MINI-LINK TN ETSI

Technical Description

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Contents

1 Introduction

1.1 General

MINI-LINK is the world's most deployed microwave transmission system. The MINI-LINK TN product family is the latest addition, offering compact, scalable, and cost-effective solutions.

The system provides integrated traffic routing, PDH and SDH multiplexing, Ethernet transport as well as protection mechanisms on link and network level. The software configurable traffic routing minimizes the use of cables, improves network quality and facilitates control from a remote location. With the high level of integration, rack space can be reduced by up to 70% compared to traditional solutions.

Configurations range from small end sites with one single radio terminal to large hub sites where all the traffic from a number of southbound links is aggregated into one link, microwave or optical, in the northbound direction.
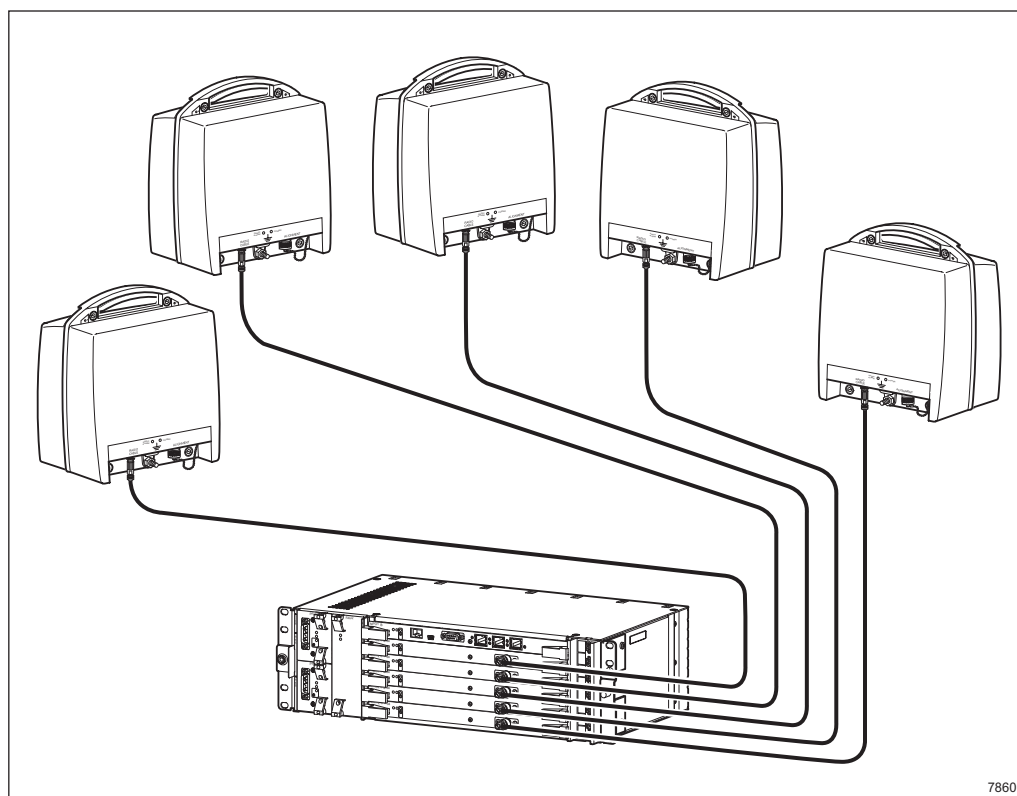
Figure 1   A MINI-LINK TN configuration

The purpose of this description is to support the reader with detailed information on included products with accessories, from technical and functional points of view.

Detailed technical system data is available in *MINI-LINK TN ETSI Product Specification*.

Note: If there is any conflict between this document and information in *MINI-LINK TN ETSI Product Specification* or compliance statements, the latter ones will supersede this document.

Some function described in this document is subject to optional features handling. For ordering information please refer to the latest revision of *MINI-LINK TN, MINI-LINK HC, MINI-LINK E ETSI Product Catalog*.

An introduction to the MINI-LINK ETSI portfolio is given in *MINI-LINK ETSI Product Portfolio Description*.

Related documents are listed in Section 1.2.

