncE Interface)

6.400 Optical Ethernet ports support the following parameters on a per port basis:

- Speed: 1000 Mb/s
- Capability: Full-duplex
- Flow control: enable or disabled
- Master-Slave: PHY Master or PHY Slave (SyncE Interface)

Auto-negotiation

6.401 Auto-negotiation is not a stand-alone function, and proper operation and use of all available functions depends on the capabilities of the external customer equipment that is connected to the radio. Just because an auto-negotiation function is checked for provisioning does not automatically mean that function is fully operable. The device on the other end of the cable must also have the capability and be provisioned with a matching function.

6.402 Auto-Negotiate details are beyond the scope of this supplement. When unsure of what functions to check or change from factory default provisioning, leave at default (all auto-negotiation functions are checked). Full auto-negotiation capability is becoming standard for manufacturers of Ethernet devices.

Allow 10, 100, and/or 1000 Mb/s half and full duplex

6.403 If in doubt as to the link speed and mode of the external device connecting Ethernet to the radio, check all boxes for speeds and modes. If you know the external Ethernet device has speed and/or mode limitations, check only the boxes that apply.

Ethernet synchronization messaging channel

6.404 Ethernet Synchronization Messaging Channel (ECSM) is supported on Ethernet interfaces configured for synchronous operation mode support SSM and ESMC processing according to ITU-T G.8264.

6.405 ESMC is supported on Core-E user Ethernet ports.

Ethernet connectivity fault management

6.406 The system supports Ethernet Connectivity Fault Management (CFM). CFM provides the capability for detecting, verifying, and isolating connectivity failures in Virtual Bridged Local Area Networks.

6.407 CFM is supported using the CLI tool.

TACACS+

6.408 The system supports a TACACS+ client as defined by IETF draft-grant-tacacs-02 to perform centralized Authentication, Authorization, and Accounting (AAA) of user logins.

6.409 TACACS+ is supported on MSS-4/8 snmp, http, and telnet interfaces.

6.410 TACACS+ is transparent to existing 9500MPR authentication procedures.

6.411 Login requests are authenticated using TACACS+ instead of the local user database, whenever TACACS+ is enabled and a configured server is available. The EC shell telnet login is not managed by TACACS+ and is authenticated locally.

6.412 TACACS+ Authorization shall only be used to determine user membership in one of the existing 9500MPR privilege groups. Authorization of individual commands is not supported.

6.413 TACACS+ accounting procedures are not supported.

6.414 To avoid a possible password conflict due to the same username in both the TACACS+ and local user databases, user modification of their local account password is denied when TACACS+ is enabled on the SNMP interface. If a password needs to be changed, the change can be completed by an administrator.

6.415 The local user account management by an administrator is not affected by TACACS+ operation except that the administrator must be re-authenticated through TACACS+, when it is enabled on the SNMP interface nd a server is available.

Server support

6.416 The client supports a priority list of up to four TACACS+ servers with a unique server encryption key for each.

6.417 All server exchanges are secured by the TACACS+ protocol by multiplexing the appropriate contents with a string of MD5 hashes based on the provisioned server secret key. The unencrypted mode of operation is not supported. Only the PAP login type (cleartext username and password) is supported. The TACACS+ server must support PAP authentication.

6.418 Server messages and custom prompts received in a TACACS+ response are accepted but not displayed to users.

Authentication/authorization

6.419 Each time an authentication is required on a user interface, the client uses the server selection process to determine if a TACACS+ server is available. When no servers are available, the local login database is used. The authentication request is denied if a matching username and password are not found. If a server is available, the client opens a TCP connection to the selected server and perform authentication/authorization as follows.

6.420 If the connection is successful, an authentication START request is sent. The request contains the PAP username and password, the port type (snmp, http, telnet, test), and the client/manager IP address (http or snmp only).

6.421 If the authentication response is PASS, an authorization REQUEST to start a shell exec service is sent in order to determine the user privilege group.

6.422 The authorization response of PASS-ADD is parsed to locate a command pair, "vacm={administrator | craftperson | operator | viewer}", that assigns the privilege group for the user. The authorization is denied for any other authorization response or if no valid privilege group is defined for the user. This provides security against authentication of valid users, who are not authorized to access the NE. If the authorization response does not include the command pair "vacm={administrator | craftperson | operator | viewer}", the login procedure will fail.

6.423 User authentication and authorization management by remote TACACS+ server is not compatible with SNMPv3 user management; see SNMP operating mode (SNMPv3 support). If the NE is configured in SNMPv3 mode, it is not possible to enable TACACS+ on the SNMP interface using the WT-CLI.

If TACACS+ is enabled on the SNMP interface, it is not possible to configure the NE in SNMPv3 mode.

6.424 The server attempt counter is incremented, if the connection/authentication/authorization process is not completed within the server configured timeout period. The current internal system time at the time of the failure is recorded. Another server is selected and the process repeated until valid responses are received or no alternate server is available.

6.425 If the elapsed time since starting the first attempt exceeds 45 seconds, the process shall abort and proceed as if no servers are available.

6.426 A server attempt counter is cleared, if the correct authentication/authorization responses are received.

6.427 A server attempt counter is cleared, if there is a change to the following server configuration parameters:

- IP address;
- Secret Key;
- Port Number.

6.428 A server attempt counter is not cleared, if there is a change to the following server configuration parameters:

- Timeout;
- Retry attempt limit.

6.429 The server attempt counter is not cleared, if there is a change to the Holdoff time.

6.430 A server attempt counter and time of last failure are cleared after an NE restart.

Server selection

6.431 The server selection process determines the server or authentication method to be used based on the following process:

6.432 The server list is searched to find the highest priority server that currently has no attempt failures (i.e. skip any servers with attempt failures).

6.433 The primary server is selected, if any lower priority servers have no attempt failures and the time since the primary server last failure exceeds the configured holdoff time. This allows the primary server to again be used for the first connection attempt of the authentication request but return directly to the last reachable server if the attempt fails. Otherwise, the highest priority server with no attempt failures is selected.

6.434 When all servers have attempt failures, the highest priority server from those with the minimum attempt count not exceeding the retry attempt limit is selected. When all servers have exceeded their retry attempt limit, the highest priority server with a time since last attempt failure that exceeds the configured holdoff time is selected.

6.435 The selection process does attempt to use another server or use the local login database if an authentication/authorization request is denied by a reachable server.

Configuration

6.436 The TACACS+ management is implemented through a command in the Ethernet Features shell.

6.437 The command is only supported for users with administrator privilege.

6.438 The command individually enables TACACS+ for telnet/http/snmp/all ports.

6.439 The command supports individual configuration of the following parameters for each server:

- index (1 to 4, 1 is highest priority)
- IP address (IPv4 dotted decimal)
- secret key (up to 32 printable characters, default to 0)
- port number (0 to 65535, default to 49)
- timeout (1 to 10 seconds, default to 3)
- retry attempt limit (1 to 3, default to 1)

6.440 Server parameters for the same index may be combined on a single line.

6.441 The command can support configuration of the server holdoff time (45 to 600 seconds, default to 300).

6.442 The user has the responsibility to ensure that valid settings and unique server IP addresses are assigned to each server. Invalid server configuration will result in failed server communication with no configuration warnings.

6.443 The user has the responsibility to ensure that the worst case combination of number of servers, connection attempts and timeouts does not exceed the time limit for the authentication process.

Server monitoring

6.444 TACACS+ status monitoring is implemented through a command in the Ethernet Features shell.

6.445 The command is only supported for users with administrator privilege.

6.446 The command displays the current TACACS+ configuration, attempt failures for each server, and time since last server failure.

Server validation

6.447 TACACS+ validation testing is implemented through a command in the Ethernet Features shell. This test allows to monitor round-trip response times for determining proper timeout settings and to confirm correct secret keys.

6.448 The command is only supported for users with administrator privilege.

6.449 The command generates a single “dummy” authentication request to each configured server. The authentication response status is reported as TCP Timeout, AA Timeout, or OK. The elapsed time from TCP connection start to the initiation of TCP connection close is reported with tenths of a second resolution.

6.450 The request is sent regardless of holdoff status or attempt counts.

6.451 The server attempt counts are cleared for any server that receives an authentication response (authorization is not required).

6.452 A server response failure is managed the same as any other authentication request.

Ethernet ring protection

6.453 Ethernet Ring Protection (ERP) Switching is implemented according to ITU-T G.8032 specifications which specify a protection switching mechanism and the Automatic Protection Switching (APS) protocol for Ethernet ring topologies.

6.454 The fundamentals of ring protection switching architectures are loop avoidance and the utilization of learning, forwarding, and address table management.

ERP topology

6.455 An ERP topology is a collection of Ethernet Ring Nodes forming a closed physical loop.

6.456 A minimum of two and maximum of sixteen Ethernet Ring Nodes are supported per ERP topology.

6.457 One ERP topology is supported per NE.

6.458 Up to two ERP instances are supported per ERP topology.

6.459 ERP Switching is supported in 802.1Q Bridging Mode ONLY.

6.460 ERP is supported using the following 1+0 unprotected radio interfaces:

- MOD300/ODU300
- MPT-HC/XP connected to MPT Access (support for only one MPT-HC/XP when configured as Ethernet Ring port)
- MPT-HC/XP connected to Core-E (support for up to two MPT-HC/XP configured as Ethernet Ring ports)

6.461 Supported radio interface configurations as Ring Ports are as follows:

- MOD300/ODU300 radio interface as one Ring port (East/West) and MOD300/ODU300 radio interface as other Ring port (West/East)
- MPT-HC/XP connected to MPT Access radio interface as one Ring port (East/West) and MPT-HC/XP connected to MPT Access radio interface as other Ring port (West/East)
- MPT-HC/XP connected to Core-E radio interface as one Ring port (East/West) and MPT-HC/XP connected to Core-E radio interface as other Ring port (West/East)
- MPT-HC/XP connected to MPT Access radio interface as one Ring port (East/West) and MPT-HC/XP connected to Core-E radio interface as other Ring port (West/East)

Ring link

6.462 Ethernet Ring Links connect two adjacent Ethernet Ring Nodes participating in the same ERP Topology.

Ring port

6.463 The Ethernet port used to construct the Ethernet Ring Link is called a Ring Port.

Ring protection link (RPL)

6.464 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).

RPL owner

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

6.466 Under a ring failure condition, the RPL Owner is responsible to unblock the RPL, allowing traffic to flow across the RPL.

R-APS protocol

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

ERP instance

6.468 An ERP Instance is responsible for protection of the VLANs that transport traffic over the physical ERP Topology. Up to two ERP Instances are supported per ERP Topology. Each ERP Instance is independent of the other ERP Instance.

6.469 Each ERP Instance has its own RPL and RPL Owner.

6.470 Additionally, each ERP Instance has its own independent R-APS protocol session using dedicated R-APS VLAN ID for protection coordination.

