8 — Functional operation

8.1 — Microwave service switch (MSS)

Microwave Service Switch (MSS) shelves provides up to 16 Gb/s packet switch node.

The MSS incorporates the base–band processing, tributaries interfaces, radio port interfaces and supervision. The MSS is frequency–independent.

The MSS-4 and MSS-8 shelf consists of a card cage and backplane in which mounts access and radio peripherals and Core control cards. The MSS-1, MSS-1c and MSS-O shelves are monoboards.

The MSS is frequency–independent.

The following MSS shelves are available:

- MSS-8 shelf
- MSS-4 shelf
- MSS-1
- MSS-1c shelf
- MSS-O

8.1.1 — MSS-8 shelf

A fully equipped Microwave Service Switch (MSS-8) shelf provides up to 314 Mb/s full-duplex Ethernet transport capacity per radio carrier channel.

MSS-8 shelf provides up to 16 Gb/s packet switching which creates flexible aggregate capacity sharing across DS1/E1, DS3, OC-3/STM-1, and Ethernet traffic.

The MSS-8 shelf supports the following:

- 1 or 2 Core Cards (Main & Spare)
- up to 6 Transport cards

- 1 AUX peripheral unit (optional: supported in transport slot #8)
- 1 DC Converter (optional: supported in transport slots 4, 6, or 8)
- 1 Fans unit
- support for MPT-HC/MC/HC-HQAM/XP/XP-HQAM, and MPT-HL/HLC/HLS radios

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

8.1.2 — MSS-4 shelf

A fully equipped Microwave Service Switch (MSS-4) shelf provides up to 314 Mb/s full-duplex Ethernet transport capacity per radio carrier channel.

MSS-4 shelf provides up to 16 Gb/s packet switching which creates flexible aggregate capacity sharing across DS1/E1, DS3, OC-3/STM-1, and Ethernet traffic.

The MSS-4 shelf supports the following:

- 1 or 2 Core Cards (Main & Spare)
- up to 2 Transport cards
- 1 AUX peripheral unit (optional: supported in Transport slot #4)
- 1 Fans unit
- support for MPT-HC/MC/HC-HQAM/XP/XP-HQAM, and MPT-HL/HLC/HLS radios

In the right part of the MSS shelf there is one sub-D 2-pole power supply connector.

8.1.3 — MSS-1 shelf

A Microwave Service Switch (MSS-1) shelf provides up to 314 Mb/s full-duplex Ethernet transport capacity per radio carrier channel.

The MSS-1 unit provides up to 16 Gb/s packet switching which creates flexible aggregate capacity sharing across E1/DS1 and Ethernet traffic.

The MSS-1 unit provides the function of the following:

- Main Core-E card
- 1 P32E1DS1 card with 16 ports
- 4 housekeeping alarm inputs

- support for MPT-HC/MC/HC-HQAM/XP/XP-HQAM radios

8.1.4 — MSS-1c shelf

Microwave Service Switch (MSS-1c) shelf provides up to 314 Mb/s full-duplex Ethernet transport capacity per radio carrier channel.

MSS-1c is a compact IDU that complements the existing portfolio addressing the last mile, the far end application in nodal solution and cost optimized point-to-point applications. Its small size of 1 rack unit height and half rack width drastically reduces the space consumption in busy sites. Supports MPT-HC/HC-HQAM/XP/XP-HQAM ODU.

8.1.5 — MSS-O

The MSS-O provides three 10/100/1000BaseT Ethernet interfaces, two with PFoE, and one GigE optical Ethernet SFP interface.

The 10/100/1000BaseT Ethernet interface supports a mixture of user Ethernet ports or MPT-HC/HC-HQAM/XP/XP-HQAM radio ports.

The GigE Optical Ethernet interface supports a User Ethernet port.

The MSS-O can be installed indoors or outdoors. It is optimized for outdoor installation.

8.1.6 — MSS to Outdoor Unit interconnections

8.1.6.1 — MSS-4/8 to ODU300 interconnection

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

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

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

8.2 — Radio

The system supports up to eighteen radio channels per node.