1.2   Related Documents

Table 1 contains documents related to this document. References are made in *Italics* using the document name only.

Table 1   Related documents

MINI-LINK TN, MINI-LINK HC, MINI-LINK E ETSI Product Catalog (referred to as Product Catalog)	EN/LZT 712 0191
MINI-LINK ETSI Product Portfolio Description	EN/LZT 712 0187
MINI-LINK TN ETSI Product Specification	1301-CSH 109 32/1
MINI-LINK DCN Guideline ETSI	1/15443-FGB 101 004/1
MINI-LINK TN ETSI Indoor Installation Manual	EN/LZT 712 0122
MINI-LINK TN ETSI Operation Manual	EN/LZT 712 0177
PSU DC/DC Kit Installation Instruction	EN/LZT 712 0219
MINI-LINK Management Product Description	5/1550-AOM 901 02/3
MINI-LINK Connexion User Manual	3/1553-ZAN 601 01/14
MINI-LINK Engineering Order Wire Feature Description	1/221 04-FGB 101 004/1

1.3   Revision Information

This release of the document includes an update of the MINI-LINK TN ETSI functions within the scope of market release MINI-LINK R11.

The following major changes have been made since the last release:

- NPU1 B replaces NPU 8x2

- AMM 6p B with PFU3 replaces AMM 6p with PFU2

- ATU is introduced

- ETU2 is introduced

- General document improvements

2 System Overview

This section gives a brief introduction to the system and its components.

2.1 Introduction
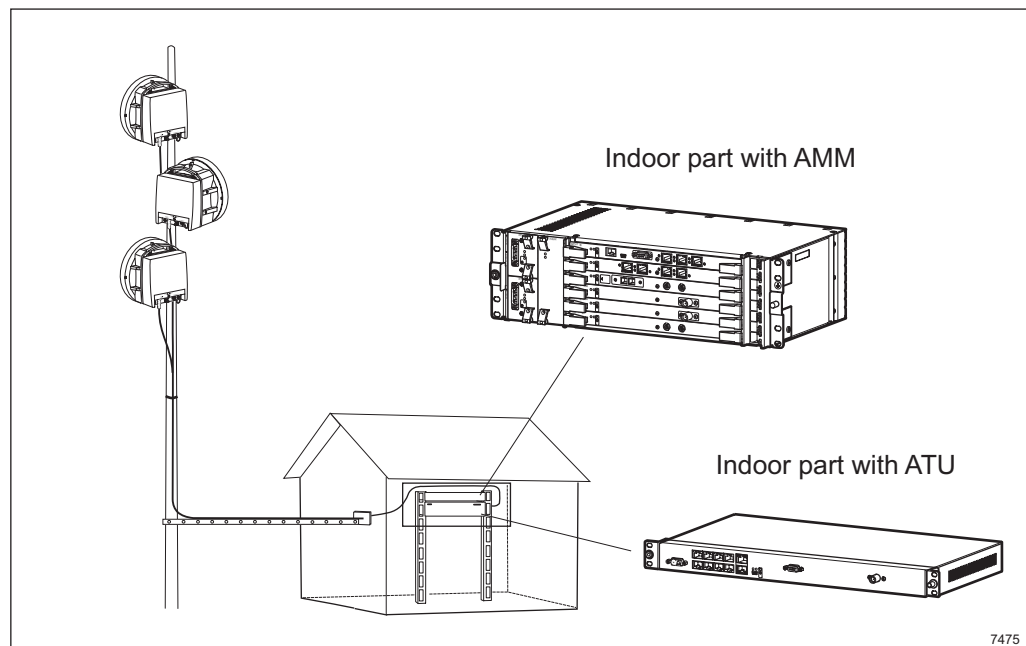
Figure 2   Outdoor and indoor parts ATU

A MINI-LINK TN Network Element (NE) can, from a hardware and installation point of view, be divided into two parts:

- Indoor part of two types:

    - Access Module Magazine (AMM) with plug-in units, see Section 2.2

    - Access Termination Unit (ATU), see Section 2.3

- Outdoor part, see Section 2.4

An NE with AMM can from a functional and configuration point of view be divided into the following parts:

Basic Node   The Basic Node holds the system platform providing traffic and system control, such as traffic routing, multiplexing, protection mechanisms and management functions.

