Technical specification

Microwave equipment for North America
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1 General

1.1 Description

This Specification details the functional requirements and performance criteria for PDH and SONET microwave transmission equipment operating in the following frequency bands:

6 GHz, 7 GHz, 8 GHz, 10 GHz, 11 GHz, 13 GHz, 18 GHz, 23 GHz, 28 GHz, and 38 GHz.

Ericsson response:
Compliant

The system shall be of split mount type, consisting of separated indoor and outdoor units. The indoor unit shall be frequency independent, and the outdoor unit shall be capacity independent.

Ericsson response:
Compliant

The microwave system is to transmit bi-directional data with capacities through 80-DS1s and up to 270 Mbps by means of a digital microwave link in a point-to-point configuration.

Ericsson response:
Compliant

The microwave system shall support PDH, SONET, and Ethernet transport in the same node.

Ericsson response:
Compliant

The SONET transport shall support ACAP, ACCP, and CCDP operation.

Ericsson response:
Compliant

The microwave system shall support a mixture of PDH and Ethernet traffic over the hop.

Ericsson response:
Compliant
The microwave system shall have the capability of operating in non-protected (1+0) or in protected (1+1) mode.

**Ericsson response:**
Compliant

It shall be possible have Ethernet over PDH, nxDS1.

**Ericsson response:**
Compliant

The throughput for each Ethernet over PDH port shall be up to 95 Mbps, 48*DS1/VC-12.

**Ericsson response:**
Compliant

It shall be possible to have Ethernet over SONET, one to four STM-1, using the following protocols:


**Ericsson response:**
Compliant

The throughput for each Ethernet over SONET port shall be up to 600 Mbps with four STM-1 links.

**Ericsson response:**
Compliant

It shall support frame sizes up to 2000 bytes, according to IEEE 802.as.

**Ericsson response:**
Compliant
1.2 Indoor unit

The indoor unit shall contain the tributary input and the output for the data as well as interfaces for network maintenance facilities, alarms, and connection to the power supply. The indoor unit shall also house multiplex/demultiplex equipment handling from 2xDS1 to 155 Mbps. In case of systems that make use of an IF interconnection between the indoor and outdoor units, the indoor unit will also contain the baseband IF modulator and IF baseband demodulator.

Ericsson response:
Compliant

The indoor unit shall support cross connection on DS1 level without the need for external cabling between microwave terminals. Maximum DS1 backplane capacity (nxDS1) shall be stated for each of the offered indoor solutions.

Ericsson response:
Compliant

There are three sub rack sizes available: AMM 2p, 6p, and 20p. AMM 2p supports close to 200 unidirectional DS1-s. AMM 6p and 20p support close to 400 unidirectional DS1-s.

It shall be possible to have DS1 traffic routing capability (without external cabling) between more than 10 microwave terminals placed on the same site.

Ericsson response:
Compliant

The indoor unit shall support termination of STM-1 connections, making it possible to cross connect DS1s directly to the PDH terminals housed in the indoor unit without the need for external cabling.

Ericsson response:
Compliant

The indoor unit shall support DS1 1+1 SNC ring protection mechanism to provide end-to-end protection.

Ericsson response:
Compliant

The STM-1 interface shall support MSP 1+1.
The microwave system shall include modems housed in the indoor unit which together can support capacities between 2xDS1 and 75xDS1. Capacity shall be possible to upgrade locally or remotely.

**Ericsson response:**
Compliant

Interfaces for DS1, E2, E3, and STM-1 shall be supported.

**Ericsson response:**
Compliant

The DCN of the nodes shall be IP-based.

**Ericsson response:**
Compliant

The following interface types shall be supported according to IEEE 802.3u, 802.3ab, and 802.3z:

10BASE-T, 100BASE-TX, 1000BASE-T, 1000BASE-LX, 1000BASE-ZX.

**Ericsson response:**
Compliant

SFP plug in modules shall be supported for Gigabit optical and electrical interfaces.

**Ericsson response:**
Compliant

The DCN of the nodes shall be IP-based.

**Ericsson response:**
Compliant

### 1.2.1 Ethernet Switching

The equipment shall support Ethernet switching according to IEEE 8021D-2004 and 802.1Q-2005.

**Ericsson response:**
Compliant

The equipment shall have an Ethernet switch with up to nine ports.

**Ericsson response:**
Compliant
The equipment shall support the possibility to upgrade the Ethernet switch to Provider Bridge (IEEE 802.1ad) functionality.

**Ericsson response:**
Compliant

### 1.2.2 SONET ADM

The equipment shall have a SONET ADM that can cross connect VC-12, VC-3, and VC-4.

**Ericsson response:**
Compliant

The equipment shall have a SONET ADM with the capacity to add / drop up to 21 DS1s.

**Ericsson response:**
Compliant

The equipment shall have a SONET ADM with up to four STM-1 ports.

**Ericsson response:**
Compliant

### 1.2.3 Native Ethernet

The equipment shall be possible to software upgrade to native Ethernet with a capacity of 155 Mbps in 28 MHz bandwidth and 310 Mbps in 56 MHz bandwidth.

**Ericsson response:**
Compliant

### 1.3 Interconnect cable

Weather proof, low-loss flexible cable shall be used to interconnect the indoor and outdoor units. The cable shall be a single coaxial cable and properly screened against possible interference. Earthing shall be possible at either end of the cable. Weatherproof connectors to seal the cable entry ports shall be provided.

**Ericsson response:**
Compliant
1.4 Outdoor unit

The weather proof outdoor unit shall house the actual microwave transmitter and receiver, duplex/circulator, and filter parts. The outdoor unit shall be possible to attach directly to an antenna with the diameter up to 1.8 m. It shall also be possible to connect the outdoor unit to a separate mounted antenna using a flexible waveguide. An interface to a receive signal strength indicator monitoring point should also be available on the outdoor unit for alignment.

**Ericsson response:**
Compliant

It shall be possible to replace the outdoor unit without affecting the antenna alignment.

**Ericsson response:**
Compliant

The outdoor unit shall support any bit rates from 2x2 to 75x2 Mbps and STM-1.

**Ericsson response:**
Compliant

The outdoor unit shall support C-QPSK, 16 QAM, 64 QAM, and 128 QAM.

**Ericsson response:**
Compliant

1.5 Antenna

The microwave system shall accommodate integrated as well as separately mounted antenna configurations. Integrated antennas imply a configuration where the outdoor unit is directly mounted onto the antenna but is easily removable. The supplier shall include integrated antennas of sizes from .65ft (0.2m) to 6ft. (1.8m)

**Ericsson response:**
Compliant

Separately mounted antennas from .65ft (0.2m) to 12 ft. (3.7 m) shall be available.