The system supports a mixture of radio technologies (MPT-HC/HC-HQAM, MPT-MC, MPT-HL, MPT-HLS, MPT-HLC, MPT-XP/XP-HQAM, and/or ODU300) on the same NE.

The radio channels can be all the same frequency, different frequencies, or a combination of both. Not all radios are available in both markets.

Radio part numbers and frequencies are provided in the *9500 MPR Frequency Plan for MPT Outdoor Transceivers*. Radio performances are provided in the 9500 MPR Technical Summary, contact Alcatel-Lucent.

8.2.1 — Radio configuration

Support for the following radio configurations:

- 1+0 and 1+1 Terminal
- 1+0 and 1+1 Drop and Insert Repeater
- 1+0 and 1+1 3-Way Junction
- 1+0 and 1+1 Nodal x-Way Junction

8.2.1.1 — Protection schemes

Support for the following radio protection schemes:

- 1+0 unprotected
- 1+0 Space Diversity (SD) for MPT-HLS and MPT-HLC with diversity combiner
- 1+1 Hot StandBy (HSB)
- 1+1 SD
- 1+1 Frequency Diversity (FD)
- 2x(1+0) XPIC
- 4x(1+0) XPIC
- 2x(1+1) HSB XPIC

For MPT-HLC and MPT-HLS:

- 1+1 HSB space diversity with RPS
- 1+1 HSB space diversity with combiner
- 1+1 frequency diversity with combiner
- N+0 frequency diversity with combiner
- N+0 frequency diversity with XPIC
- N+0 frequency diversity with XPIC and combiner: for MPT-HLC only at L6-U6-11 GHz

For MPT-HLC only at L6/U6/11 GHz:

- 1+1 HSB with antenna protection with diplexer and stack
- 1+1 HSB 60 MHz compact and stack (L6 only)

8.2.1.2 — Channel spacing

See the *9500 MPR Frequency Plan for MPT Outdoor Transceivers* for supported channel spacing information.

8.2.1.3 — Radio configuration rules for MPT-MC/HC/HC-HQAM/XP/XP-HQAM

For the following configurations using multiple channel arrangements on one antenna, one sub-band for all the MPTs is recommended. If you need to use two sub-bands, contact Alcatel-Lucent.

- 4+0 XPIC
- N+0 (with or without LAG)
- 1+1 FD using coupler, OMT or OMT-C

8.2.1.4 — Rule for 2048 QAM modulation scheme with MPT-HC-HQAM/XP-HQAM

To reach the 2048 QAM modulation scheme, the RSL must be higher than the values described in the following table. If ATPC is in use, the ATPC threshold must follow the same rule.

Modulation	Channel Spacing	Frequency	RSL
2048 QAM	28 to 60 MHz	6-13 GHz	RSL ≥ -45 dBm

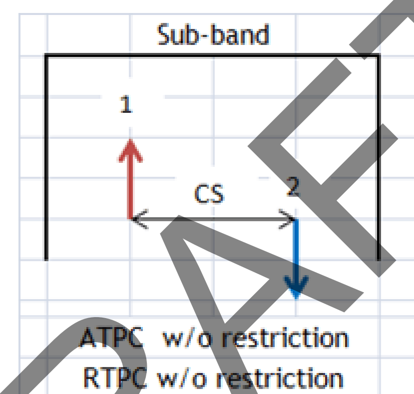
2048 QAM	14 MHz	6-13 GHz	RSL ≥ -50 dBm
2048 QAM	14 to 60 MHz	15-23 GHz	RSL ≥ -42 dBm

8.2.1.5 — Multiple channels arrangement for 1024 and 2048 QAM with the same sub-band on one antenna for MPT-HC-HQAM/XP-HQAM

The following rules apply when configuring a multiple channel arrangement for 1024 and 2048 QAM. Each rule assumes the previous rules in the list are also being followed.