It also provides traffic interfaces, PDH, SDH and Ethernet, for connection to network equipment such as a radio base station, ADM or LAN.

Finally, it includes indoor mechanical housing, power distribution and cooling.

For more information, see Section 3.

Radio Terminals   Each Radio Terminal provides microwave transmission from 2x2 to 32x2 Mbit/s, operating within the 7 to 38 GHz frequency bands, utilizing C-QPSK and 16 QAM modulation schemes. It can be configured as unprotected (1+0) or protected (1+1).

For more information, see Section 4.
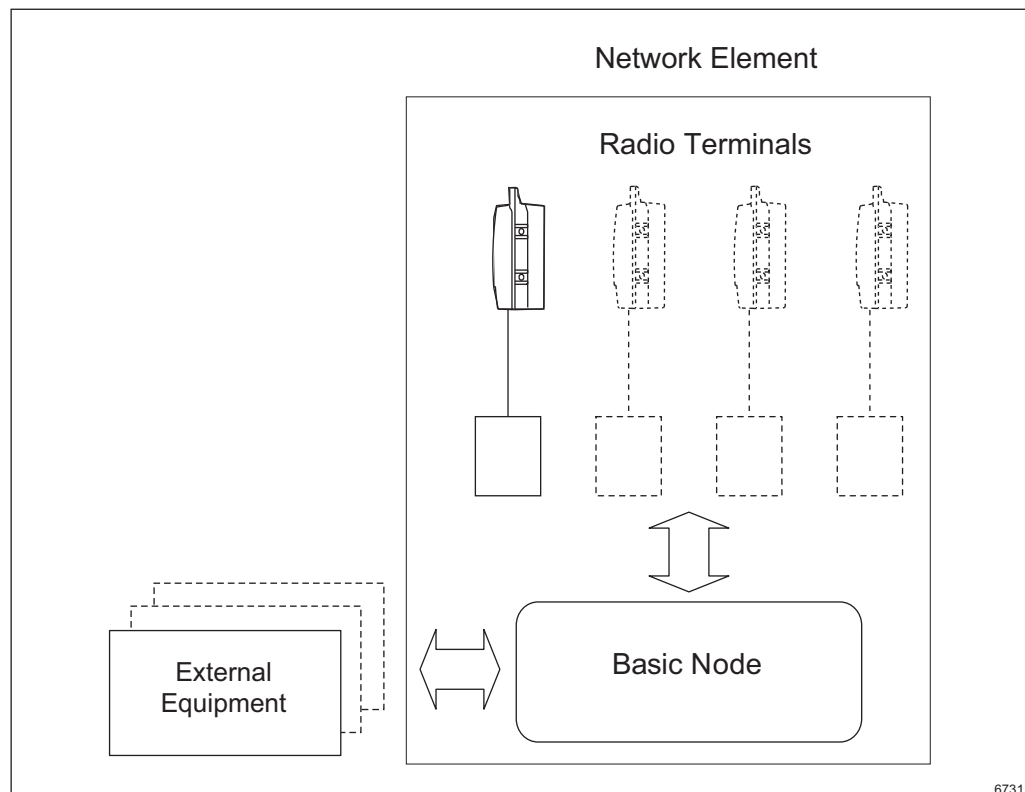
Figure 3   Basic Node and Radio Terminals

The Basic Node and Radio Terminal concept does not apply to an NE with ATU. However, the self-contained unit implements applicable parts such as, traffic interfaces, control and management functions, power, cooling and the indoor part of an unprotected (1+0) Radio Terminal with C-QPSK modulation.

The management features and tools are described in Section 5.