**Ericsson response:**
Compliant
The waveguide flanges of the antenna for RF connection shall be stated.

**Ericsson response:**
Compliant

<table>
<thead>
<tr>
<th>Radio unit</th>
<th>Waveguide interface flange type</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU1 N 6L/RAU2 X 6L</td>
<td>154 IEC-UDR 70</td>
</tr>
<tr>
<td>RAU1 N 6U/RAU2 X 6U</td>
<td>154 IEC-UDR 70</td>
</tr>
<tr>
<td>RAU1 N 7/RAU2 X 7</td>
<td>154 IEC-UBR 84</td>
</tr>
<tr>
<td>RAU1 N 8/RAU2 X 8</td>
<td>154 IEC-UBR 84</td>
</tr>
<tr>
<td>RAU2 X 10</td>
<td>154 IEC-UBR 120</td>
</tr>
<tr>
<td>RAU2 N 11, RAU2 X 11</td>
<td>154 IEC-UBR 120</td>
</tr>
<tr>
<td>RAU2 15/RAU2 N 15/RAU2 X/Xu 15</td>
<td>154 IEC-UBR 140</td>
</tr>
<tr>
<td>RAU2 18/RAU1 N 18/RAU2 X/Xu 18</td>
<td>154 IEC-UBR 220</td>
</tr>
<tr>
<td>RAU2 23/RAU2 N 23/RAU2 X/Xu 23</td>
<td>154 IEC-UBR 220</td>
</tr>
<tr>
<td>RAU2 N 24</td>
<td>154 IEC-UBR 260</td>
</tr>
<tr>
<td>RAU2 N 28</td>
<td>154 IEC-UBR 260</td>
</tr>
<tr>
<td>RAU2 38/RAU2 N 38</td>
<td>154 IEC-UBR 320</td>
</tr>
</tbody>
</table>

**1.6 Management system**

The microwave system shall be manageable locally and centrally via suitable management interfaces. The management system shall at least support the following functions:

Fault, performance, configuration, security.

**Ericsson response:**
Compliant
2 Conditions

2.1 Environmental conditions

2.1.1 Indoor equipment

The Vendor shall state the temperature and relative humidity limits for indoor equipment.

**Ericsson response:**
Compliant

**AMMs equipped with Fan**
Continuous conditions: -5 to +55 °C (+23 to +131 °F) normal operation
Extended continuous conditions: -25 to +60 °C (-13 to +140 °F) outdoor equipment

**AMM2p B equipped with NPU3 B**
Continuous conditions: up to +50 °C (+122 °F)
Extended continuous conditions: up to +55 °C (+131 °F)

**AMM 2p B not equipped with Fan **)**
Continuous conditions: -5 to +45 °C (+23 to +113 °F) normal operation
Extended continuous conditions: -25 to +50 °C (-13 to +122 °F)

**Humidity range**
Relative humidity range: 5 to 95 %
2.1.2 Outdoor equipment

The housing and connectors must be capable of allowing normal equipment operation under the most severe weather conditions.

The Vendor shall state the temperature and humidity limits for outdoor equipment:

**Ericsson response:**
Compliant

**Temperature range**

<table>
<thead>
<tr>
<th>Continuous conditions (Normal Operation)</th>
<th>-33 to +45 °C (-27 to 113 °F) (solar radiation ≤ 1120 W/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-33 to +55 °C (-27 to 131 °F) (no solar radiation)</td>
</tr>
<tr>
<td>Extended continuous conditions (Safe Function)</td>
<td>-45 to +60 °C (-49 to +140 °F) (no solar radiation)</td>
</tr>
</tbody>
</table>

Relative humidity range: 8 to 100 %EMC conditions

2.1.3 Radiated immunity

The Network Element does not exhibit any degradation of performance when subjected to electrical fields up to the following level:

AM 1kHz, 80% and level 3 V/m in the band 80 – 2700 MHz and 10 V/m in the band 800 – 960 MHz and 1400 – 2700 MHz.

**Ericsson response:**
Compliant

2.1.4 Conducted immunity radio frequency, dc power ports, signal ports & ground

The Network Element does not exhibit any degradation of performance when the DC power leads, signal leads, and ground are subjected to interference injection up to the following level:

3 VRMS, AM 1 kHz, 80% in the frequency range 0.15 - 80 MHz.

**Ericsson response:**
Compliant
2.1.5 Conducted immunity burst, dc power ports

The Network Element does not exhibit any degradation of performance when the DC power cable is subject to interference injection of fast transients (bursts) (direct connection and capacitive coupling) up to the following level:

1 kV open circuit voltage.

Ericsson response:
Compliant

2.1.6 Conducted immunity burst, signal ports

The Network Element does not exhibit any degradation of performance when the signal leads are subjected to interference injection of fast transients (bursts) up to the following level:

0.5 kV open circuit voltage.

Ericsson response:
Compliant

2.1.7 Conducted immunity surge, signal ports – indoor

The Network Element does not exhibit any damage when the indoor signal leads are subjected to injection of surge (1.2/50 μs) up to the following level:

0.5 kV True Common Mode (Lines – ground - 37 Ω).
0.5 kV True Common Mode (Shield – ground – 2 Ω).

The communication link shall be maintained after the test. After the test, the apparatus shall continue to operate as intended.

Ericsson response:
Compliant
2.1.8 Conducted immunity surge, signal ports – outdoor

The Network Element does not exhibit any damage when the outdoor signal leads are subjected to injection of surge (1.2/50 μs) up to the following level:

1 kV True Common Mode (Lines – ground - 37 Ω).
1 kV True Common Mode (Shield – ground – 2 Ω).

The communication link shall be maintained after the test. After the test, the apparatus shall continue to operate as intended.

Ericsson response: Compliant

2.1.9 Electrostatic discharge

The Network Element does not exhibit any degradation of performance or permanent damage when it is subjected to electrostatic discharge up to the following levels:

Air discharge: ±2 kV, ±4 kV, and ±8 kV
Contact discharge: ±2 kV, ±4 kV

Ericsson response: Compliant

3 General requirements

3.1 Mechanical data

3.1.1 Radio module

The outdoor unit shall have a maximum weight of 8 kg, independent of traffic capacity, not including the antenna weight.

Ericsson response: Compliant
3.1.2  Indoor unit

The Vendor shall indicate the maximum rack space and weight for the indoor units.

**Ericsson response:**

**Weight**

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMM 2p B (excluding units)</td>
<td>2.1 kg (4.6 lb)</td>
</tr>
<tr>
<td>AMM 6p C&amp;D (excluding units)</td>
<td>3.9 kg (8.7 lb)</td>
</tr>
<tr>
<td>AMM 20p and AMM 20p B (excluding units)</td>
<td>7.0 kg (15.4 lb)</td>
</tr>
</tbody>
</table>

**AMM 2p B**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (total; with connectors)</td>
<td>276 mm (10 7/8 in.)</td>
</tr>
<tr>
<td>Depth (behind mounting brackets)</td>
<td>236 mm (9 1/4 in.)</td>
</tr>
<tr>
<td>Width (total)</td>
<td>483 mm (19 in.)</td>
</tr>
<tr>
<td>Width (without mounting brackets)</td>
<td>448 mm (17 5/8 in.)</td>
</tr>
<tr>
<td>Height</td>
<td>44 mm (1 7/8 in.)</td>
</tr>
<tr>
<td>Rack Units</td>
<td>1</td>
</tr>
</tbody>
</table>

**AMM 6p C&D**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (total; with connectors)</td>
<td>280 mm (11 in.)</td>
</tr>
<tr>
<td>Depth (behind mounting brackets)</td>
<td>240 mm (9 3/8 in.)</td>
</tr>
<tr>
<td>Width (total)</td>
<td>483 mm (19 in.)</td>
</tr>
<tr>
<td>Width (without mounting brackets)</td>
<td>438 mm (17 1/4 in.)</td>
</tr>
<tr>
<td>Height</td>
<td>133 mm (5 1/4 in.)</td>
</tr>
<tr>
<td>Rack Units</td>
<td>3</td>
</tr>
</tbody>
</table>