ERP operation

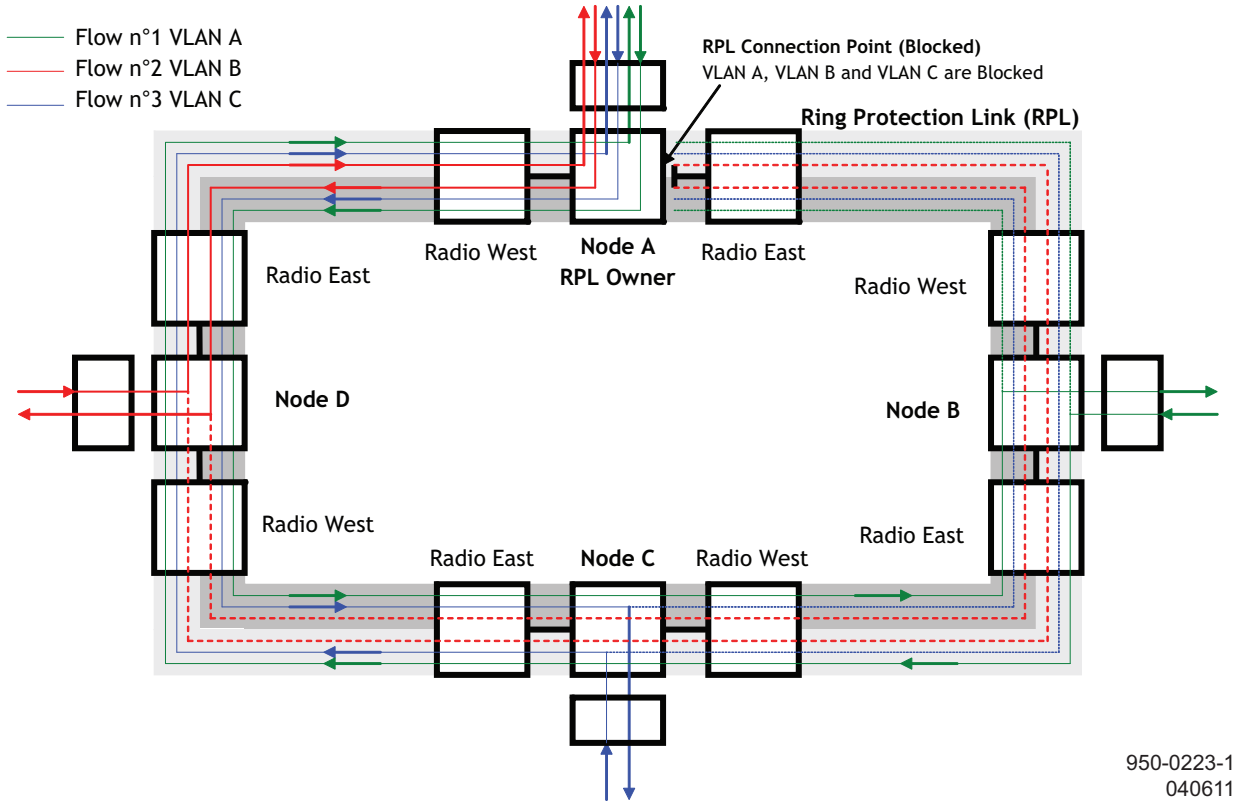
6.471 The protection switching mechanism is based on the Automatic Switching protocol for Ethernet ring topologies, R-APS, and is used to coordinate the protection actions over the ring.

6.472 The fundamentals of this ring protection architecture are:

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

6.473 Under normal operating conditions the RPL is blocked, and traffic flows on all links in the ring except the RPL. See Figure 6-35 for an example of an ERP Instance in normal operating condition.

Figure 6-35. Ethernet ring protection, normal operation



6.474 Under a ring link failure condition, the RPL owner is responsible to unblock the RPL. The Ring Node (or nodes) which perform local detection of the signal fail condition, put their Ring Ports in a blocking state the set of VLANs assigned to the ERP Instance on the radio interface where the failure has been detected. See Figure 6-36 for an example of an ERP Instance in a link failure operating condition.

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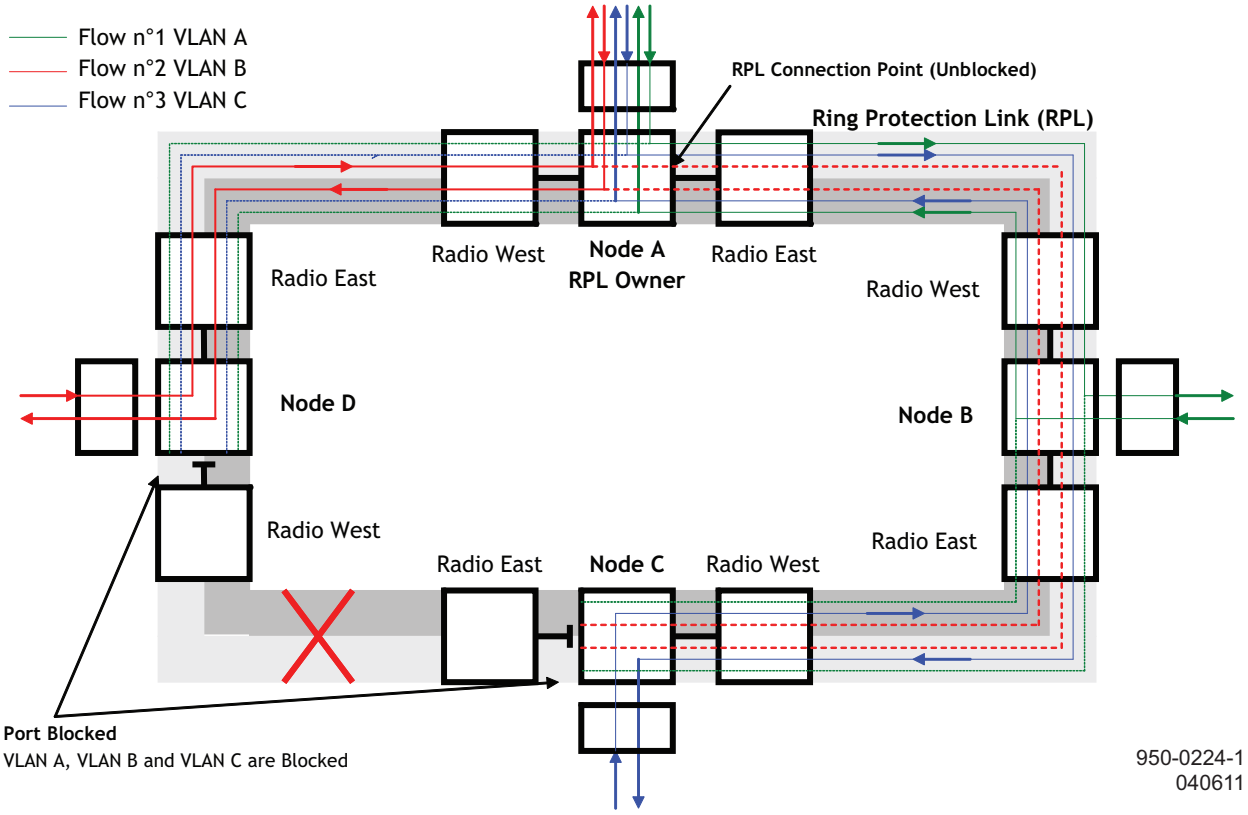
Figure 6-36. Ethernet ring protection, single link failure



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

- To disable forwarding over the set of VLANs assigned to the ERP Instance corresponding to blocked ring links.
- To flush the learned MAC address table

6.476 Radio bandwidth is managed using the radio QoS feature.

6.477 Only revertive switching mode is supported.

6.478 A Wait-to-Restore timer is used to prevent undesired protection switches for intermittent failures. The Wait-to-Restore timer is managed by the RPL Owner. It is configured by the operator in 1 minute increments between 1 and 12 minutes. The default value is 5 minutes.

6.479 A Guard Timer is used to prevent ring nodes from receiving outdated R-APS messages. During the guard timer period, all received R-APS messages are ignored by the ERP Control Process. It is configured by the operator in 10 ms increments between 10 ms and 2 seconds. The default value is 500 ms.

6.480 Ethernet traffic is managed only in 802.1Q bridging configuration.

6.481 Traffic is switched according to MAC learning.

6.482 Each Radio interface belonging to the ring is seen as a single interface in the VLAN table port membership.

6.483 In order to deliver Ethernet traffic over the Ring, the operator creates the VLAN and assigns the ring's ports as members of that VLAN.

Two ERP instances

6.484 Two ERP instances are supported on each ring's node. Each Ring Instance has its own RPL and RPL Owner. See Figure 6-37 for an example of two ERP Instances in normal operating condition.

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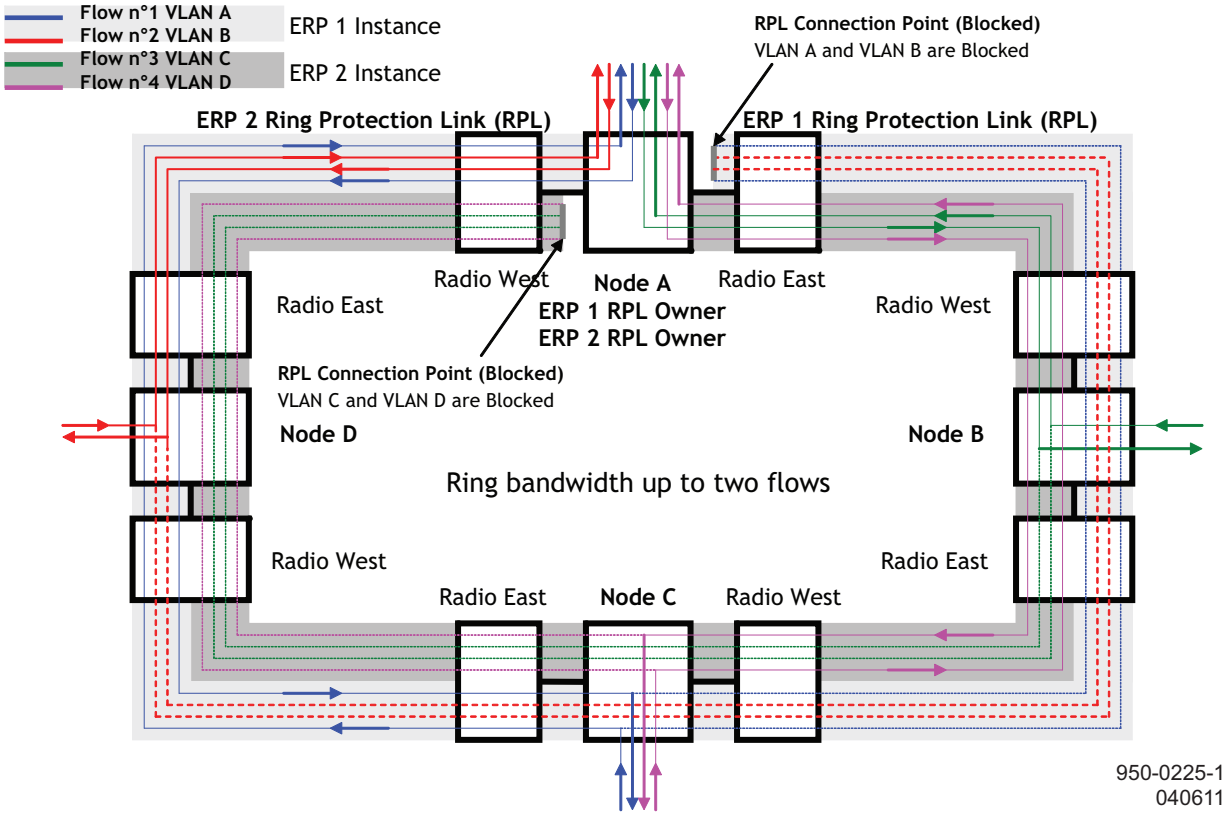
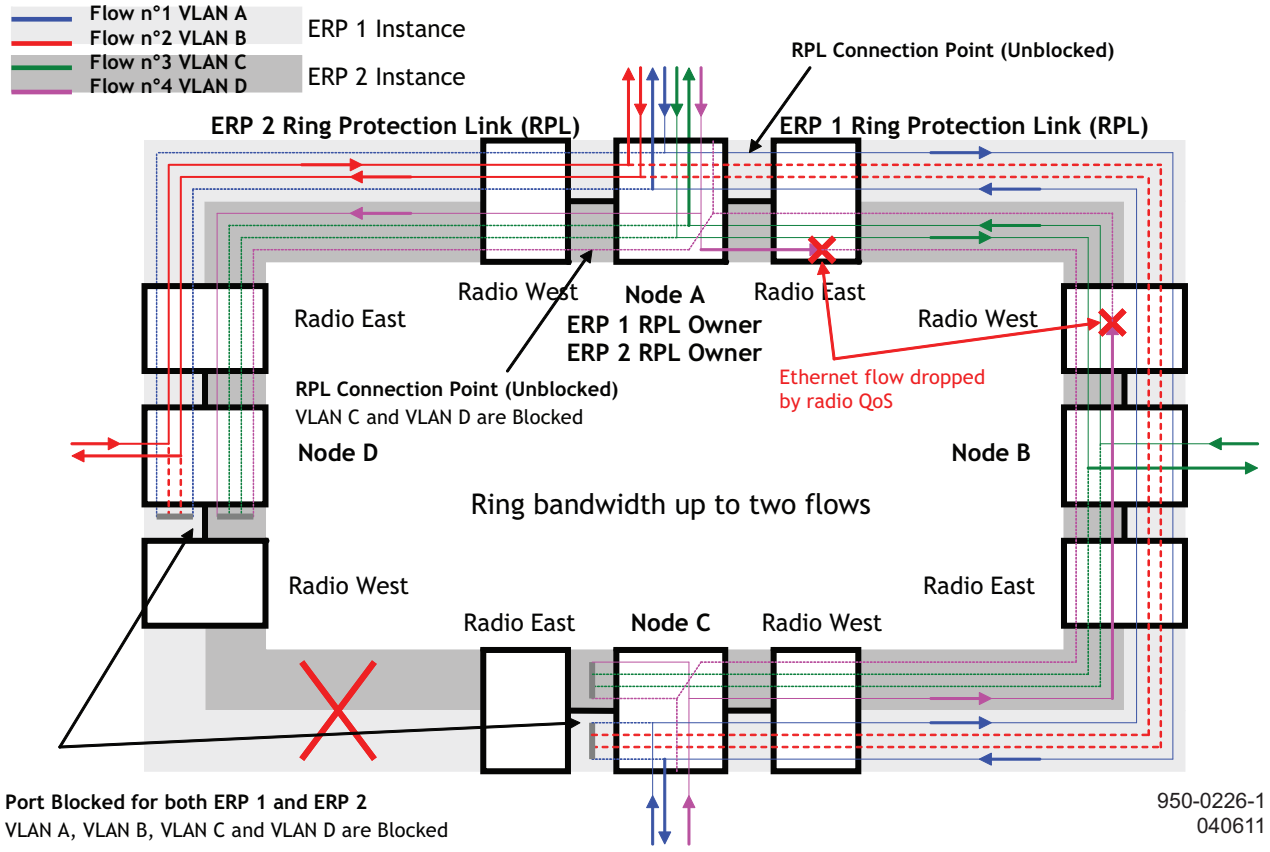
Figure 6-37. Two ERP instances, normal operation