2.2 Indoor Part with AMM
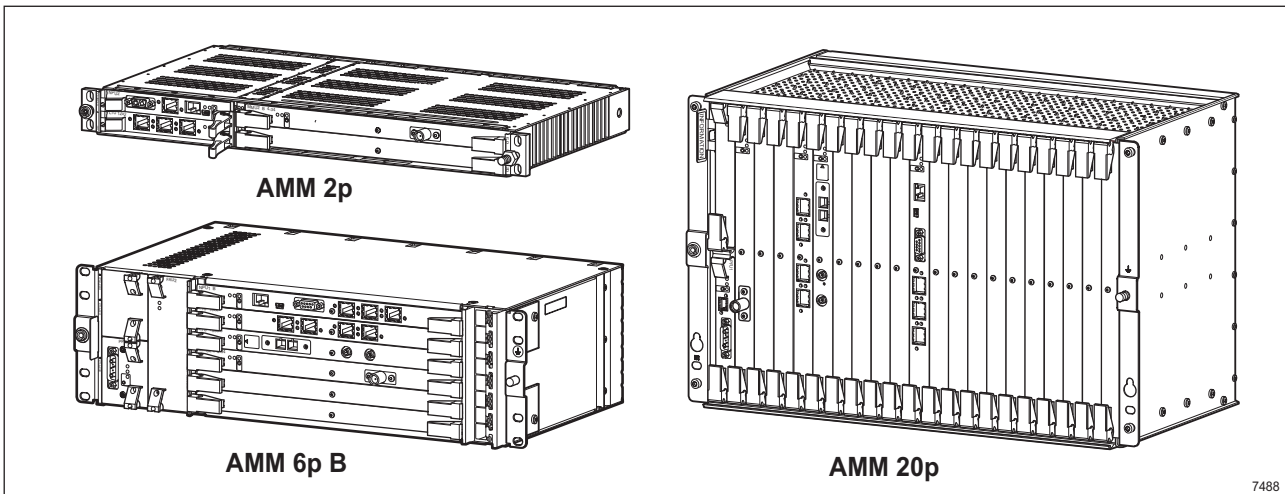
Figure 4   AMMs

The indoor part consists of an Access Module Magazine (AMM) with plug-in units interconnected via a backplane. One plug-in unit occupies one slot in the AMM. The AMM fits into standard 19" or metric racks and cabinets.

The following text introduces the standard indoor units and their main functions. For each unit there exist several types with different properties, further described in Section 3 and Section 4.

Access Module Magazine (AMM)	Houses the plug-in units and provides backplane interconnection of traffic, power and control signals.
Node Processor Unit (NPU)	Handles the system's control functions. It also provides traffic and management interfaces.
Line Termination Unit (LTU)	A plug-in unit that provides PDH or SDH traffic interfaces.
Modem Unit (MMU)	The indoor part of a Radio Terminal. This plug-in unit determines the traffic capacity and modulation scheme of the Radio Terminal.
Ethernet Interface Unit (ETU)	A plug-in unit that provides Ethernet traffic interfaces.
Power Filter Unit (PFU)	Filters the external power and distributes the internal power to the plug-in units via the backplane.
Fan Unit (FAU)	Provides cooling for the indoor part.

The indoor part also includes cables and installation accessories.

The interconnection between the outdoor part (Radio Units and antennas) and the indoor part is one coaxial cable per MMU carrying full duplex traffic, DC supply voltage, as well as management data.

2.3 Indoor Part with ATU

The Access Termination Unit (ATU) implements the indoor part of an NE dedicated as an edge node for microwave transmission in mobile networks. It can also be used in Ethernet bridge applications.

The ATU comprises one self-contained unit for installation in 19" or metric racks and cabinets. It can also be mounted on a wall.
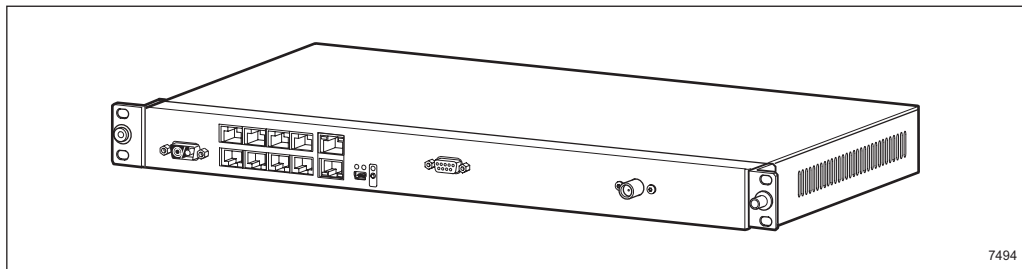
Figure 5   ATU

The ATU provides unprotected (1+0) microwave transmission within the 7 to 38 GHz frequency bands using C-QPSK modulation, when connected to an RAU with antenna. The interconnection between the ATU and the outdoor part is one coaxial cable carrying full duplex traffic, DC supply voltage, as well as management data.