**AMM 20p and AMM 20p B:**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (total; with connectors)</td>
<td>280 mm (11 in.)</td>
</tr>
<tr>
<td>Depth (behind mounting brackets)</td>
<td>240 mm (9 3/8 in.)</td>
</tr>
<tr>
<td>Width (total)</td>
<td>483 mm (19 in.)</td>
</tr>
<tr>
<td>Width (without mounting brackets)</td>
<td>448 mm (17 5/8 in.)</td>
</tr>
<tr>
<td>Height</td>
<td>300 mm (12 in.)</td>
</tr>
<tr>
<td>Rack Units</td>
<td>7</td>
</tr>
</tbody>
</table>
3.1.2.1 The following typical configurations shall be described:

**Ericsson response:**
Compliant

The MINI-LINK TN has three sizes of magazines (AMM 2p, 6p, and 20p) which can handle 2, 6, and 20 plug in units respectively.

The different versions are:
- 2pB (two full size and two half size slots)
- 6pC (five full size and two half size slots)
- 6pD (four full size and four half size slots)
- 20pB (twenty full size slots)

1. **End site terminal: 1+0 terminal with capacity of 4xDS1.**

**Ericsson response:**
An AMM 2pB with a modem unit (MMU) with capacity 4xDS1 and a radio unit (RAU). The MMUs can be capacity/modulation agile for easy capacity/modulation upgrade. The traffic is terminated on the mandatory node processor unit (NPU).

2. **Repeater site: 2x (1+0) terminal with drop capacity of 4xDS1.**

**Ericsson response:**
An AMM 2pB with two modem units (MMUs) with capacity 4xDS1 and two radio units (RAUs). The MMUs can be capacity/modulation agile for easy capacity/modulation upgrade. The traffic is add/dropped on the mandatory node processor unit (NPU).

All the DS1 cross connections between the links are done via the Time Division Multiplex (TDM) bus in the backplane of the magazine. No external traffic cables are needed.

3. **Medium Capacity aggregation site.**

**Ericsson response:**
An AMM 6pC with five modem units (MMUs), three with capacity 4xDS1 and two with capacity 16xDS1, and five radio units (RAUs). The one MMU pair in 1+1 configuration is placed next to each other. The MMUs can be capacity/modulation agile for easy capacity/modulation upgrade.

All the DS1 cross connections between the links are done via the Time Division Multiplex (TDM) bus in the backplane of the magazine. No external traffic cables are needed.
4. Medium Capacity aggregation site.

**Ericsson response:**
An AMM 6pC with five modem units (MMUs), three with capacity 8xDS1 and two with capacity 32xDS1, and five radio units (RAUs). The one MMU pair in 1+1 configuration is placed next to each other. The MMUs can be capacity/modulation agile for easy capacity/modulation upgrade.

All the DS1 cross connections between the links are done via the Time Division Multiplex (TDM) bus in the backplane of the magazine. No external traffic cables are needed.

5. High Capacity aggregations site.

**Ericsson response:**
An AMM 20pB with twelve modem units (MMUs), four with capacity 8xDS1 and eight with capacity 16xDS1, twelve radio units (RAUs), and one STM-1 terminal multiplexer board (LTU 155).

The four MMU pairs in 1+1 configuration are placed next to each other. The MMUs can be capacity/modulation agile for easy capacity/modulation upgrade.

All the DS1 cross connections between the links are done via the Time Division Multiplex (TDM) bus in the backplane of the magazine. No external traffic cables are needed.

6. End site terminal: 1+0 terminal with Ethernet 30 Mbps.

**Ericsson response:**
An AMM 2pB with a modem unit (MMU) with capacity 16xDS1 and a radio unit (RAU). The traffic is terminated on the mandatory node processor unit (NPU) in an electrical 10/100BaseT connector.

7. End site terminal: 1+0 terminal with Ethernet 100 Mbps.

**Ericsson response:**
An AMM 2pB with a modem unit (MMU) with capacity 46xDS1, Ethernet termination unit (ETU), and a radio unit (RAU). The traffic is terminated on the ETU in an electrical 10/100BaseT connector.

8. End site terminal: 1+0 terminal with Ethernet 150 Mbps.

**Ericsson response:**
An AMM 2pB with a modem unit (MMU) with capacity STM-1 (155 Mbps), SONET mapper and add drop unit (SXU3 B), and a radio unit (RAU).

The node processor NPU3 B is used to get two electrical 1000BaseT interfaces.
9. End site terminal: 1+0 terminal with Ethernet 600 Mbps.

**Ericsson response:**
An AMM 6pD with four modem units (MMUs) with capacity STM-1 (155 Mbps), SONET mapper and add drop unit (SXU3 B), and four radio units (RAUs).

The node processor NPU3 B is used to get one or two electrical 1000BaseT interfaces.

The Ethernet capacity of 600 Mbps is distributed over four MMUs, and if one fails, the Ethernet connection will still be open but with reduced capacity.

10. Aggregation site: SONET ADM with 2+0 (2x155) ring configuration with 16 DS1 drop on site.

**Ericsson response:**
An AMM 6pD with four modem units (MMUs) with capacity STM-1 (155 Mbps), SONET mapper and add drop unit (SXU3 B), and four radio units (RAUs).

The node processor NPU3 B is used to get one or two electrical 1000BaseT interfaces. An additional interface board with twelve DS1s is added. The SXU3 B has four DS1 interfaces.

### 3.2 DC supply

#### 3.2.1 Input power range

Power supply shall be connected to the equipment, and the possible input power range shall be within -48 V (-57.0 to -40.5 V).

**Ericsson response:**
Compliant
3.2.2 Maximum power consumption and power dissipation

The Vendor shall state maximum power consumption and power dissipation of all indoor and outdoor equipment.