6.485 Under a ring link failure condition, both RPL owners are responsible to unblock their RPL. The Ring Node (or nodes) which perform local detection of the signal fail condition, puts in blocking state for the set of VLANs assigned to both ERP Instances on the radio interface where the failure has been detected. Ethernet flows are managed using radio QoS. Lower priority Ethernet flows may be dropped to maintain higher priority Ethernet flows. See Figure 6-38 for an example of two ERP Instances in a link failure operating condition.

Figure 6-38. Two ERP instances, single link failure



TDM traffic

6.486 TDM traffic is switched according to cross-connections.

6.487 In normal operation, the VLAN IDs assigned to TDM traffic are cross-connected to an ERP Instance.

6.488 Under a ring link failure condition, the RPL owner is responsible to unblock its RPL. The Ring Node (or nodes) which perform local detection of the signal fail condition, puts in blocking state for the set of TDM VLANs assigned to the ERP Instance on the radio interface where the failure has been detected.

6.489 VLANs used for TDM traffic can not be used for User Ethernet traffic.

TMN

6.490 PPPoE connections are established over each ring's link.

6.491 Flooding of Ethernet frames carrying PPPoE must be avoided by sending the frame only to the relevant Ethernet switch interface facing the radio where PPP connection has to be established.

6.492 The OSPF routing protocol must be enabled on every PPP interface. The OSPF calculates the routing path breaking the loop from an IP point of view.

6.493 In case of ring link failure, the PPP connection will cause a recalculation of the OSPF topology in order to have all nodes reachable.

6.494 Static route which have PPP interfaces belonging to the ring as gateway are not supported.

6.495 The VLAN used to deliver TMN traffic is not blocked by any ERP Instance.

Jumbo frame

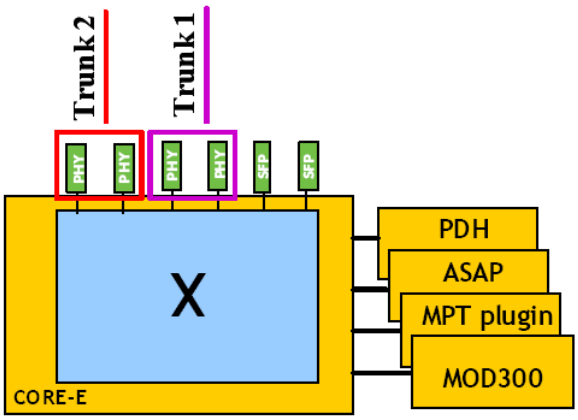
6.496 The system supports Jumbo frame lengths up to 9728 bytes with VLAN tag or 9724 without VLAN tag.

Ethernet L2 LAG

6.497 The system supports 802.1ad Ethernet Link Aggregation (L2 LAG).

6.498 User Ethernet ports (electrical or optical) on the same Core-E card can be provisioned as a member of an Ethernet L2 LAG port.

Figure 6-39. Ethernet L2 LAG block diagram



6.499 Ethernet L2 LAG ports supports a minimum of two and maximum of four user Ethernet ports.

6.500 Ethernet L2 LAG size is restricted to the following:

- up to eight Ethernet L2 LAG ports per NE
- up to four electrical Ethernet ports per Ethernet L2 LAG
- up to two optical Ethernet ports per Ethernet L2 LAG

6.501 The LACP protocol is supported.

6.502 Members of an Ethernet L2 LAG port must be:

- same media type (either all electrical or optical)
- full duplex
- a single data rate
- same data rate as all other members of the L2 LAG
- provisioned either Auto negotiations enabled or disabled on all user Ethernet ports

6.503 To add a user Ethernet port to an Ethernet L2 LAG port the user Ethernet port must NOT be provisioned as a member to any of the following:

- cross-connection
- VLAN
- port segregation

6.504 If the Ethernet ports that will be part of the Ethernet L2 LAG will be used as TMN in-band interfaces, the TMN in-band must be configured before the Ethernet L2 LAG is created. After the Ethernet L2 LAG has been created, the TMN in-band parameters cannot be changed. To change the TMN in-band parameters, the Ethernet L2 LAG must be removed.

Note: The user interfaces that are part of the Ethernet L2 LAG will not be shown in the Associated Ethernet Ports panel of the TMN in-band interface.

6.505 ALL cross-connections, VLAN, and port segregation provisioning must be removed before adding the user Ethernet port to an Ethernet L2 LAG port.

6.506 After a user Ethernet port has been added to an Ethernet L2 LAG port, the following user Ethernet port parameters may not be modified:

- Link Capacity (10, 100, 1000 Mbps)
- Duplex Mode
- VLAN 802.1Q port priority
- VLAN 802.1Q port filter mode
- Auto Negotiation Enabled/Disabled
- Disable the port
- Synchronous Ethernet Operation Mode
- SynchE Master/Slave (electrical only)
- SSM support

6.507 In 802.1Q virtual bridge mode, filter mode (acceptable frame type), Port VLAN ID, and port priority are provisioned at the L2 LAG level through the Craft Terminal.

Performance monitoring

6.508 To facilitate commissioning, remote maintenance, and troubleshooting various Ethernet PM counters are supported by the system.

6.509 The system supports Ethernet user port PM counters:

6.510 For a detailed description of radio PM, see **Performance monitoring**.

Port segregation

6.511 Port segregation provides the ability to prohibit packet flow from one port to another port.

6.512 For a detailed description of port segregation, see **Port segregation**.

Synchronous ethernet

6.513 The system supports electrical and optical Synchronous Ethernet (SyncE) signals. When SyncE is enabled on a port, the receive side extracts the frequency of the input signal and passes it to the system clock as a candidate frequency reference.

6.514 SyncE interfaces support SSM for synchronous Ethernet and ESMC processing according to ITU-T G.8264.

6.515 SyncE enabled interfaces are not supported on P8ETH Ethernet interfaces.

VLAN IDs

6.516 The system supports VLAN IDs in the range of (0-4080). VLAN IDs outside the supported range are dropped. VLAN IDs associated with TDM flows are accepted.

Managed services and profiles

6.517 Here below the association of managed services and profiles:

- **TDM2TDM** – This is the typical service associated to a traditional TDM network in which DS1 traffic is transported, switched and terminated inside a MPR network.
- **TDM2ETH** – 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 DS1 is transported, switched and provided to an external ETH network in standard format (MEF-8).
- **SDH2SDH** – This is the typical service associated to a traditional TDM network in which OC-3 traffic is transported, switched and terminated inside a MPR network.
- **ETH2ETH** – 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.

TDM2TDM

6.518 Definition: This service identifies a flow inside MPR network, in which DS1 is transported, switched and *terminated*.

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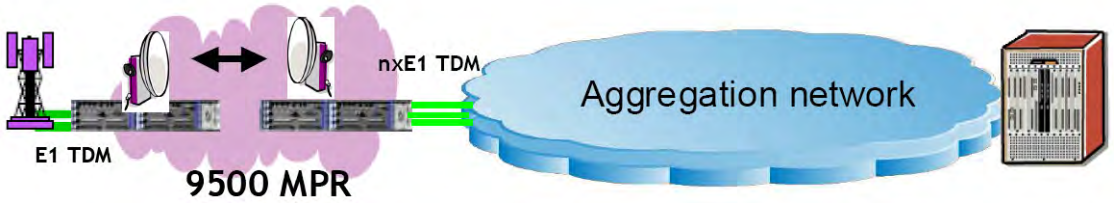
6.519 Application: Typical microwave 2G back hauling application, in which DS1s are terminated before entering into aggregation network.

Figure 6-40. TDM2TDM flow diagram



TDM2ETH

6.520 **Definition**: DS1 TDM input signals are packetized according to MEF8 standard; DS1s are transported, switched and provided to an external ETH network in standard format (MEF-8).

6.521 **Application**:

- Typical microwave 2G back hauling application, in which DS1s are terminated before entering into aggregation network, where aggregation network is a packet network. DS1s are not terminated at the end of the microwave back hauling and an end-to-end circuit emulation services could be established between 9500 MPR-A and the service router in front of BSC/RNC
- 9500 MPR-A 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 DS1 TDM) into the common Ethernet layer.

Figure 6-41. TDM2Eth flow diagram

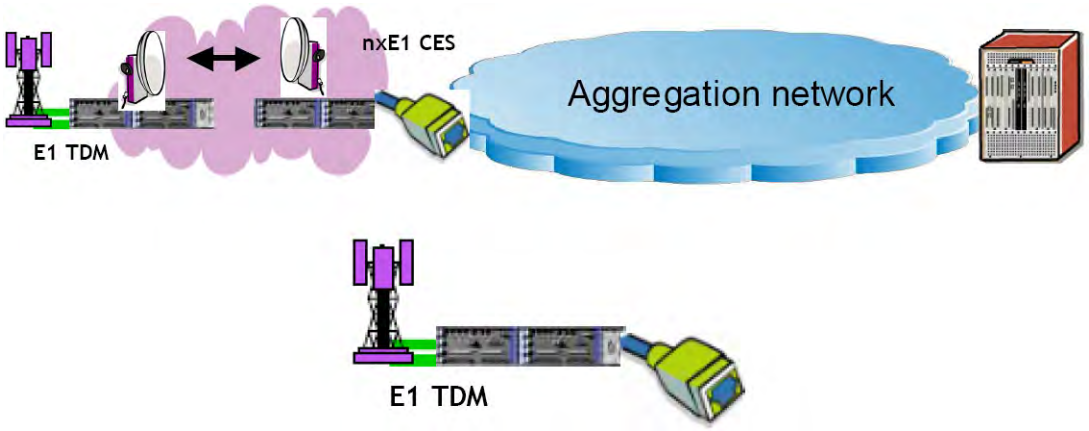
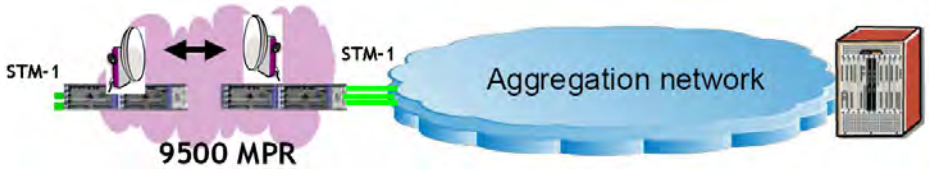


Figure 6-42. TDM to TDM STM-1 Flow Diagram



SDH2SDH

6.522 Definition: This service identifies a flow inside MPR network, in which OC-3 is transported, switched and *terminated*.