1. Adjacent channels must be in alternate polarization, as shown in Figure 8.47.

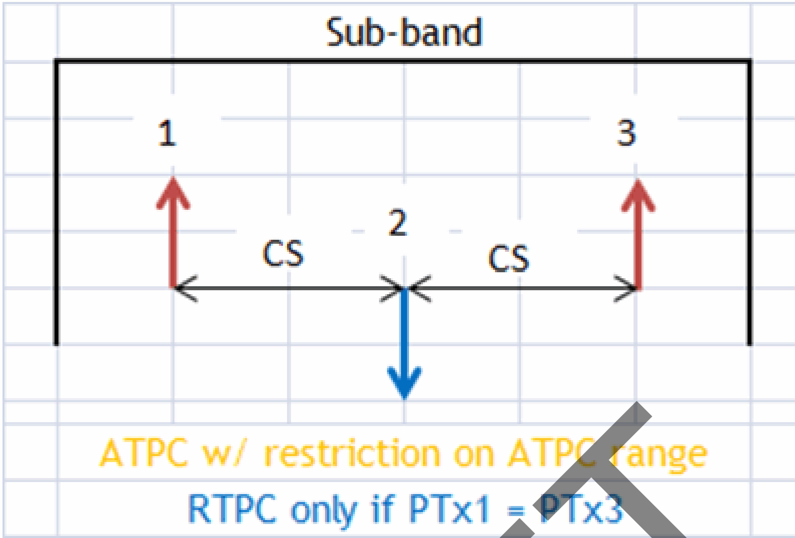
Figure 8.47 — Adjacent channels must be in alternate polarization



2. In RTPC mode, the Transmit Power of all channels in the same polarization must be set at the same level, assuming that adjacent channels are in alternate polarization.
3. At 1024 and 2048 QAM, with copolar multiple channels in the same sub-band, the maximum modulation scheme could be affected by different PTx values in ATPC. Consequently for those cases, ATPC range is recommended to be limited to:
   - -10dB for 6 to 8GHz frequency bands
   - -5dB for 11 to 38GHz frequency bands

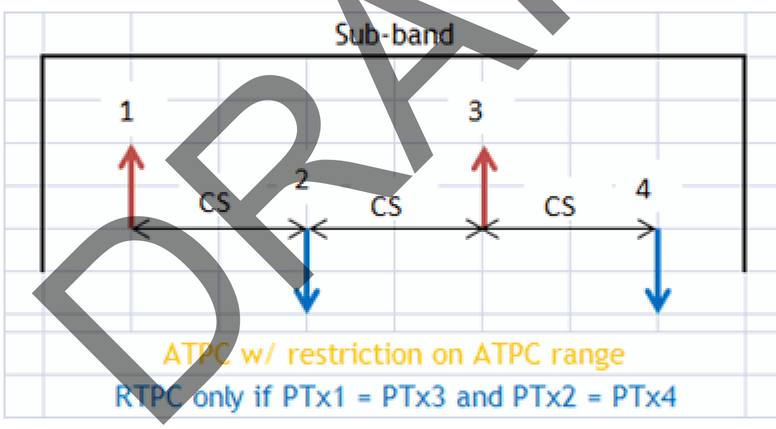
   See Figure 8.48.

Figure 8.48 — ATPC with restriction



4. In RTPC mode, LAG 4+0 is supported with OMT-C with four different frequencies, see Figure 8.49.

Figure 8.49 — RTPC mode with four different frequencies



ATPC mode can also be supported for 1 Sub-Band if two antennas (and consequently two OMTs) are configured.

8.2.2 — Adaptive modulation

Adaptive modulation is a mixed mode technology which uses different modulation techniques to maximize capacity during degraded propagation conditions (fading).

Modulation switching is errorless for all frequencies.

When a terminal operates in adaptive modulation, it is possible to commission the total capacity of both Ethernet and TDM traffic, up to a bandwidth corresponding to the maximum modulation scheme chosen by the operator. This capacity depends on the channel spacing and the modulation scheme.