**Ericsson response:**

<table>
<thead>
<tr>
<th>Sub rack</th>
<th>Maximum power consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMM 20p</td>
<td>952 W</td>
</tr>
<tr>
<td>AMM 20p B</td>
<td>952 W</td>
</tr>
<tr>
<td>AMM 6p C</td>
<td>370 W</td>
</tr>
<tr>
<td>AMM 6p D</td>
<td>352 W</td>
</tr>
<tr>
<td>AMM 2p B</td>
<td>177 W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit</th>
<th>Power consumption &amp; dissipation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAU1 (Not plug-in unit)</td>
<td>15 W</td>
</tr>
<tr>
<td>FAU2</td>
<td>10 W</td>
</tr>
<tr>
<td>FAU4</td>
<td>6 W</td>
</tr>
<tr>
<td>LTU 16/1</td>
<td>5 W</td>
</tr>
<tr>
<td>LTU 32/1</td>
<td>12 W</td>
</tr>
<tr>
<td>LTU3 12/1</td>
<td>5 W</td>
</tr>
<tr>
<td>LTU 3/3</td>
<td>10 W</td>
</tr>
<tr>
<td>LTU 155 ANSI</td>
<td>18 W</td>
</tr>
<tr>
<td>ETU2</td>
<td>20 W</td>
</tr>
<tr>
<td>ETU3</td>
<td>13 W + 1 W per SFP module (0-2)</td>
</tr>
<tr>
<td>SMU2 ANSI</td>
<td>6 W</td>
</tr>
<tr>
<td>AMM 2p B</td>
<td>5 W</td>
</tr>
<tr>
<td>AMM6p C&amp;D</td>
<td>8 W</td>
</tr>
<tr>
<td>AMM 20p &amp; 20p B</td>
<td>12 W</td>
</tr>
<tr>
<td>PSU sub-rack</td>
<td>135 W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RAU type</th>
<th>Power consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU2 N 15, RAU2 38</td>
<td>&lt; 20 W</td>
</tr>
<tr>
<td>RAU2 15 St/HP</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 X/Xu 15</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU1 N 18</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 18 St/HP</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 X/Xu 18</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 23 St/HP</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU type</td>
<td>Power consumption</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>RAU2 N 23 St/HP</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 X/Xu 23</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 N 24</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU2 N 28</td>
<td>&lt; 27 W</td>
</tr>
<tr>
<td>RAU1 N 6L</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 6L</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU1 N 6U</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 6U</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU1 N 7</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 7</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU1 N 8</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 8</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 10</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 N 11</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 X 11</td>
<td>&lt; 35 W</td>
</tr>
<tr>
<td>RAU2 N 38</td>
<td>&lt; 35 W</td>
</tr>
</tbody>
</table>

3.3 Pay-as-you-grow, capacity license

The microwave transmission equipment shall support a scalable capacity upgrade approach with licensing cost per capacity. This will support a low initial investment and easy upgrade of the capacity when needed.

Ericsson response:
Compliant
3.4 Channel spacing

The microwave transmission equipment shall support the following channel spacing.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Channel spacing (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4xDS1</td>
<td>2.5</td>
</tr>
<tr>
<td>8xDS1</td>
<td>3.75</td>
</tr>
<tr>
<td>8xDS1</td>
<td>5</td>
</tr>
<tr>
<td>16xDS1</td>
<td>5</td>
</tr>
<tr>
<td>16xDS1</td>
<td>10</td>
</tr>
<tr>
<td>32xDS1</td>
<td>10</td>
</tr>
<tr>
<td>32xDS1</td>
<td>20</td>
</tr>
<tr>
<td>69xDS1</td>
<td>20</td>
</tr>
<tr>
<td>80xDS1</td>
<td>30</td>
</tr>
<tr>
<td>80xDS1</td>
<td>40</td>
</tr>
<tr>
<td>OC-3</td>
<td>30</td>
</tr>
<tr>
<td>OC-3</td>
<td>40</td>
</tr>
<tr>
<td>OC-3</td>
<td>50</td>
</tr>
</tbody>
</table>

**Ericsson response:**
Compliant

3.5 Safety

All equipment shall be designed so that, under all conditions of normal use and under likely fault conditions, it protects against risk for personal injury and against fire originating from the equipment.

**Ericsson response:**
Compliant

The design complies with relevant parts of the following standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 60950-1</td>
<td>Safety of Information Technology Equipment</td>
</tr>
<tr>
<td>CSA C22.2 No. 60950-1</td>
<td>Safety of Information Technology Equipment</td>
</tr>
<tr>
<td>UL 50</td>
<td>Enclosures for Electrical Equipment</td>
</tr>
<tr>
<td>IEC 60825-1</td>
<td>Safety of laser products. Part 1: Equipment classification, requirements and users guide</td>
</tr>
<tr>
<td>FCC OET Bulletin 65</td>
<td>Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields</td>
</tr>
<tr>
<td>Safety Code 6</td>
<td>Limits of Human Exposure to radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz</td>
</tr>
</tbody>
</table>
### 4 kHz to 300 GHz performance characteristics

#### 4.1 Transmitter performance

##### 4.1.1 Frequency bands and channel plans

**Ericsson response:**
Compliant

Ericsson’s microwave equipment complies with the following:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCC 47 CFR part 2</td>
<td>Frequency allocations and radio treaty matters, general rules and regulations</td>
</tr>
<tr>
<td>FCC 47 CFR part 101</td>
<td>Fixed microwave services</td>
</tr>
<tr>
<td>SRSP-305.9 Issue 5</td>
<td>Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 5925 - 6425 MHz</td>
</tr>
<tr>
<td>SRSP-307.7 Issue 6</td>
<td>Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 7725 - 8275 MHz</td>
</tr>
<tr>
<td>SRSP-310.7 Issue 3</td>
<td>Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 10.7 - 11.7 GHz</td>
</tr>
</tbody>
</table>
4.1.2 Frequency tolerance

The transmitter frequency shall not deviate more than ±10 ppm from the nominal value.

**Ericsson response:**
Compliant

4.1.3 Output power

The Vendor shall state the output power range, tolerance for all available radio units.

**Ericsson response:**
Compliant

<table>
<thead>
<tr>
<th>Radio unit</th>
<th>Output power version</th>
<th>Output power range (dBm)</th>
<th>Output power tolerance (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU2 15</td>
<td>STD</td>
<td>-10 to +18</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>HP</td>
<td>-10 to +25</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 18 fd &gt;1000 MHz</td>
<td>STD</td>
<td>10 to +16</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>HP</td>
<td>-10 to +24</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 18 d &gt;1000 MHz</td>
<td>STD</td>
<td>-10 to +17</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>HP</td>
<td>-10 to +24</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 23</td>
<td>STD</td>
<td>-7 to +20</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>HP</td>
<td>-7 to +23</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 38</td>
<td>STD</td>
<td>-15 to +17</td>
<td>±2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radio unit</th>
<th>Output power version</th>
<th>Output power range (dBm)</th>
<th>Output power tolerance (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU2 N 15</td>
<td>STD</td>
<td>-2 to +25</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 X/Xu 15</td>
<td>STD</td>
<td>-10 to +25</td>
<td>±2</td>
</tr>
<tr>
<td>RAU1 N 18</td>
<td>STD</td>
<td>+1 to +24</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 X/Xu 18</td>
<td>STD</td>
<td>-10 to +24</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 N 23</td>
<td>STD</td>
<td>-2 to +18</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>HP</td>
<td>-2 to +23</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 X/Xu 23</td>
<td>STD</td>
<td>-10 to +24</td>
<td>±2</td>
</tr>
<tr>
<td>RAU2 N 24</td>
<td>STD</td>
<td>-5 to +21</td>
<td>±2</td>
</tr>
</tbody>
</table>
The output power setting range shall be software controllable.

**Ericsson response:**
Compliant

### 4.1.4 QPSK transmitter spurious levels

Transmitter spurious levels shall be less than:

- -50 dBm in the band 30 MHz-21.2 GHz
- -30 dBm in the band 21.2-80 GHz

excluding a frequency band ± 2.5 times the channel spacing from the nominal transmitter frequency.

**Ericsson response:**
Compliant

### 4.1.5 SONET transmitter spurious emissions

The transmitter spurious emission shall be in accordance with ITU-R F.1191 and CEPT/ERC/Rec. 74-01. Transmitted spurious signals at the RAU antenna interface shall be less than:

- -50 dBm in the band 9 kHz ± 21.2 GHz
- -30 dBm in the band 21.2 GHz ± 80 GHz

excluding a frequency band ± 2.5 times the channel separation from the nominal transmitter frequency.