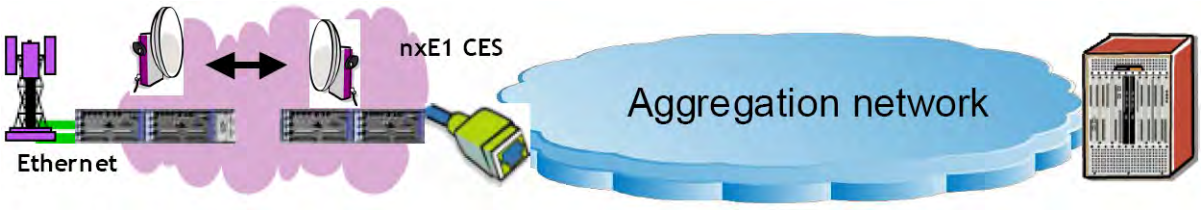
6.523 Application: Typical microwave 2G back hauling application, in which OC-3s are terminated before entering into aggregation network.

ETH2ETH

6.524 **Definition**: Ethernet traffic is transported and switched automatically by the standard auto-learning algorithm of the built-in MPR 10 Gbit Ethernet switch.

6.525 **Application**: Typical microwave 3G back hauling/WiMax application, in which transport of Ethernet packets coming from base stations is requested.

Figure 6-43. Eth to Eth flow diagram



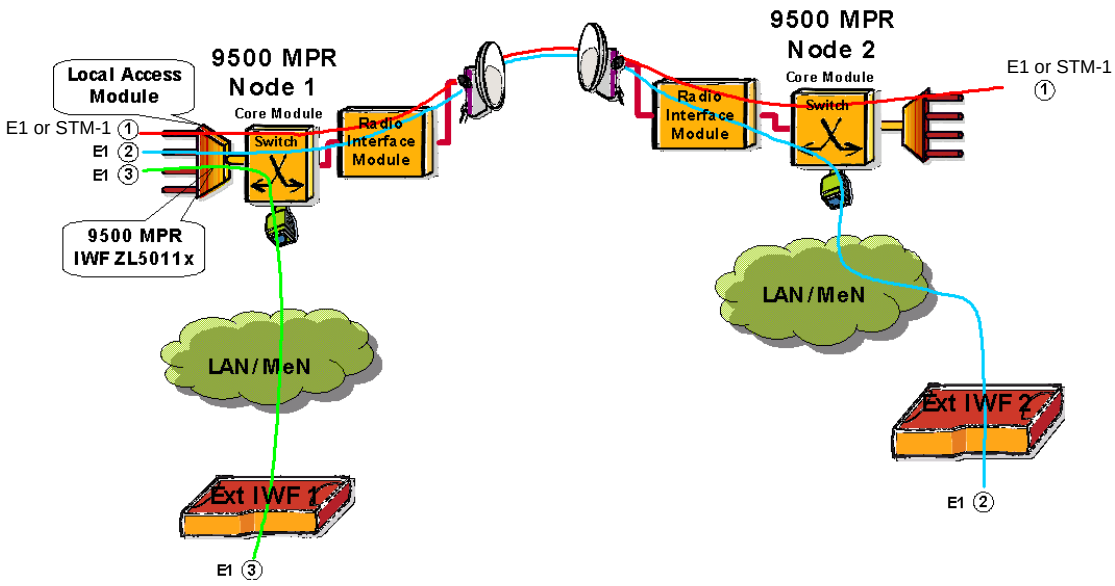
TDM and ethernet traffic management

6.526 Three kinds of traffic management have been identified:

- TDM2TDM (9500 MPR-A ⇔ 9500 MPR-A, internal to the MPR network)
- TDM2ETH (9500 MPR-A ⇔ TDM to Ethernet)
- ETH2ETH (Ethernet to Ethernet)

6.527 The first two profiles meet MEF8 standard.

Figure 6-44. Traffic profiles



Case ① for DS1/DS3 (TDM2TDM)

6.528 The DS1/DS3 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-A 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 OC-3 (SDH2SDH)

6.529 The OC-3 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-A 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 for TDM2Eth

6.530 The DS1/DS3 stream is inserted in Node 1 and extracted in Node 2. One IWF is inside the 9500 MPR-A, but the second IWF is external to the 9500 MPR-A 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 for TDM2Eth

6.531 The DS1/DS3 stream is inserted/extracted in Node 1. One IWF is inside the 9500 MPR-A, but the second IWF is external to the 9500 MPR-A 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.

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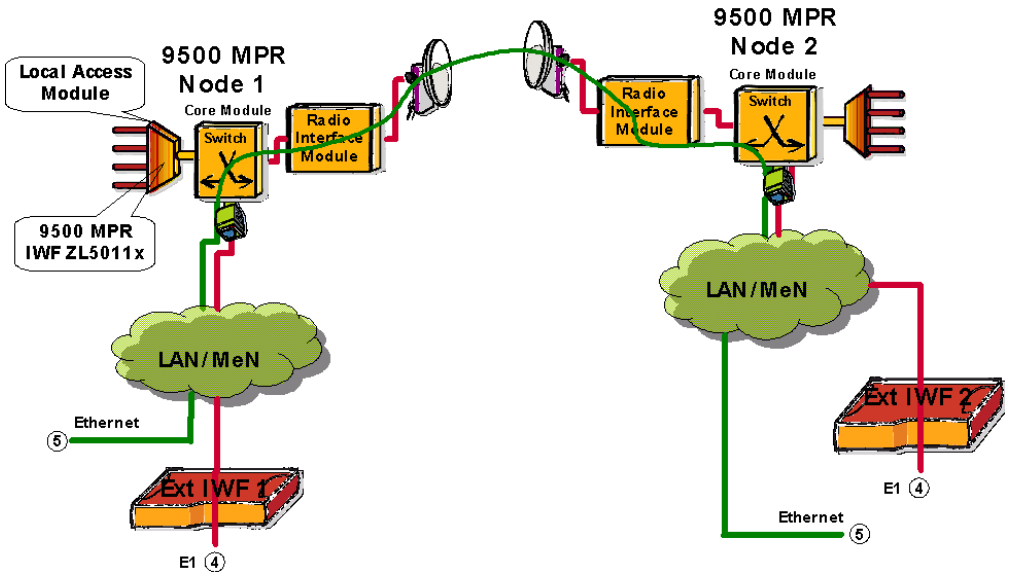
Figure 6-45. Traffic profiles



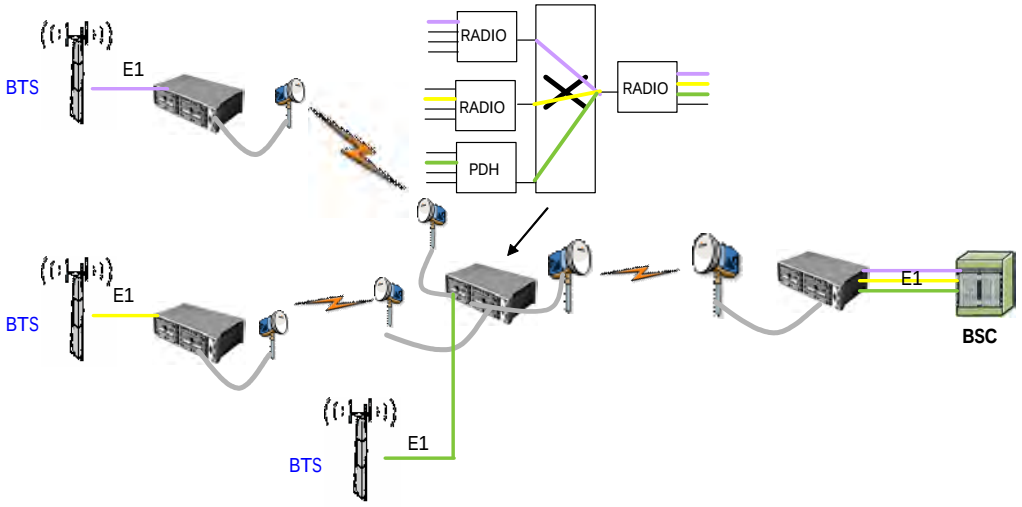
Case ④ and ⑤ for ETH2ETH

6.532 In these cases Ethernet packets enter Node 1 and are extracted in Node 2. In case 4 the Ethernet packets encapsulate the DS1/DS3 stream; in case 5 the packets are native Ethernet packets. None of the IWFs belongs to the 9500 MPR-A 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-A Ethernet switch.

TDM2TDM

6.533 DS1 traffic packetized only internally to 9500 MPR-A equipment.

Figure 6-46. TDM2TDM E1/DS1/DS3 traffic



6.534 Flow Id present (user defined)

6.535 Intermediate node configuration (E1/DS1/DS3 provisioning):

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

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

6.537 No flooding-auto learning necessary

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

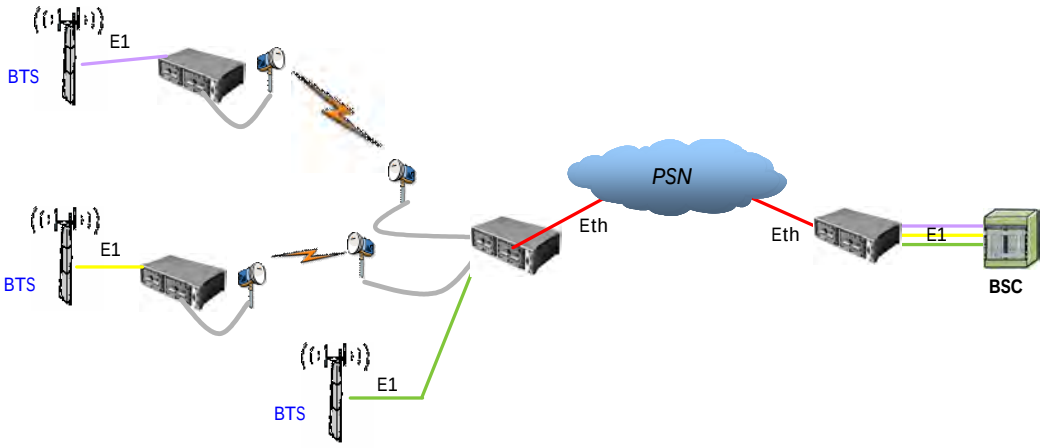
6.539 The IWF parameters listed above, have predetermined values and don't need to be provisioned.

- 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

TDM2Eth

6.540 DS1 traffic both internal and external to 9500 MPR-A equipment.

Figure 6-47. TDM2Eth E1/DS1/DS3 traffic



6.541 Flow Id present (user defined)

6.542 All the parameters must be configured compliant with the MEF8 standard

6.543 Adaptive or differential clock recovery supported

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

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

6.546 Only one of the IWFs belongs to 9500 MPR-A and the packets are supposed to exit the 9500 MPR-A 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 DS1/DS3 flow)

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

SDH2SDH

6.548 OC-3 (STM-1) traffic both internal and external to 9500 MPR-A equipment.

Figure 6-48. SDH2SDH OC-3 traffic

6.549 Flow Id present (user defined)

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

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

6.552 No flooding-autolearning necessary

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

6.554 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

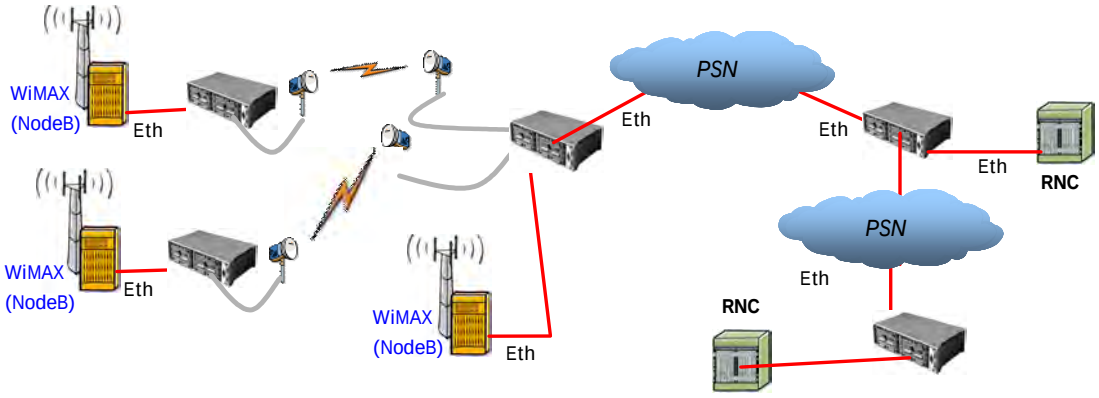
– Flow Id provisioned by ECT/NMS

ETH2ETH

6.555 None of the IWFs belongs to 9500 MPR-A.

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

Figure 6-49. Eth2Eth DS1/DS3 traffic



6.557 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.