8.2.2.1 — Admission control

Admission control ensures that TDM flows are maintained when the modulation scheme is downgraded automatically by the system due to degraded propagation conditions. The number of TDM links supported is limited to the capacity of the lowest modulation technique selected (typically 4 or 64 QAM).

The Admission Control feature protects the TDM traffic when TDM traffic is provisioned.

The maximum number of E1/DS1 links that can be provisioned (or cross-connected in a given radio direction) equals the number of E1/DS1s supported by the lowest modulation provisioned, typically 4 QAM or 64 QAM capacity. The remaining capacity is devoted to other types of traffic such as Ethernet best effort.

From the system point of view, it is not possible to provision more E1/DS1s than are supported by the lowest modulation scheme. When the modulation scheme is downgraded to the lowest value (16QAM to 4QAM), it is not possible for the system to know which E1/DS1s should be maintained and which should be dropped because all E1/DS1 links have the same priority.

Admission control checks have been added at the CT level, preventing the user from provisioning more E1/DS1s than are supported by the lowest modulation scheme bandwidth.

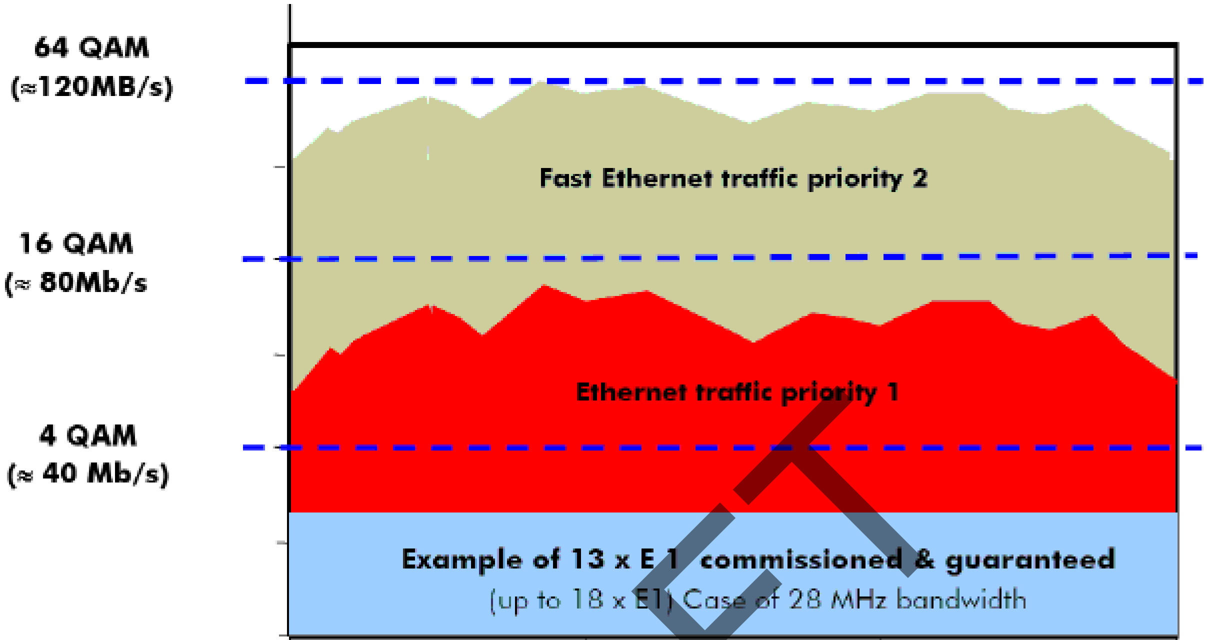
When RSL (received signal level) value decreases, modulation scheme is downgraded first from 64QAM to 16QAM: the traffic with lower priority exceeding 16QAM bandwidth is dropped and all the E1/DS1s are kept.

If the RSL value further decreases, modulation scheme is downgraded to 4QAM and any traffic exceeding 4QAM bandwidth is dropped while the E1/DS1s are maintained.