**Ericsson response:**
Compliant
### 4.2 Receiver performance

#### 4.2.1 Detection performance

The Vendor shall state the guaranteed detection performance for \( \text{BER} = 10^{-3} \) and \( \text{BER} = 10^{-6} \) for each frequency band, modulation and traffic capacity.

**Ericsson response:**

Compliant

<table>
<thead>
<tr>
<th>Radio unit</th>
<th>Capacity</th>
<th>BER 10-3</th>
<th></th>
<th>BER 10-6</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU2 15</td>
<td>4xDS1</td>
<td>-91</td>
<td>-88</td>
<td>-87</td>
<td>-84</td>
</tr>
<tr>
<td></td>
<td>8xDS1</td>
<td>-88</td>
<td>-85</td>
<td>-84</td>
<td>-81</td>
</tr>
<tr>
<td></td>
<td>16xDS1</td>
<td>-85</td>
<td>-82</td>
<td>-81</td>
<td>-78</td>
</tr>
<tr>
<td>RAU2 18 fd &lt; 1 GHz</td>
<td>4xDS1</td>
<td>-91</td>
<td>-88</td>
<td>-87</td>
<td>-84</td>
</tr>
<tr>
<td></td>
<td>8xDS1</td>
<td>-88</td>
<td>-85</td>
<td>-84</td>
<td>-81</td>
</tr>
<tr>
<td></td>
<td>16xDS1</td>
<td>-85</td>
<td>-82</td>
<td>-81</td>
<td>-78</td>
</tr>
<tr>
<td>RAU2 18 fd &gt; 1 GHz</td>
<td>4xDS1</td>
<td>-92</td>
<td>-89</td>
<td>-88</td>
<td>-85</td>
</tr>
<tr>
<td></td>
<td>8xDS1</td>
<td>-89</td>
<td>-86</td>
<td>-85</td>
<td>-82</td>
</tr>
<tr>
<td></td>
<td>16xDS1</td>
<td>-86</td>
<td>-83</td>
<td>-82</td>
<td>-79</td>
</tr>
<tr>
<td>RAU2 23</td>
<td>4xDS1</td>
<td>-91</td>
<td>-88</td>
<td>-87</td>
<td>-84</td>
</tr>
<tr>
<td></td>
<td>8xDS1</td>
<td>-88</td>
<td>-85</td>
<td>-84</td>
<td>-81</td>
</tr>
<tr>
<td></td>
<td>16xDS1</td>
<td>-85</td>
<td>-82</td>
<td>-81</td>
<td>-78</td>
</tr>
<tr>
<td>RAU2 38</td>
<td>4xDS1</td>
<td>-89</td>
<td>-86</td>
<td>-85</td>
<td>-82</td>
</tr>
<tr>
<td></td>
<td>8xDS1</td>
<td>-86</td>
<td>-83</td>
<td>-82</td>
<td>-79</td>
</tr>
<tr>
<td></td>
<td>16xDS1</td>
<td>-83</td>
<td>-80</td>
<td>-79</td>
<td>-76</td>
</tr>
</tbody>
</table>
4.2.2 Co-channel interference

The Vendor shall state the C/I ratio for interferer with the same modulation as the wanted signal for 1 dB and 3 dB increase of 10-6 BER limit receiver thresholds.

Ericsson response:
Compliant.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>BER limit</th>
<th>C/I (dB) for 1 dB increase of BER limit</th>
<th>C/I (dB) for 3 dB increase of BER limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>16QAM</td>
<td>10-3</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>16QAM</td>
<td>10-6</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>32QAM</td>
<td>10-3</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>32QAM</td>
<td>10-6</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>64QAM</td>
<td>10-3</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>64QAM</td>
<td>10-6</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>128QAM*</td>
<td>10-3</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>128QAM</td>
<td>10-3</td>
<td>34</td>
<td>30</td>
</tr>
<tr>
<td>128QAM</td>
<td>10-6</td>
<td>35</td>
<td>31</td>
</tr>
</tbody>
</table>

4.2.3 Adjacent channel interference

The Vendor shall state the C/I ratio for one adjacent channel interferer with the same modulation as the wanted signal for 1 dB and 3 dB increase of 10-6 BER limit receiver thresholds.

Ericsson response:
Compliant.

<table>
<thead>
<tr>
<th>Bit-rate</th>
<th>Channel spacing (MHz)</th>
<th>Modulation</th>
<th>BER limit</th>
<th>C/I (dB) for 1 dB increase of BER limit</th>
<th>C/I (dB) for 3 dB increase of BER limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4xDS1</td>
<td>2.5</td>
<td>16QAM</td>
<td>10-3</td>
<td>-9</td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-6</td>
<td>-8</td>
<td>-12</td>
</tr>
<tr>
<td>8xDS1</td>
<td>3.75</td>
<td>32QAM</td>
<td>10-3</td>
<td>-5</td>
<td>-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-6</td>
<td>-4</td>
<td>-8</td>
</tr>
<tr>
<td>8xDS1</td>
<td>5</td>
<td>16QAM</td>
<td>10-3</td>
<td>-9</td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-6</td>
<td>-8</td>
<td>-12</td>
</tr>
<tr>
<td>16xDS1</td>
<td>5</td>
<td>128QAM</td>
<td>10-3</td>
<td>-2</td>
<td>-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-6</td>
<td>-1</td>
<td>-5</td>
</tr>
</tbody>
</table>
### CW (unmodulated carrier) interference

The Vendor shall state the BER degradation due to a CW interferer.

**Ericsson response:**
Compliant

**CW Interference C-QPSK**
For a receiver operating at the specified 10⁻⁶ threshold, the introduction of a CW interferer with C/I of -30 dB at any frequency up to 80 GHz excluding a frequency two times the channel spacing either side of the wanted frequency does not result in a BER greater than 10⁻⁵.

**CW Interference QAM**
For a receiver operating at the specified 10⁻⁶ threshold, the introduction of a CW interferer with C/I of -30 dB at any frequency up to 80 GHz excluding a frequency two times the channel spacing either side of the wanted frequency does not result in a BER greater than 10⁻⁵.