Traffic interfaces

6.558 The system supports the following traffic interfaces:

- Core-E
- DS1 PDH interface (P32E1DS1)
- DS3 PDH interface (P2E3DS3)
- OC-3 SDH interface (SDHACC)
- Ethernet access switch (P8ETH)
- MODEM 300 radio interface (MOD300)
- MPT access (MPTACC)

Core-E

6.559 The Core-E, Control Switching Module card provides six user Ethernet interfaces, up to four 10/100/1000BaseT electrical Ethernet Interfaces, up to two 1000 Base-X (GigE) SFP Ethernet interfaces, the local WebEML interface, and local debug interface.

6.560 The Core-E card has two roles, main and spare Core-E.

6.561 The main Core-E performs key node management, control functions, provisioning, configuration management, and cross-connection matrix. The matrix is a standard Ethernet switch based on VLAN. The card also houses a plug-in flash card which stores node configuration and license data. The main Core-E card is required.

6.562 The spare Core-E card provides aggregate traffic and control platform protection. The spare Core-E card is optional.

10/100/1000 Base-T ethernet interfaces

6.563 Four 10/100/1000Base-T interfaces provide access for traffic, data, or MPT-HC/XP connections.

GigE SFP ethernet interfaces

6.564 Two GigE SFP Ethernet interfaces are 1000 Base-X, Base-T, or copper cable access for traffic, data, or MPT-HC/XP connections.

MPT-HC/XP radio interface

6.565 The 10/100/1000 BaseT Ethernet interfaces support connectivity for up to four 1+0 MPT-HC/XP ODUs.

6.566 The GigE SFP interfaces support connectivity for up to two 1+0 MPT-HC/XP ODUs.

2xDS1 SFP

6.567 The 2xDS1 SFP supports two MEF8 circuit emulation DS1 tributaries. Is 1000Base-X optical SFP compliant. Manages the encapsulation/reconstruction of PDH data to/from standard Ethernet packets, and sends/receives standard Ethernet packets to/from Core-E switch fabric.

6.568 The system supports up to two 1+0 unprotected 2xDS1 SFPs (4 DS1s) per node.

6.569 The 2xDS1 SFP supports:

- Differential Clock Recovery
- Node timing
- Loop timing

6.570 The 2xDS1 is Synchronous Ethernet capable and can deliver the clock recovered from one of the two tributaries to the CSM-E card through the standard SFP pin-out.

6.571 Supports TDM2TDM and TDM2ETH services.

DS1 PDH interface

6.572 The P32E1DS1, DS1 PDH Interface card is a transport card which provides the external interfaces for up to 32 DS1 tributaries. Manages the encapsulation/reconstruction of PDH data to/from standard Ethernet packets, and sends/receives standard Ethernet packets to/from both Core-E cards. Supports 1+1 EPS protection switching. Contains DC/DC converter unit.

6.573 The system supports up to six 1+0 unprotected (192 DS1s) or up to 3 pairs of 1+1 EPS protected (96 DS1s) P32E1DS1 cards per MSS-8 shelf.

6.574 The system supports up to two 1+0 unprotected (64 DS1s) or up to 1 pair of 1+1 EPS protected (32 DS1s) P32E1DS1 cards per MSS-4 shelf.

6.575 System supports unframed format, Superframe Format (SF), and Extended Superframe Format (ESF) DS1 frame formats.

6.576 The system supports PM on incoming and outgoing DS1 signals. For a detailed description of DS1 PDH PM, refer to Performance monitoring.

6.577 The system supports insertion of AIS upon detection of Loss of Frame (LOF) on DS1 inputs and outputs. This behavior is provisionable enable or disable at the NE level.

DS3 PDH interface

6.578 The P2E3DS3, DS3 TDM Interface card is a transport card which provides the external interfaces for up to 2 DS3 tributaries. Manages the encapsulation/reconstruction of PDH data to/from standard Ethernet packets, and sends/receives standard Ethernet packets to/from both Core-E cards. Supports 1+1 EPS protection switching. Contains DC/DC converter unit.

6.579 The system supports up to six 1+0 unprotected (12 DS3s) or up to 3 pairs of 1+1 EPS protected (6 DS3s) P2E3DS3 cards per MSS-8 shelf.

6.580 The system supports up to two 1+0 unprotected (4 DS3s) or up to 1 pair of 1+1 EPS protected (2 DS3s) P2E3DS3 cards per MSS-4 shelf.

6.581 System supports unframed clear channel and framed clear channel Format for Loss Of Frame (LOF) detection DS3 frame formats.

OC-3 SDH interface

6.582 The SDHACC, OC-3 TDM Interface card is a transport card which provides the external interfaces for up to 2 OC-3 tributaries. Manages the encapsulation/reconstruction of SDH data to/from standard Ethernet packets, and sends/receives standard Ethernet packets to/from both Core-E cards. Supports 1+1 EPS protection switching. Contains DC/DC converter unit.

6.583 The system supports up to six 1+0 unprotected (12 OC-3s) or up to 3 pairs of 1+1 EPS protected (6 OC-3s) SDHACC cards per MSS-8 shelf.

6.584 The system supports up to two 1+0 unprotected (4 OC-3s) or up to 1 pair of 1+1 EPS protected (2 OC-3s) SDHACC cards per MSS-4 shelf.

Ethernet access switch

6.585 The Ethernet Access Switch (P8ETH) card provides user interfaces for four 10/100/1000BaseT Ethernet Interfaces and four GigE SFP Ethernet interfaces or MPT-HL radio interfaces.

6.586 The system supports up to six 1+0 unprotected or three pairs of stacked P8ETH cards per MSS-8 shelves.

6.587 The system supports up to two 1+0 unprotected or 1 pair of stacked P8ETH cards per MSS-4 shelves.

10/100/1000Base-T ethernet interfaces

6.588 Four 10/100/1000Base-T interfaces provide access for traffic or data connections.

GigE SFP ethernet interfaces

6.589 Four GigE SFP Ethernet interfaces are 1000 Base-X, Base-T, or copper cable access for traffic, data, or MPT-HL connections.

MPT-HL radio interface

6.590 The GigE SFP interfaces support connectivity for up to four MPT-HLs per P8ETH card.

MODEM 300 radio interface

6.591 The MOD300, Modem Radio Interface card is a transport card which provides connectivity to ODU300 RF transceivers. Manages the modulation/demodulation of IF signal to/from ODU300, and sends/receives standard Ethernet packets to/from both Core-E cards. Supports 1+1 EPS, HSB, and RPS protection switching. Contains DC/DC converter unit.

6.592 The system supports up to six 1+0 unprotected radios or up to 3 pairs of 1+1 protected radios per MSS-8 shelf.

6.593 The system supports up to two 1+0 unprotected radios or up to 3 pairs of 1+1 protected radios per MSS-4 shelf.

MPT access

6.594 The MPT Access card is a transport card which provides Ethernet connectivity for up to two MPT-HC/XP transceivers. Connectivity is accomplished using either two 10/100/1000Base-T interfaces, two GigE SFP interfaces, or one of each.

6.595 The MPT Access card provides power to the MPT-HC using either Power over Ethernet (PFoE) solution or a dedicated coaxial connection.

Power

6.596 The system supports the following power interfaces:

- Power injector box

- MPT power unit
- MPT Extended Power Unit

Power injector card

6.597 The Power Injector card is installed in the MSS-4/8 slot. The card combines DC battery and Ethernet connections for interconnections with MPT-HC for interconnection between MSS-4/8 Core-E Ethernet ports.

Power injector box

6.598 The Power Injector box mounts to the rack. The box combines DC battery and Ethernet connections for interconnections with MPT-HC for interconnection between MSS-4/8 Core-E Ethernet ports. Power connections A & B connect directly to battery supply.

MPT power unit

6.599 The MPT Power Unit mounts to the rack and remotely powers four external MPT-HC ODUs through N-connector cables.

MPT Extended Power Unit

6.600 The MPT Extended Power Unit mounts to the rack and feeds power to up to two MPT-HC/XP ODUs. Compared to the standard power bar, the MPT Extended Power Unit offers the following additional features:

- Galvanic Isolation between Battery Input and ODU Power Output
- Output voltage stabilized at -57V
- Power Input capability for the following voltages:
  - +20.4VDC to +28VDC
  - -57.6VDC to -38.4VDC
- Output Power available by means of both N-Connectors and RJ-45 Connectors
- Use of the RJ-45 connectors to establish an Ethernet data link connection between IDU and ODU.

PRELIMINARY

Configurations

6.601 Refer to table 6-M for descriptions of the modular configurations the system supports.

Table 6-M. Configurations

ITEM	DESCRIPTION
Microwave Switching Services (MSS-8) Shelf PN: 3DB18001AA Qty: 1 per node	The MSS-8 houses equipment that supports 10 Gb/s packet switching, synchronization, protection switching, provisioning, and alarm management utilizing either one Core-E card in unprotected configuration or two Core-E cards in protected configuration. Six transport slots support any mixture of unprotected and/or 1+1 EPS protected transport cards. Supported transport types include: up to six P8ETH (Ethernet) cards, up to six P32E1DS1 (DS1) cards, up to six P2E3DS3 (DS3), up to six SDHACC (OC-3), up to six MOD300 (radio), and/or up to six MPTACC (radio) cards. One fan card is required for system cooling.
Microwave Switching Services (MSS-4) Shelf PN: 3DB18219AB Qty: 1 per node	The MSS-4 houses equipment that supports 10 Gb/s packet switching, synchronization, protection switching, provisioning, and alarm management utilizing either one Core-E card in unprotected configuration or two Core-E cards in protected configuration. Two transport slots support either unprotected and/or 1+1 EPS protected transport cards. Supported transport types include: up to two P8ETH (Ethernet) cards, up to two P32E1DS1 (DS1) cards, up to two P2E3DS3 (DS3), up to two SDHACC (OC-3), up to two MOD300 (radio), and/or up to two MPTACC (radio) cards. One fan card is required for system cooling.
Microwave Packet Transport-Long Haul (MPT-HL) Shelf PN: 3EM22618AA Qty: Up to 4 per 9500 MPR-A node	The MPT-HL shelf supports Two MPT-HL transceiver radio cards.
Transport cards	Thirty-two port P32E1DS1 for DS1(T1) interface Two port P2E3DS3 for DS3(T3) interface Two port SDHACC for OC-3 interface Eight port P8ETH for 10,100,1000,GigE Ethernet Ports
I/O interface types	DS1, DS3, OC-3, Ethernet

Table 6-M. Configurations (cont.)

ITEM	DESCRIPTION
Battery feeds	Independent, redundant battery feeds Independent, isolated battery returns
Power supply redundancy	1:1 protected
Bay power distribution	PDU

MSS-8 shelf configurations

6.602 MSS-8 shelf has a modular design: Consists of backplane, card cage, and nine front access card slots. Two slots are dedicated for the Core-E, Control Switching Module (Core-E) Six slots are dedicated for Transport, Auxiliary or Power Converter cards. One slot is dedicated for the FAN card. See Figure 6-50 for a front view of the MSS-8 shelf.

Figure 6-50. MSS-8 shelf - front view

6.603 MSS-8 shelf slot 1 is dedicated to the main Core-E card and is required in every application. See figure 6-51 to see an example of the unprotected Core-E configuration.