Figure 8.50, Figure 8.51, and Figure 8.52 show how the system operates, in case of modulation changes with admission control (28 MHz bandwidth).

In this case, the operator has commissioned 13xE1’s. Additionally two other kinds of traffic are provisioned, Ethernet traffic #1 and Fast Ethernet traffic #2. Ethernet traffic #1 has a higher QoS priority than Fast Ethernet traffic #2. See Figure 8.50 for an example of this configuration in normal operating mode.

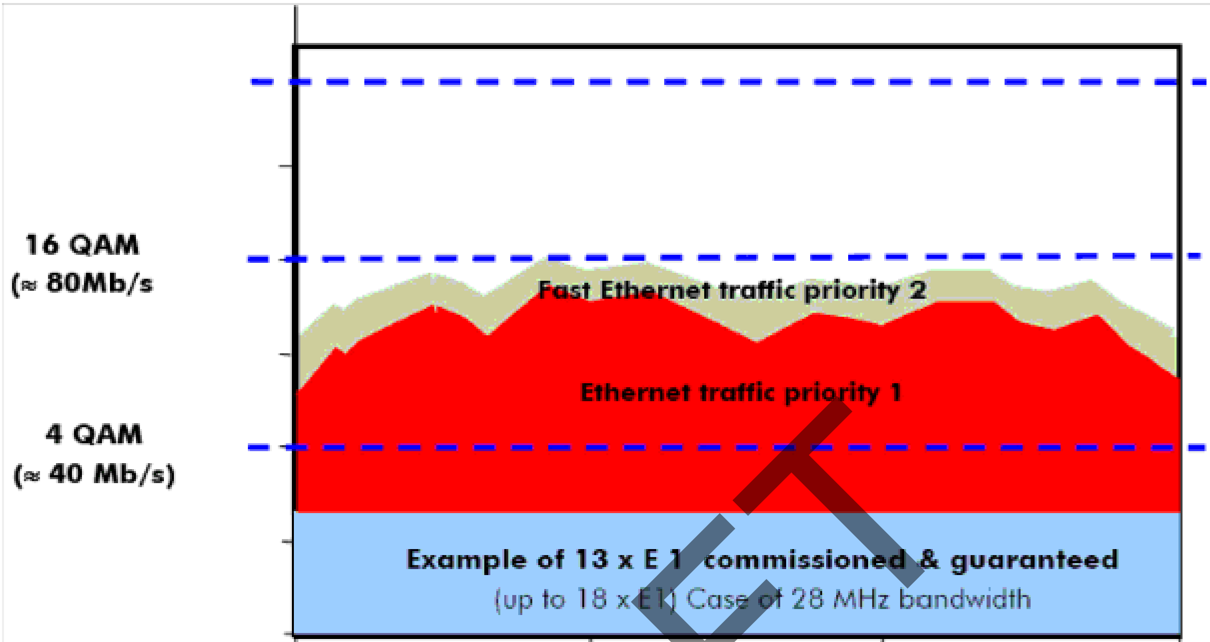
Figure 8.50 — Example of traffic 28MHz bandwidth and admission control



The 13xE1s are saved even in the case of a degradation of the modulation down to 4QAM. Remaining available capacity is used to transmit other types of traffic.