<table>
<thead>
<tr>
<th>Bit-rate</th>
<th>Channel spacing (MHz)</th>
<th>Modulation</th>
<th>BER limit</th>
<th>C/I (dB) for 1 dB increase of BER limit</th>
<th>C/I (dB) for 3 dB increase of BER limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>16xDS1</td>
<td>10</td>
<td>16QAM</td>
<td>10⁻³</td>
<td>-9</td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-8</td>
<td>-12</td>
</tr>
<tr>
<td>32xDS1</td>
<td>10</td>
<td>128QAM</td>
<td>10⁻³</td>
<td>-2</td>
<td>-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-1</td>
<td>-5</td>
</tr>
<tr>
<td>32xDS1</td>
<td>20</td>
<td>16QAM</td>
<td>10⁻³</td>
<td>-9</td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-8</td>
<td>-12</td>
</tr>
<tr>
<td>69xDS1</td>
<td>20</td>
<td>128QAM</td>
<td>10⁻³</td>
<td>-2</td>
<td>-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-1</td>
<td>-5</td>
</tr>
<tr>
<td>80xDS1</td>
<td>30</td>
<td>128QAM</td>
<td>10⁻³</td>
<td>-2</td>
<td>-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-1</td>
<td>-5</td>
</tr>
<tr>
<td>80xDS1</td>
<td>40</td>
<td>16QAM</td>
<td>10⁻³</td>
<td>-5</td>
<td>-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-4</td>
<td>-8</td>
</tr>
<tr>
<td>OC-3</td>
<td>30</td>
<td>128QAM</td>
<td>10⁻³</td>
<td>-6</td>
<td>-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-5</td>
<td>-8</td>
</tr>
<tr>
<td>OC-3</td>
<td>40</td>
<td>64QAM</td>
<td>10⁻³</td>
<td>-8</td>
<td>-12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-7</td>
<td>-11</td>
</tr>
<tr>
<td>OC-3</td>
<td>50</td>
<td>16QAM</td>
<td>10⁻³</td>
<td>-12</td>
<td>-16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10⁻⁶</td>
<td>-11</td>
<td>-15</td>
</tr>
</tbody>
</table>
4.2.5 **Residual BER**

The Vendor shall state the residual BER of the equipment.

**Ericsson response:**
Compliant

**Residual BER C-QPSK**
The RBER is < 10\(^{-10}\) for DS1 signals from RF input level -30 dBm down to a level of 10 dB above the 10\(^{-6}\) threshold. Typical RBER is < 10\(^{-12}\).

**Signature C-QPSK**

<table>
<thead>
<tr>
<th>Bit-rate (Mbps)</th>
<th>Notch depth (dB)</th>
<th>Sign. width (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4xDS1</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>8xDS1</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>16xDS1</td>
<td>13</td>
<td>22</td>
</tr>
</tbody>
</table>

**Residual BER QAM**

**DS-1 traffic**
The RBER is < 10\(^{-10}\) for DS1 signals from RF input level -30 dBm down to a level of 10 dB above the 10\(^{-6}\) threshold. Typical RBER is < 10\(^{-12}\).

**OC3 Traffic**

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Residual BER thresholds</th>
<th>Residual BER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower (dB rel. 10(^{-6}) threshold)</td>
<td>Upper (dBm)</td>
</tr>
<tr>
<td>16QAM</td>
<td>+5</td>
<td>-27</td>
</tr>
<tr>
<td>64QAM</td>
<td>+5</td>
<td>-27</td>
</tr>
<tr>
<td>128QAM</td>
<td>+10</td>
<td>-27</td>
</tr>
</tbody>
</table>
4.3 Measurement of received signal level

4.3.1 Through test port

The system shall support the measurement of received RF signal level through a test port on the outdoor unit.

**Ericsson response:**
Compliant

The Vendor shall state the accuracy for measurement of received signal level, such as AGC.

**Ericsson response:**
Compliant

**For Path Acceptance**
When measured in steady state condition, an RF-input level measure is given with an accuracy of:

\[ \pm 2 \text{ dB for RF-input levels } -30 \text{ dBm to } -60 \text{ dBm} \]
\[ \pm 3 \text{ dB for RF-input levels } -60 \text{ dBm to } -80 \text{ dBm} \]

This detector shall present a voltage to an external standard voltmeter connected to the outdoor unit corresponding to RF-input level.

**Ericsson response:**
Compliant

The RF input level referred to the antenna port in dBm can be calculated from the measured voltage using the following formula:

\[ \text{RFin(dBm)} = 40 \times \text{measured\_voltage(V)} - 120 \]

4.3.2 Through the O&M system

The system shall support measurement of the received RF signal level through the O&M system.

**Ericsson response:**
Compliant
The Vendor shall state accuracy for measurement of received signal level, such as AGC.

**Ericsson response:**
Compliant

The RF input level referred to the antenna port in dBm can be calculated from the measured voltage using the following formula:

\[ \text{RFin(dBm)} = 40 \times \text{measured\_voltage(V)} - 120 \]

The accuracy of the measured voltage converted to RF-input level using the formula above shall, when measured at the Antenna Alignment Port, be within:

- ± 2.5 dB for RF-input levels -30 dBm to -60 dBm
- ± 3 dB for RF-input levels -60 dBm to -80 dBm

### 4.4 Interface characteristics

#### 4.4.1 Traffic ports

The electrical traffic interfaces of the equipment shall be according to ITU-T recommendation ITU-T G.703.

**Ericsson response:**
Compliant

The STM-1 optical interfaces of the equipment shall be according to ITU-T recommendation ITU-T G.957 S1.1.

**Ericsson response:**
Compliant

### 4.5 Latency

The latency end-to-end between two Ethernet ports, with Ethernet over PDH, directly connected excluding over the hop delay shall be:

- Less than 0.2 ms for 64 byte frame size
- Less than 0.8 ms for 2000 byte frame size

**Ericsson response:**
Compliant
The latency end-to-end between two Ethernet ports, with Ethernet over SONET, directly connected excluding over the hop delay shall be:

Less then 0.1 ms for 64 byte frame size
Less then 0.1 ms for 2000 byte frame size

**Ericsson response:**
Compliant

4.5.1 **Jitter performance**

The microwave transmission system shall comply with ITU-T Rec. G.823 (PDH) and G.825 (SONET) in terms of jitter and wander performance.

**Ericsson response:**
Compliant

4.6 **Protection schemes**

The protected system shall be able to operate in hot-standby mode or working standby mode, frequency or space diversity.

**Ericsson response:**
Compliant

The protected system shall support automatic, manual, and remote switching.

**Ericsson response:**
Compliant

The protected system shall support the replacement of faulty units, radio units, and modems, without the occurrence of errors.

**Ericsson response:**
Compliant
4.6.1 Transmitter switching

The Vendor shall state the maximum interruption time on any traffic channel during protection switching, from failure until regained frame synchronization.

Maximum interruption time on any traffic channel at hot standby switching, that is time from failure until regained frame synchronization, on final demultiplexer on receive side shall be <200 ms.

**Ericsson response:**
Compliant

The switching time is less than 200 ms.

4.6.2 Receiver hardware switching

The Vendor shall state the maximum interrupt time for hardware switching with maximum interrupt time <40 ms.

**Ericsson response:**
Compliant

The switching time is less than 40 ms.

4.6.3 Receiver hitless switching

The protected system shall support receiver hitless switching.

**Ericsson response:**
Compliant

The equipment shall support Rapid Spanning Tree Protocol (RSTP) according to IEEE 802.1D.

**Ericsson response:**
Compliant
5 Network management

5.1 Installation and field service software

It shall be possible to configure, maintain, and monitor the equipment using a PC or laptop by utilizing special network maintenance software.

Ericsson response:
Compliant

The Installation Software shall enable authorized personnel to set up and perform functional tests in both near and far end network element.

Ericsson response:
Compliant

It shall be possible to monitor alarms, receive levels, and the performance for the link according to ITU-T Rec.G826.

Ericsson response:
Compliant

Local and remote loop-back tests should be available via the software.

Ericsson response:
Compliant

The interface used for the connection between the PC and the equipment shall be specified.