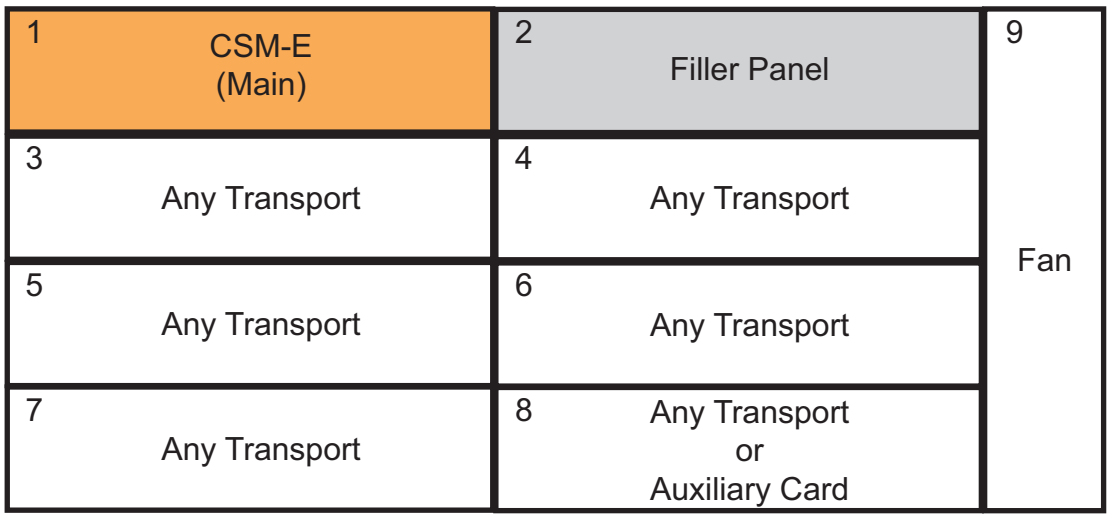
6.604 Slot 2 is dedicated for an optional spare Core-E card for protected Core-E configurations. See Figure 6-52 to see an example of the MSS-8 protected Core-E configuration.

6.605 Slots 3 through 8 support any Transport cards, MPTACC, MOD300, P2E3DS3, P32E1DS1, SDHACC, and P8ETH cards. Slot 8 supports the Auxiliary card. Power Converter card is supported in slots 4, 6, and 8, one per shelf.

6.606 Unprotected 1+0 transport cards are supported in any slots 3 through 8. Protected 1+1 transport cards are horizontally located. The main transport cards are located in slots 3, 5, and 7 and the spare transport cards are located in slots 4, 6, and 8 respectively.

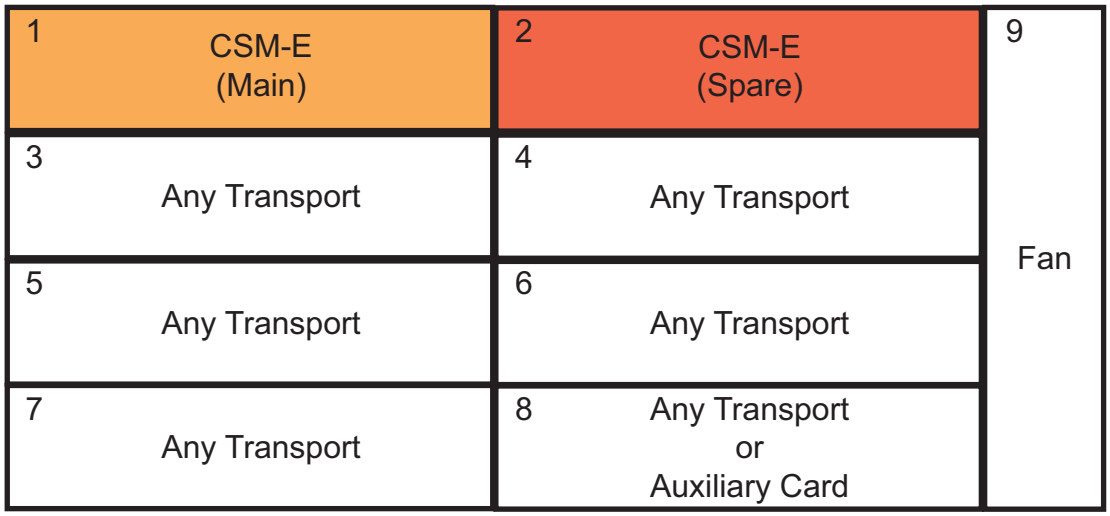
PRELIMINARY

Figure 6-51. MSS-8 shelf, unprotected Core-E configuration



950-0006-2
091410

Figure 6-52. MSS-8 shelf, protected Core-E configuration

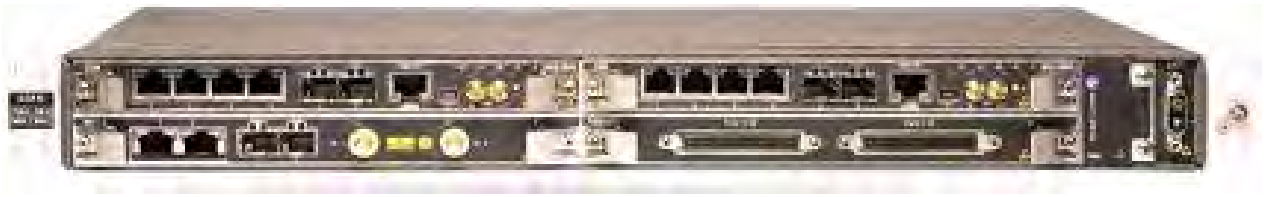


950-0005-3
091410

MSS-4 shelf configurations

6.607 MSS-4 shelf has a modular design: Consists of backplane, card cage, and five front access card slots. Two slots are dedicated for the Core-E, Control Switching Module (Core-E). Two slots are dedicated for Transport cards and one slot supports the Auxiliary card. One slot is dedicated for the FAN card. See Figure 6-53 for a front view of the MSS-4 shelf.

Figure 6-53. MSS-4 shelf - front view



6.608 MSS-4 shelf slot 1 is dedicated to the main Core-E card and is required in every application. See figure 6-54 to see an example of the unprotected Core-E configuration.

6.609 Slot 2 is dedicated to an optional spare Core-E card for protected Core-E configurations. See Figure 6-55 to see an example of the MSS-8 protected Core-E configuration.

6.610 Slots 3 and 4 support any Transport cards, MPTACC, MOD300, P2E3DS3, P32E1DS1, SDHACC, and P8ETH. Slot 4 supports the Auxiliary card.

6.611 Unprotected 1+0 transport cards are supported in both slots 3 and 4. Protected 1+1 transport cards are horizontally located. The main transport card is located in slot 3 and the spare transport card is located in slot 4 respectively.

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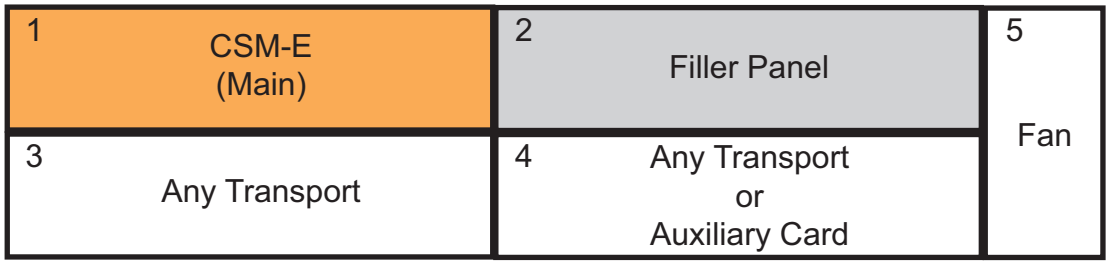
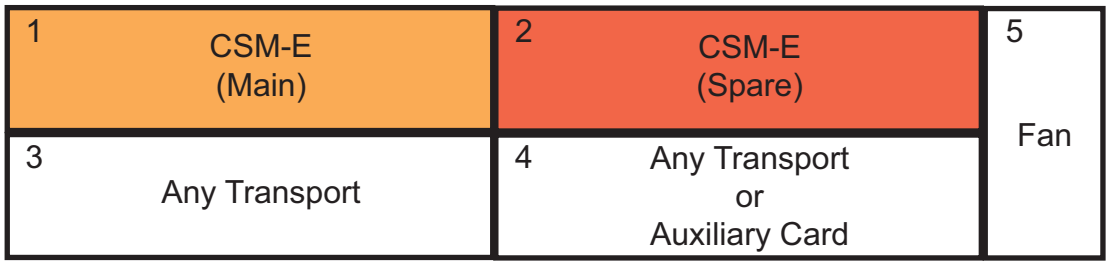
Figure 6-54. MSS-4 shelf, unprotected Core-E configuration



950-0049-1
030311

Figure 6-55. MSS-4 shelf, protected Core-E configuration



950-0023-1
091410

Stand alone MSS-4/MSS-8 shelf

6.612 MSS-4/8 may be deployed in standalone configuration and provides up to 16 Gb/s packet aggregation for DS1, DS3, OC-3, and Ethernet traffic.

Stacking MSS-4/MSS-8 shelf configuration

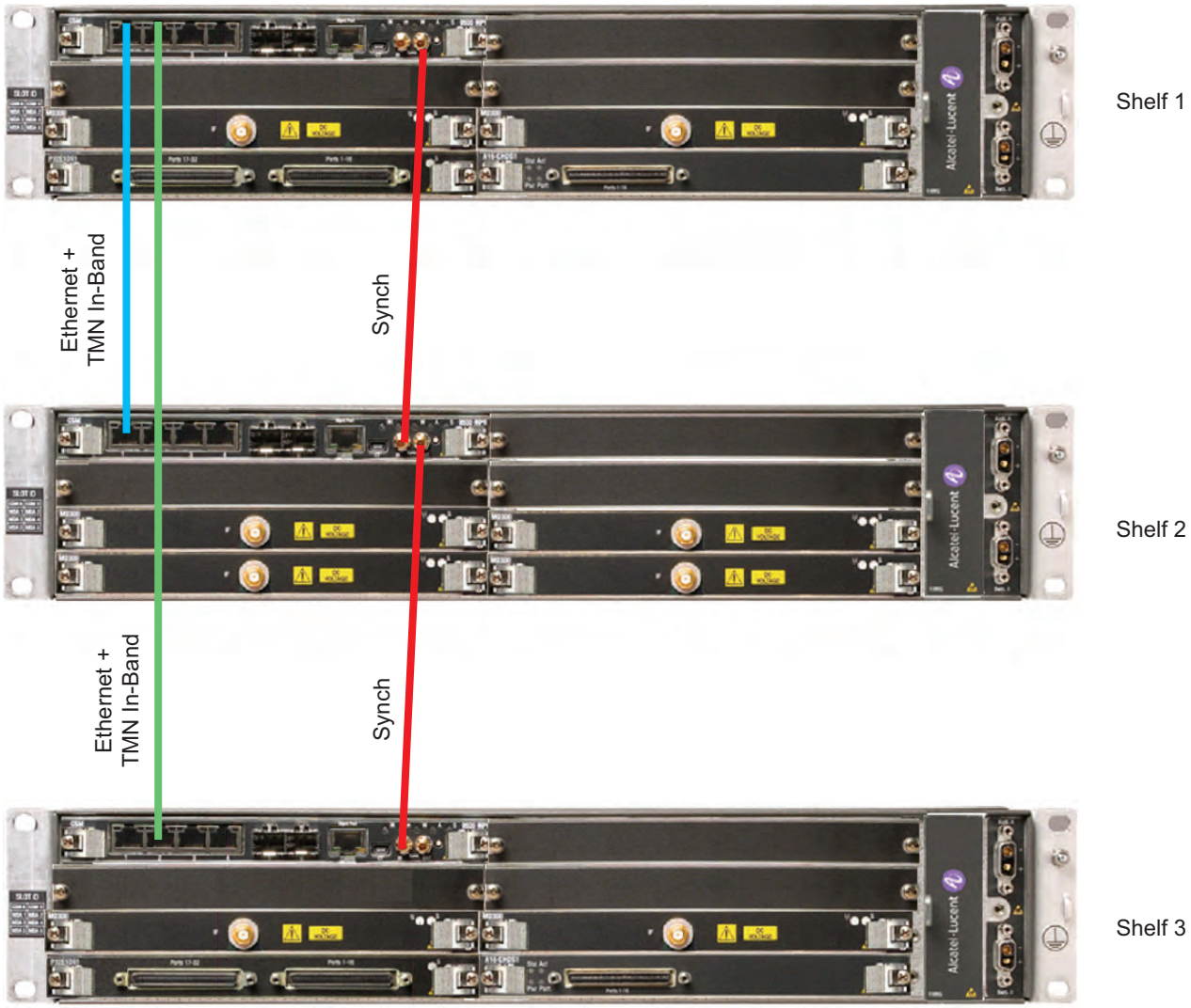
6.613 To manage more directions the “Stacking configuration” can be realized by installing up to 3 MSS-4/MSS-8 shelves, interconnected through the Ethernet ports and Synchronization ports on the Core-E cards. An example of three stacked MSS-8 shelves equipped with unprotected Core-E cards is shown in Figure 6-56. An example of three stacked MSS-8 shelves equipped with protected Core-E cards is shown in Figure 6-57.