The available traffic capacity from 2x2 to 17x2 Mbit/s is shared between PDH traffic with a maximum of 8xE1and Ethernet traffic over a maximum of 16xE1.

The ATU is further described in Section 5.

2.4　Outdoor Part

The outdoor part is supplied for various frequency bands. It consists of an antenna, a Radio Unit (RAU) and associated installation hardware. For protected (1+1) systems, two RAUs and one or two antennas are used. When using one antenna, the two RAUs are connected to the antenna using a power splitter.

The RAU and the antenna are easily installed on a wide range of support structures. The RAU is fitted directly to the antenna as standard, integrated installation. The RAU and the antenna can also be fitted separately and connected by a flexible waveguide. In all cases, the antenna is easily aligned and the RAU can be disconnected and replaced without affecting the antenna alignment.

The RAU is described in Section 4.3.

The antennas are described in Section 4.4.

1+0 terminal
integrated installation
0.2 m compact antenna

1+0 terminal
separate installation
0.6 m compact antenna

1+1 terminal
integrated power splitter
0.3 m compact antenna

7463
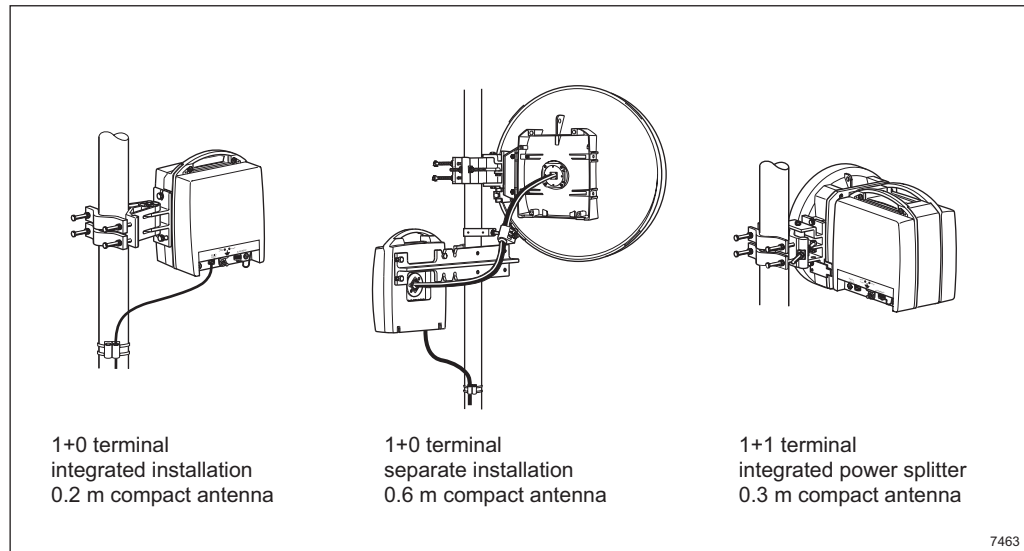
Figure 6　RAUs and antennas in different installation alternatives

3 Basic Node

This section describes the Basic Node functions, hardware and traffic interfaces.