Ericsson response:
Compliant

USB.

5.2 Centralized management

The Centralized Management Software shall make it possible to configure and monitor a whole network of microwave links that are interconnected at common sites by means of a data communications network.

Ericsson response:
Compliant
The Vendor shall give a general description of the management system.

**Ericsson response:**
Compliant

The ServiceOn Microwave management system is a complete element level solution for the management of the Ericsson Microwave transport portfolio. When used with the ServiceOn Network Management system, the solution can offer end-to-end management of PDH, SONET, and Ethernet services. From a single network level management screen, it offers an operator complete network control of the microwave network.

The Vendor shall give a description of the following parts of the management system:
Fault Management, Configuration Management, Performance Management, Security Management

**Ericsson response:**
Compliant

**Fault Management**

The ServiceOn Microwave management system provides up-to-the-minute information about alarm status throughout the entire transport network, regardless of the type of equipment. It is a total fault management solution for the broadband transport portfolio, enabling monitoring and control in real-time of faults and other events.

From the Network Management level, the graphical user interface allows an operator to view the complete network and through the color-coded icons and links see the state of the network and the services it carries. At both the network and element levels, the real-time alarm list displays detailed network alarm data in a textual list and allows the operator to filter the alarm list to focus in on areas of concern. At the network level, the alarms are correlated to the circuit or trail identifier to assist operators in identifying affected services. In addition, the root cause feature at the network level suppresses lower order alarms that occur as a consequence of higher level fault. This reduces the impact of major disruptions on the operators by only showing the major network faults, aiding fault finding and reducing repair times.

**Configuration Management**

ServiceOn Microwave supports detailed remote configuration of the managed equipment by use of a native terminal session for each network element family. The network element screen can be started from the icon on the network map, clicking on an entry in the alarm list, or the entry in the network tree view, saving operator time.
All the key configurable features of the network element are made available via the element interface, including port level configuration, traffic connections, test and maintenance features, and alarm and performance reporting. ServiceOn Microwave supports license key download functionality to one or more network elements enabling new feature rollout.

The manager enables remote network element configuration backup and restore operations for the MINI-LINK TN equipment to aid recovery in the event of a catastrophic loss of equipment or site. ServiceOn Microwave also enables the operator to perform remote network element software upgrades. This facility is configured to operate on a scheduled basis for a user defined selection of network elements. This facility removes the need for on site visits to upgrade element software and simplifies the rollout of upgrades and new features.

**Performance Management**

ServiceOn Microwave collects, stores, and process performance data from all the supported network elements and produces customized reports on performance and circuit quality for operations, maintenance, and planning.

Performance data is made available in both table and graph form, allowing an operator to quickly identify potential problems. Performance data from the network level is correlated to circuit or trail identifier, allowing traffic performance to be investigated.

An export interface for transferring performance management information to other systems is available. The PPM interface from the Element Manager exports data in the form of XML files, which can be transferred by FTP to the remote system.

**Security Management**

ServiceOn Microwave enforces application level security features to ensure that only authorized operators can gain access to the system and that the features they have access to are defined and controlled. The applications use a combination of passwords and user profiles to identify each user and define each user’s access rights within the system. In addition, the working days and start / end times can be defined for each operator. All operator actions are logged by the system, giving traceability.

ServiceOn Microwave also takes advantage of the operating system’s security features to extend the management solutions security features.

The Centralized Management system shall be built on a scalable hardware platform.

**Ericsson response:**
Compliant
The Vendor shall state the hardware requirements for the equipment in the management system and give an example of typical hardware.

**Ericsson response:**
Compliant

The exact hardware platform depends on a number of factors, including performance needs, availability, history log, number of plug-ins, and number of applications.

For the ServiceOn Microwave Server, Ericsson offers a basic HP Proliant platform with Linux Suse 9 SP4 OS.

For the ServiceOn Microwave client, Ericsson offers Mediation Server, an HP Compaq platform with MS Windows XP Professional SP2 OS.

For the MINI-LINK E Adapter software, Ericsson offers an HP Proliant platform with MS Windows XP Professional SP2 and MS Windows Server 2003 Standard Edition SP1 OS.

It is also possible to order increments in memory, CPU, and other optional hardware in order to get the correct hardware dimensioning for the network size.

The Vendor shall specify the availability of a connection manager capable of remotely setting up, modifying, and rerouting (manually and automatically) connections through the microwave network.

**Ericsson response:**
Compliant

Indication of any assumed third party software needed to run the management system shall be given.

**Ericsson response:**
Compliant

Linux, WM ware, Windows Server, and Windows XP.
5.3 Integration possibilities

The Vendor shall state the possibilities of integrating the management functionality of the radio link element manager into an overlaying Network Management System.

**Ericsson response:**
Compliant

ServiceOn Microwave provides a number of North Bound Interfaces that allow interworking with other higher OSS layers or BSS systems that provide functions in the overall management of a transport network. This allows the operators to integrate the system for operation, engineering, or planning purposes.

5.4 Data communication network

5.4.1 Transport capabilities

The Vendor shall state the possibility to carry non-compliant management traffic for 3rd party equipment.

**Ericsson response:**
Compliant

A Terminal Server connection can be established in MINI-LINK TN IP DCN on the G.703/64kbps, V.28, and V.11 DCN interfaces.

The Vendor shall state the possibility to propagate MINI-LINK IP-based management traffic over 3rd party non-IP compatible equipment.

**Ericsson response:**
Compliant

A PPP connection is established through the 3rd party equipment using the G.703/64kbps, V.28, and V.11 DCN interfaces.

The Vendor shall state the possibility for IP compliant 3rd party equipment to be connected to the DCN of the MINI-LINK TN.

**Ericsson response:**
Compliant

A 10/100 BASE T interface is used to connect the DCN.
5.5 System alarms and interfaces

The microwave system shall optionally provide output interfaces for the systems major alarm conditions on the indoor units in order to extend to an external monitoring system. The major alarms shall also be visible on LEDs on the indoor units.

**Ericsson response:**
Compliant

External user defined alarms shall also be optionally catered for.

**Ericsson response:**
Compliant

5.6 Loopback testing

It shall be possible to perform local and remote loop-back tests at baseband and radio levels from the indoor units. It shall also be possible to loop-back each individual tributary in the remote end. The loop-back test shall also be a feature of the network maintenance software.

**Ericsson response:**
Compliant

5.7 Receive signal strength indicator

A receive signal strength monitoring point must be provided on the outdoor unit in order for installation and maintenance staff to check the RF receive strength with a volt meter or through the network maintenance software.

**Ericsson response:**
Compliant
6 Installation and operational requirements

6.1 Portability

It shall be possible for a staff member to easily carry the outdoor unit including an integrated antenna. For this purpose, a handle or a facility that can act as a handle for carrying purposes must exist on the outdoor units.

Ericsson response:
Compliant

6.2 Maintainability

The system shall require no routine maintenance or adjustment to keep it in operation. Maintenance shall be performed on a card or unit replacement basis to keep the maintenance skill level as low as possible.

Ericsson response:
Compliant

6.3 Outdoor unit mounting

The Vendor shall supply standard antenna mounting kits for poles with diameters of up to 114 mm.