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

6.615 With Core-E protection a maximum of three MSS-4/MSS-8 shelves can be interconnected as shown in Figure 6-57.

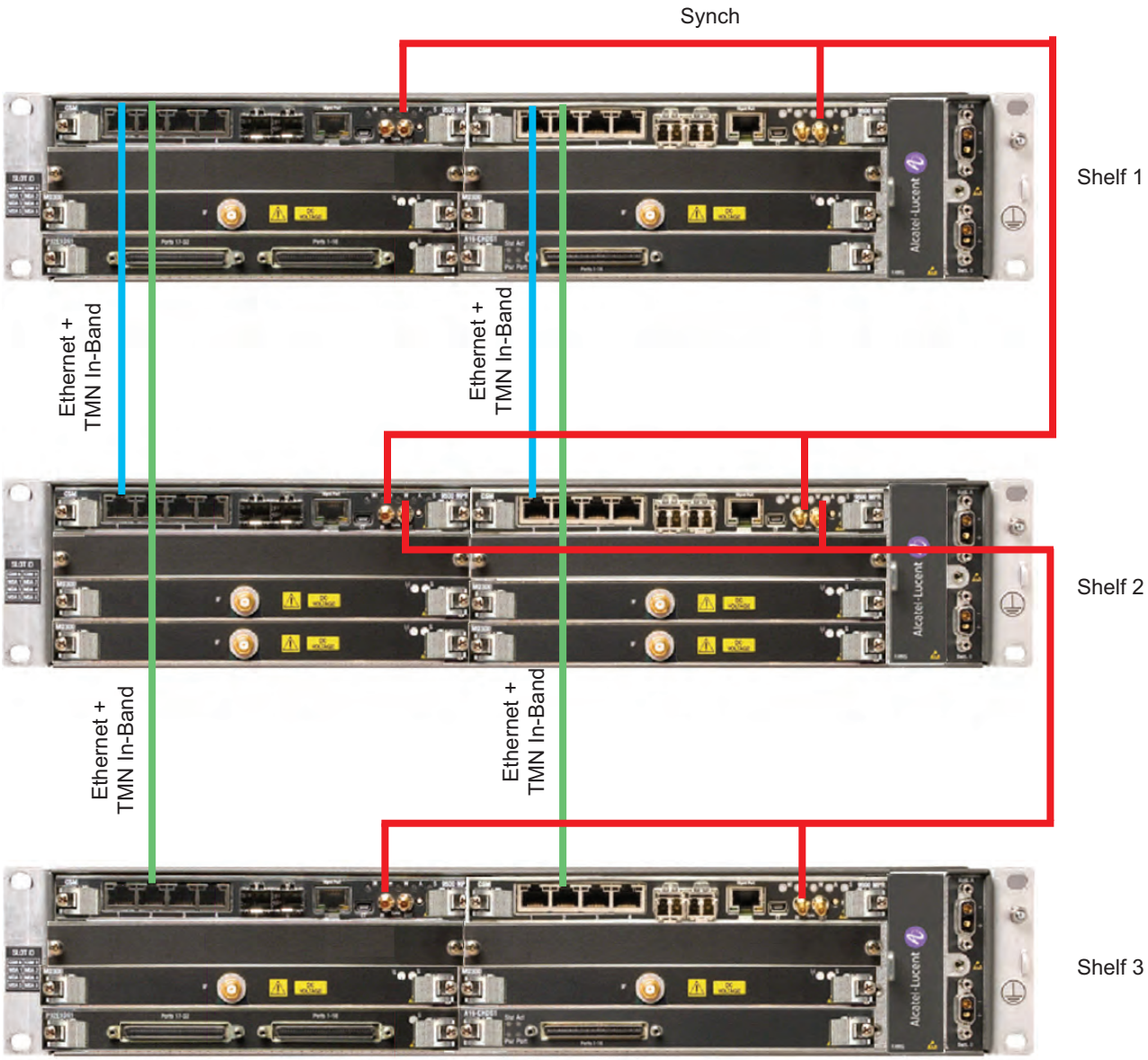
6.616 To implement this configuration the LOS alarm on the Ethernet ports must be enabled as switching criterion for Core-E protection. To enable this functionality the "Ethernet LOS Criteria" feature must be enabled.

Figure 6-56. Stacking configuration with 3 MSS-8, unprotected Core-E cards



PRELIMINARY

Figure 6-57. Stacking configuration with 3 MSS-8, protected Core-E cards



Alarm management

Alarm Monitor Tool

6.617 TBA

6.618 TBA

DHCP server support

System Alarms

6.619 The alarm LEDs on the.

6.620 System alarms indicate detection of faults in the system, local office, or network. The system provides the following fault indications:

- Visible indicators on the equipment
- Contact closures that can be connected to an external alarm system

6.621 The system logs all alarm and status information and maintains the status of current active alarms in the system status database. Summaries of active alarms can be retrieved on command. Alarms are reported automatically to network management equipment.

6.622 The system logs all alarm and status information and maintains the status of current active alarms in the system status database. Summaries of active alarms can be retrieved on command and displayed at the Craft. Alarms are reported automatically to network management equipment.

Equipment Alarms

6.623 The equipment alarms

Facility Alarms

6.624 Facility alarms indicate failures of a DS1 and/or Ethernet. Facility alarms and parameters can be established individually. Notification codes follow:

- Critical (CR)
- Major (MJ)
- Minor (MN)
- Cleared (CL)

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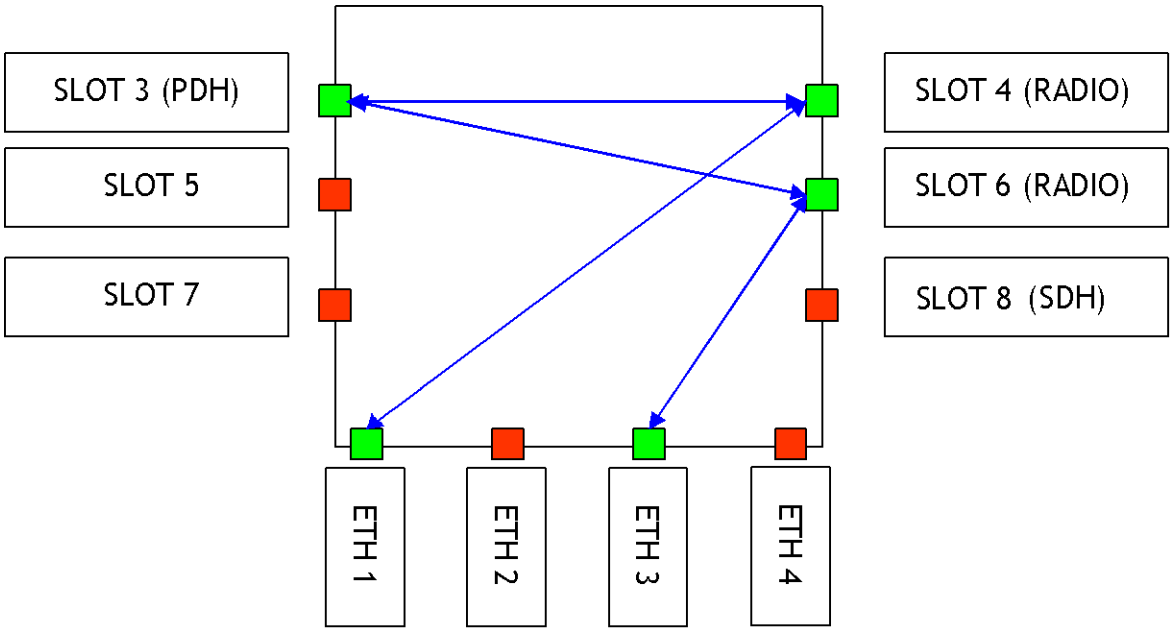
Housekeeping alarms

Cross-connections

6.625 The cross-connections between slots and between slot and Ethernet user ports are realized with a Layer-2 Ethernet Switch inside the Core-E unit.

6.626 The decision made by the switch to forward the received packet is based on the destination MAC address.

Figure 6-58. Cross-connection



DS1/DS3 Cross-connections

6.627 Each DS1/DS3 can be cross connected independently.

6.628 DS1/DS3s can be cross connected to the following interfaces:

- Radio interface
- Ethernet interface

6.629 Each DS1/DS3 (board #, port #) must be associated to an unique signal flow ID.

OC-3 Cross-connections

6.630 Each OC-3 can be cross connected independently.

6.631 OC-3s can be cross connected to Radio interface.

6.632 Each OC-3 (board #, port #) must be associated to an unique signal flow ID.

Radio-radio cross-connections

6.633 Ethernet frames, coming from a radio direction, can be cross-connected to another radio direction.

Ethernet cross-connections

Generic ethernet flows

6.634 All flows different from the TDM2TDM, TDM2ETH, and SDH2SDH ones are managed as the standard Ethernet packets: if the 802.1Q is enabled the related management is performed looking the VLAN and then, according to the destination address, each packet is switched to the correct port: radio, user Ethernet, or DS1. If the 802.1D is enabled only the destination MAC address is considered.

6.635 For each radio interface, the bandwidth assigned, globally, to the Ethernet traffic is the consequence, with a given radio capacity, of the number of DS1s cross-connected on that radio interface. Hence the available bandwidth for Ethernet flows will be the configured radio bandwidth decreased by bandwidth used by TDM2TDM, TDM2ETH, and SDH2SDH traffic flows.

Database backup and restore

6.636 The system supports a full database backup and restore from the Craft Terminal or network manager, including provisioning and configuration information stored on the NE.

External Communications

6.637 TBA

- TMN Port

- Local Access Port
- TMN In-Band Ports
- Event Log Browser

SNMP Management

6.638 TBA

SNMP v2

- Alcatel-Lucent 5620 SAM
- Alcatel-Lucent 1340 INC Support
- Alcatel-Lucent 1350 OMS Support
- Alcatel-Lucent 1352 Compact
- Alcatel-Lucent TSM8000 Support

Craft OS Support

6.639 TBA

Web Interface

6.640 TBA

Web browser support

6.641 TBA

In-service upgrade

6.642 Systems software and hardware can be upgraded to a new release, as specified in the upgrade procedure. The upgrade procedure can be completed in less than four hours and within one maintenance window. Default values used when upgrading to are defined for all new provisioning parameters.

6.643 The system saves and maintains the content of the customer's existing generic database through the upgrade process, including the alarm database and all provisioning. Historical PM data and the log file are not preserved.

6.644 Software upgrade to version R4.1.0 is supported. Refer to Table 6-N for supported software upgrade paths based on existing software versions.

Table 6-N. Software upgrade paths to R4.1.0

SOURCE RELEASE	UPGRADE PATH
R1.02.x[1]	R1.2.x > R3.1.0 > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R2.0.x	R2.0.x > R2.1.0 > R2.2.1 > R3.1.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R2.1.0	R2.1.0 > R2.2.1 > R3.1.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R2.2.3	R2.2.3 > R3.2.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R2.2.x	R2.2.x > R3.1.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R3.0.x	R3.0.x > R3.3.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R3.1.x	R3.1.x > R3.2.x/R3.3.x/R3.4.x > R4.0.x
R3.2.x	R3.2.x > R4.0.x
R3.3.x	R3.3.x > R4.0.x
R3.4.x	R3.4.x > R4.0.x

[1] Upgrade from R1.2.x to R3.1.0 requires replacement from CORE-B card to CORE-E card.

LAG (link aggregation group)

LAG overview

6.645 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.

6.646 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.

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

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

6.649 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.

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

6.651 Supported LAG ID numbers are 1 to 14.

L2 LAG hashing

6.652 L2 LAG hashing provides two different traffic load balancing algorithms configured on the LAG: Layer2 (L2 Hash) and Layer3 (L3 Hash).

- L2 Hash (load balancing algorithm is based on fields contained in the Ethernet MAC frame header:
  - Destination MAC Address + Source MAC Address + VLAN ID + EtherType + Ethernet Switch Source Port
  - Destination MAC Address + Source MAC Address + Ethernet Switch Source Port (for Multicast, Broadcast, and Unknown traffic)
- L3 Hash (load balancing algorithm is based on fields contained in the IP frame header and TCP/UDP ports):
  - Destination MAC Address + Source MAC Address + TCP/UDP Destination Port + TCP/UDP Source Port
  - Destination MAC Address + Source MAC Address (for Multicast IP traffic)
- If the frame is not IP and Destination and Source IP Addresses are not available, Destination MAC Address + Source MAC Address are used to evaluate the traffic distribution.