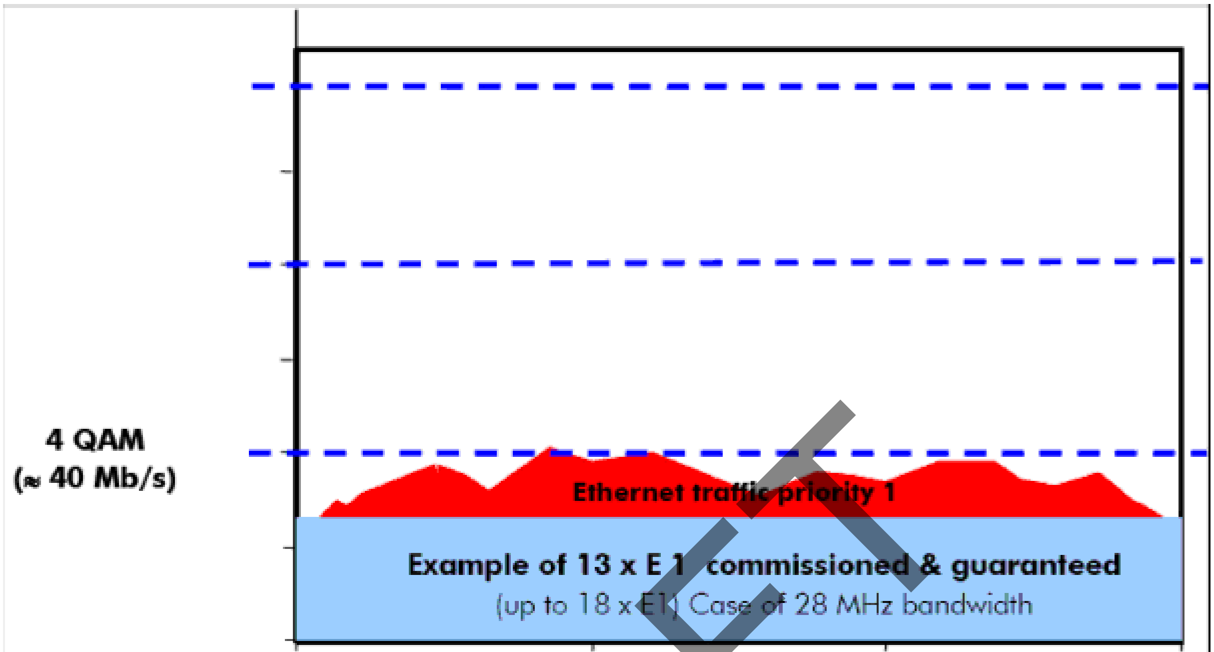
When the modulation is degraded from 64QAM to 16QAM (Figure 8.51), the E1 flows are maintained while the Ethernet traffic with lowest priority (Fast Ethernet traffic #2) is reduced.

Figure 8.51 — Example of traffic 28MHz bandwidth and modulation downgraded to 16QAM



When the modulation is further degraded to 4QAM (Figure 8.52), the E1 flows are still maintained while the Ethernet traffic with the lowest priority is dropped (Fast Ethernet traffic #2) and the Ethernet traffic with the highest priority is reduced (Ethernet traffic #1) to fit the remaining available bandwidth.

Figure 8.52 — Example of traffic 28MHz bandwidth and modulation downgraded to 4QAM



8.2.3 — Adaptive modulation and admission control with MPT-HLC

The Admission Control feature on the MPT-HLC allows the operator to select any of the supported modulation levels as the reference modulation level. This allows the user to provision a number of DS1s that is greater than are supported by any selected modulation level lower than the reference modulation level selected.

If the modulation level drops below the reference modulation level, the system can no longer guarantee DS1 traffic.

It is possible to provision a number of DS1s greater than the ones fitting in any selected modulation level lower than the reference modulation level. Since all the DS1 links have the same priority, it is not possible from a system point of view to decide which DS1s should be dropped when the modulation scheme is downgraded below the reference modulation (for example, 64 QAM to 16 QAM). For this reason, careful consideration must be adhered to when selecting the reference modulation level and to the number of DS1s to provision on the radio direction.

8.2.4 — Adaptive equalization

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

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

8.2.5 — Fiber-microwave protection

The Fiber-Microwave Protection feature allows to protect an Optical Fiber link with a Microwave link.

The Main protection resource is the Optical Fiber, while the Spare protection resource is the Microwave link.

The Optical Fiber link can be either a physical connection between two MPR NEs or a connection between two MPR NEs by a Wireline network, where the access to that Wireline network by MPR NEs is made by Optical Fiber connections. See Figure 8.53.