Ericsson response:
Compliant

In case of integrated configurations, the main pole-mounting bracket shall preferably be screw mounted on the antenna. In this case the outdoor unit shall be mounted onto the antenna by means of a hooking mechanism and a minimum amount of screws. It shall be possible for maintenance staff to remove the outdoor unit without disturbing the antenna alignment, and in a (1+1) configuration without disturbing the traffic. The mounting bracket shall allow for easy fine alignment of elevation and azimuth.

Ericsson response:
Compliant
The outdoor unit shall be housed in an enclosure suitable for roof top, wall mount, tripod, and mast installations with suitable connectors for a flexible waveguide where necessary.

**Ericsson response:**
Compliant

All units are to be clearly identifiable as high or low band transmitting with reference to the operating frequency band.

**Ericsson response:**
Compliant

### 6.4 Indoor unit mounting

It shall be possible to mount the indoor units in 19" racks.

**Ericsson response:**
Compliant

**MINI-LINK TN indoor enclosures can be mounting in 19 inch enclosures.**

The Vendor shall specify the availability and provide a description of outdoor cabinets and housings.

**Ericsson response:**
Compliant

**MPH for MINI-LINK TN**

The MPH for MINI-LINK TN is a slim, water protected outdoor casing used to house the subrack AMM 2p B connected to an RAU with antenna. The MPH can be installed on a pole with a diameter of 50-120 mm or on a wall.

The AMM 2p B is placed vertically inside the MPH, which provides cooling fins on the inside and the outside. A sun shield is placed on the MPH, in order to reduce the effects of solar radiation. The FAU inside the AMM 2p B helps cooling the MPH.

The bottom of the MPH holds seven cable bushings and two adapters for connection of the radio cables. One traffic cable and one DC cable are always fed while the remaining cable bushings can be used for different cables.

The front of the MPH is easily opened to get access to the AMM 2p B and its PIUs.
TMR 9302

TMR 9302 can house 19" units, placed in a vertical position. The available space in the cabinet is 6U. It holds an AMM 6p C/D or AMM 2p B with plug-in units. It can be mounted on a pole with diameter of 50 - 120 mm or on a wall. Two eyebolts are included for hoisting.

The cabinet has two doors, one on the front and one on the back.

Cooling of the equipment is done by a heat exchanger, including four fans. One internal air loop and one external air loop divide the outdoor air from the indoor air. Two indoor fans and two outdoor fans provide redundancy.

The cabinet can be equipped with an optional heater, including a thermostat, for operation in cold environments. The heater is power supplied by -48 V DC.

The bottom of the cabinet holds 12 cable bushings where DC and traffic cables can be fed. The bottom also holds five adapters for radio cable connection. A fan alarm can be used to detect cooling system malfunction. Furthermore, a door sensor is mounted in the cabinet, which can be used to generate an alarm when the lockable door is opened.

The TMR 9302 is power supplied by -48 V DC, from an external DC supply source or an optional dedicated AC/DC converter (PSU). The PSU converts 100-250 V AC to -48 V DC. The maximum output power is 420 W. The PSU fulfills Over Voltage Category II, according to IEC60950. The PSU supports the same mounting alternatives as the TMR 9302.

6.5 Antennas

6.5.1 Antenna alignment

In order to simplify antenna alignment and maintenance, test access to the RF unit is required by installation and maintenance staff so that the receive signal level can be peaked during antenna alignment operations.

**Ericsson response:**

Compliant

For alignment operations, Vendor shall provide a means of confirmation of the transmitter identity derived from the far end and means of determining the test receive signal strength, within a limit of +/- 2 dB with a received signal strength range of -30 dBm to -60 dBm.

**Ericsson response:**

Compliant
Alignment of the integrated RF unit and antenna should provide +/- 15° for fine adjustment for both elevation and azimuth.

**Ericsson response:**
Compliant

### 6.5.2 Antenna feeder

Where the RF unit and antenna are installed as separate items, the interconnecting mechanism shall be compatible with the use of flexible waveguide. Vendor shall provide a suitable means of clamping the flex section to prevent wind related failures and comply with the bending and twist specifications.

**Ericsson response:**
Compliant

Weatherproof connection to seal the waveguide flanges shall be impervious to moisture. It shall be possible to mount the antenna and radio unit separately without the use of pressurization or dehydrators up to a distance of .9 meter.

**Ericsson response:**
Compliant

The Vendor shall specify the availability of integrated power splitters in order to reduce or avoid the use of flexible waveguides in 1+1 configurations.

**Ericsson response:**
Compliant

### 6.5.3 Antenna polarization

It shall be possible to use integrated antennas with both horizontal and vertical polarization. Changing from one to the other polarization shall be possible with the same antenna without disturbing the antenna alignment.

**Ericsson response:**
Compliant
6.5.4 Antenna interface

The antenna interface shall be according to IEC standards as indicated in the table below.

The waveguide flanges of the antenna interface should be according to:

<table>
<thead>
<tr>
<th>Frequency band</th>
<th>The antenna interface mate</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 GHz</td>
<td>154 IEC-UDR 70</td>
</tr>
<tr>
<td>7 GHz</td>
<td>154 IEC-UBR 84</td>
</tr>
<tr>
<td>8 GHz</td>
<td>154 IEC-UBR 84</td>
</tr>
<tr>
<td>10 GHz</td>
<td>154 IEC-UBR 120</td>
</tr>
<tr>
<td>11 GHz</td>
<td>154 IEC-UBR 120</td>
</tr>
<tr>
<td>15 GHz</td>
<td>154 IEC-UBR 140</td>
</tr>
<tr>
<td>18 GHz</td>
<td>154 IEC-UBR 220</td>
</tr>
<tr>
<td>26 GHz</td>
<td>154 IEC-UBR 260</td>
</tr>
<tr>
<td>28 GHz</td>
<td>154 IEC-UBR 260</td>
</tr>
<tr>
<td>32 GHz</td>
<td>154 IEC-UBR 320</td>
</tr>
<tr>
<td>38 GHz</td>
<td>154 IEC-UBR 320</td>
</tr>
</tbody>
</table>

Ericsson response: Compliant

6.6 Equipment reliability

The Vendor shall state the availability figures for complete unprotected terminals PDH or SONET (1+0) and for protected terminals (1+1) based on an MTTR of 4 hours.

Ericsson response: Compliant

The equivalent MTBF figures for an unprotected PDH terminal (1+0) with a maximum capacity of 32xDS1 shall be at least 52 years.

Ericsson response: Compliant
The equivalent MTBF figures for an unprotected PDH terminal (1+0) with a maximum capacity above 32xDS1 shall be at least 27 years.

**Ericsson response:**
Compliant

The equivalent MTBF figures for an unprotected SONET terminal (1+0) shall be at least 27 years.

**Ericsson response:**
Compliant

The equivalent MTBF figures for a protected PDH terminal (1+1) with a maximum capacity of 32xDS1 shall be at least 500 years.

**Ericsson response:**
Compliant

The equivalent MTBF figures for a protected PDH terminal (1+1) with a maximum capacity above 32xDS1 shall be at least 200 years.

**Ericsson response:**
Compliant

The equivalent MTBF figures for a protected SONET terminal (1+1) shall be at least 200 years.

**Ericsson response:**
Compliant