The chosen algorithm applies only to traffic learnt by the switch.

6.653 The same interface will be used for all packets in Ethernet flow. Traffic from the same flow is not evenly distributed over all the interfaces. Even if multiple physical interfaces are used at the same time for traffic forwarding, it is not guaranteed at all to have a complete and full load balance on ports in L2 LAG. This means that a single physical port can be overloaded in L2 LAG and consequently discards all traffic in excess (according to QoS priorities) even when other physical ports in the L2 LAG have residual bandwidth not exploited.

6.654 Neither Revertive nor Not Revertive behavior can be associated to frame distribution performed by the hashing function. It is not guaranteed that the association of a traffic flow to a specific interface is maintained when the interface has been removed from L2 LAG due to a failure and then re-inserted in the L2 LAG due to the clear of the failure.

L1/L2 link aggregation on radio ports (radio L1/L2 LAG)

6.655 Link aggregation can be applied to radio ports, in this case it is named Radio L1/L2 Link Aggregation (Radio L1/L2 LAG).

6.656 For a detailed description of Radio L1 LAG, refer to **Radio L1 LAG**.

6.657 For a detailed description of Radio L2 LAG, refer to **Radio L2 LAG**.

L2 Link aggregation on user ethernet ports (ethernet L2 LAG)

6.658 User Ethernet ports (electrical or optical) on the same Core-E card can be provisioned as a member of an Ethernet L2 LAG port.

6.659 For a detailed description of Ethernet L2 LAG, refer to **Ethernet L2 LAG**.

License key management

6.660 License Key Management provides the mechanism to enable features on the basis of the customer needs, considering a predefined set of different functionalities as different elementary licenses. A set of key features is identified and each one of them is associated to one elementary license, giving the possibility to add features in an incremental approach.

6.661 The management of the license key is managed utilizing the following items:

- **RMU Serial Number**: The Serial Number of the Flash Card (read-only field)
- **License String**: The license string displays the set of key features supported by the NE (read-only field)
- **License Key**: This field is used to upgrade the license string

6.662 Provisioning the RMU Serial Number, License String, and License Key are supported from the Craft Terminal.

6.663 The RMU Serial Number and License String are viewable from the Web Server.

License String

6.664 There are five unique Elementary Licenses (EL) available to construct the License String. The loaded License String determines the provisionable features on the NE. The available ELs are as follows:

- Transmission Capacity
- Unlicensed Option
- Adaptive Modulation
- Data Awareness
- ERPS

Transmission Capacity

6.665 Transmission Capacity defines the maximum net Ethernet throughput for the radio interface. Ethernet throughput is based on the radio profile's channel spacing and modulation technique selected. Ethernet throughput is rounded to the nearest 10 Mbps to determine the minimum required Transmission Capacity EL. The Transmission Capacity EL consists of two parts, number of radio interfaces and maximum net Ethernet throughput. Up to eighteen radio interfaces may be licensed with one Transmission Capacity EL.

6.666 There are five levels of Transmission Capacity supported. Transmission Capacity uses the following format: *YCapXXX*, where 'Y' equals the number of radio interfaces licensed and 'XXX' equals the maximum throughput of the radio interface(s). The supported Transmission Capacity throughputs are as follows:

- 40 Mbps: Format: YCap040. Example: *1Cap040* means only one license available for radio interface capacity up to 40 Mbps.
- 80 Mbps: Format: YCap080. Example: *3Cap080* means three licenses available for radio interface capacities up to 80 Mbps.
- 120 Mbps: Format: YCap120. Example: *4Cap120* means four licenses available for radio interface capacities up to 120 Mbps.
- 160 Mbps: Format: YCap160. Example: *8Cap160* means eight licenses available for radio interface capacities up to 160 Mbps.
- 320 Mbps: Format: YCap320. Example: *12Cap320* means twelve licenses available for radio capacities up to 320 Mbps.

6.667 More than one Transmission Capacity EL is supported in a single license string. Example: *4Cap080/2Cap160/TDM2ETH* means four licenses available for radio interface capacities up to 80 Mbps and two licenses available for radio interface capacities up to 160 Mbps.

Unlicensed Option

6.668 Unlicensed Option EL restricts the usage of Transmission Capacity license(s) to the unlicensed band (5725 to 5875 MHz). Unlicensed Option EL uses the following format: *YUnlOpt*, where 'Y' equals the number of radio interfaces restricted to unlicensed radio profile(s), up to the total of Transmission Capacity licenses available. When no Unlicensed Option EL is present, none of the available Transmission Capacity licenses are restricted to the unlicensed band. The following are examples of license strings with and without Unlicensed Option LE:

- *4Cap160/TDM2ETH*; means four licenses available for radio interface capacities up to 160 Mbps, none are restricted to the unlicensed band.
- *6Cap080/2Cap320/TDM2ETH/2UnlOpt*; means six licenses available for radio interface capacities up to 80 Mbps, two licenses available for radio interface capacities up to 320 Mbps, and two of the eight available Transmission Capacity licenses are restricted to the unlicensed band.

Adaptive Modulation

6.669 Adaptive Modulation EL provides the right to use adaptive modulation for Transmission Capacity license(s). Adaptive Modulation EL uses the following format: *YModAdp*, where 'Y' equals the number of radio profiles available to use adaptive modulation radio profile(s), up to the total of Transmission Capacity licenses available. When no Adaptive Modulation EL is present, none of the available Transmission Capacity licenses are available to be configured with adaptive modulation. The following are examples of license strings with and without Adaptive Modulation EL:

- *7Cap080/TDM2ETH*; means seven licenses available for radio interface capacities up to 80 Mbps, none are available for adaptive modulation.
- *6Cap080/3ModAdp/TDM2ETH/1UnlOpt*; means six licenses available for radio interface capacities up to 80 Mbps, three Transmission Capacity licenses are available for adaptive modulation, and one of the six available Transmission Capacity licenses are restricted to the unlicensed band.

Data Awareness

6.670 Data Awareness EL provides the right to support TDM over Ethernet, MEF8 standard traffic. Data Awareness license uses the following format: *TDM2ETH*. Currently all license strings available include the Data Awareness EL.

ERPS

6.671 ERPS EL provides the right to configure ERPS Topology with any type of interface as Ring Port. ERPS license uses the following format: *Ring*.

Loopback

6.672 To facilitate installation, commissioning, remote maintenance, and troubleshooting various loopbacks are supported by the system.

6.673 The activation of a loopback affects traffic. The presence of a loopback is indicated with an abnormal condition.

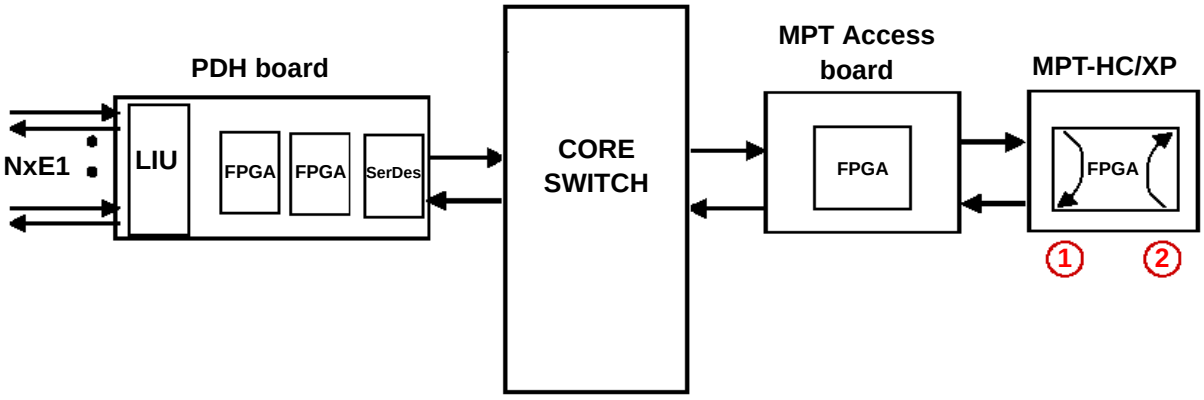
6.674 The system supports the following loopback types:

- Core facing radio digital loopback
- Radio facing circuit loopback
- Core facing IF cable loopback
- Core facing RF loopback
- Line facing PDH (DS1/DS3) loopback
- Radio facing PDH (DS1/DS3) loopback

Core facing radio digital loopback

6.675 Core facing radio digital loopback is an internal loopback on the aggregate traffic.
For MPT-HC/XP, this loopback routes data from the output of the Tx Data Awareness block (after compression) to the input of the Rx data awareness block (before decompression).
For MPT-HL, this loopback routes the Tx modem signal (after compression and QoS) to Rx modem signal (before decompression). This loopback type is shown in Figure 6-59.

Figure 6-59. Core and radio facing radio loopbacks



1. Core facing radio digital loopback
2. Radio facing circuit loopback

6.676 This loopback is supported by MPT-HC/XP ODUs and MPT-HL transceivers.

6.677 This loopback is loop and continue.

6.678 This loopback is configured using the Craft Terminal.

6.679 The Core facing radio loopback operation applies an "Automatic Tx mute" before the execution of the command and the "Tx mute removed" after the execution of the loopback command.

6.680 When this loopback is activated the behavior is as follows:

- Compressed flows (TDM2TDM and TDM2ETH) 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 values are the same. In cases where the ECID Tx is different form ECID Rx, the TDM2ETH flows are dropped.
- Generic Ethernet flows are dropped.

Radio facing circuit loopback

6.681 Radio facing loopback is a remote loopback which provides an over-the-air loopback test on the aggregate traffic. This loopback connects the receive data interface to the transmit data interface. This loopback type is shown in Figure 6-59.

6.682 This loopback is supported by MPT-HC/XP ODUs only.

6.683 This loopback is loop and continue.

6.684 This loopback is a line external loopback on the aggregate signal level.

6.685 This loopback is configured using the Craft Terminal.

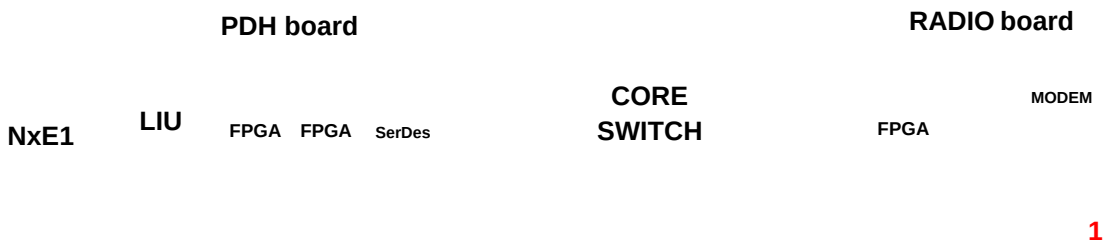
6.686 When this loopback is activated the behavior is as follows:

- Compressed flows (TDM2TDM and TDM2ETH) 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 values are the same. In cases where the ECID Tx is different form ECID Rx, the TDM2ETH flows are dropped.
- Generic Ethernet flows are dropped.

Core facing IF cable loopback

6.687 Core facing IF cable loopback provides a method to troubleshoot the IF cable connecting the MSS to the ODU300. This loopback is implemented by routing the analog IF Tx output (towards ODU300) to the IF Rx input. This loopback type is shown in Figure 6-60.

Figure 6-60. Core Facing IF Cable Loopback UPDATE



6.688 This loopback is supported by ODU300 transceivers only.

6.689 This loopback can be activated only on the aggregate traffic.

6.690 This loopback is configured using the Craft Terminal.

6.691 This loopback is loop and cut type.

6.692 When this loopback is activated the behavior is as follows:

- 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.

Core facing RF loopback

6.693 Local core facing RF loopback provides a method to troubleshoot RF paths constructed with MPT-HLs. The mode is enabled by the user provisioning the MPT-HL Tx and Rx frequencies to the same value. This loopback type is shown in Figure 6-61.

Figure 6-61. Core Facing RF Loopback

6.694 This loopback is supported by MPT-HL transceivers only.