3.1 System Architecture

The system architecture is based on a Node Processor Unit (NPU) communicating with other plug-in units, via buses in the AMM backplane. The buses are used for traffic handling, system control and power distribution.
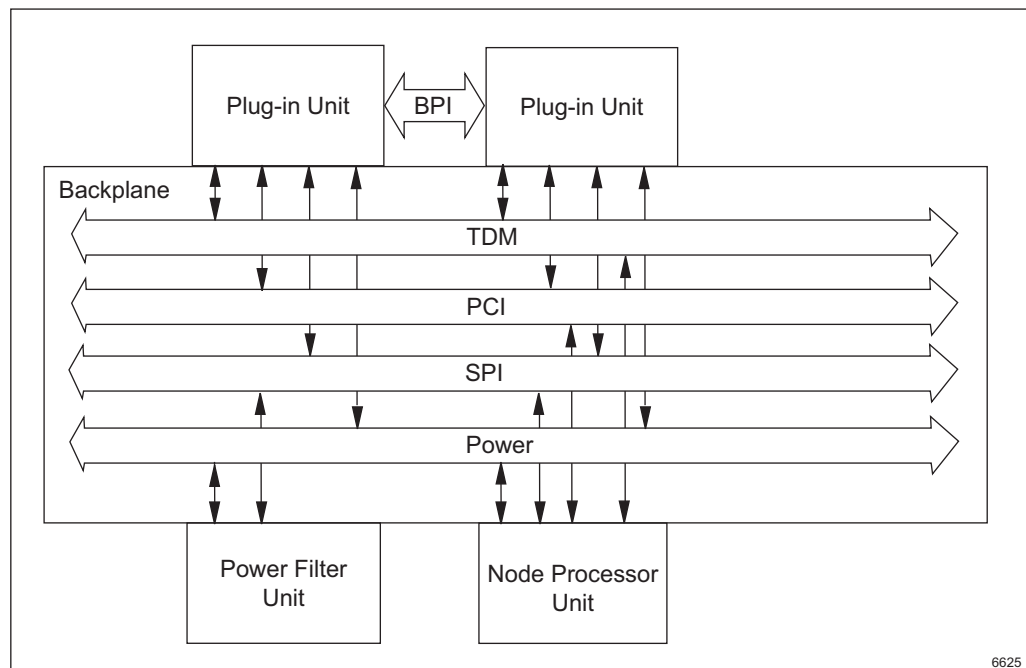
Figure 7   System architecture

3.1.1 TDM Bus

The Time Division Multiplexing (TDM) bus is used for traffic routing between the plug-in units. It also used for routing of the DCN channels, used for O&M data transport. The switching granularity is E1 for traffic connections and 64 kbit/s for DCN channels. The traffic connections on the TDM bus are unstructured with independent timing.

The bus has a switching capacity of 820 Mbit/s. It is redundant for additional protection against hardware failures.

3.1.2 PCI Bus

The Peripheral Component Interconnect (PCI) bus is a high bandwidth multiplexed address/data bus used for control and supervision. Its main use is for communication between the NPU software and other plug-in units' software and functional blocks.

3.1.3 SPI Bus

The Serial Peripheral Interface (SPI) bus is a low speed synchronous serial interface bus used for:

- Unit status control and LED indication

- Board Removal (BR) button used for unit replacement

- Inventory data

- Temperature and power supervision

- User I/O communication

- Reset of control and traffic logic

3.1.4 Power Bus

The external power supply is connected to a PFU (or NPU2 for AMM 2p). The internal power supply is distributed via the Power bus to the other plug-in units. When using two PFUs in an AMM 20p, the bus is redundant.

3.1.5 BPI Bus

The Board Pair Interconnect (BPI) bus is used for communication between two plug-in units in a protected (1+1) configuration, for example when using two LTU 155 units in a Multiplexer Section Protection (MSP) 1+1 configuration.

3.2 Access Module Magazine (AMM)

The indoor part consists of an Access Module Magazine (AMM) with plug-in units. This section describes the AMM types and their associated cooling and power supply functions.

3.2.1 AMM 2p

AMM 2p is suitable for end site and repeater site applications. It has two full-height slots and two half-height slots and it houses one NPU2, one or two MMUs, and the optional LTU 12x2 and FAU4.

AMM 2p can be fitted in a rack or on a wall.

Figure 8   AMM 2p

3.2.1.1 Power Supply

AMM 2p is power supplied by –48 V DC or +24 V DC, connected to the NPU2. The power is distributed from the NPU2 to the plug-in units, via the power bus in the backplane of the AMM.
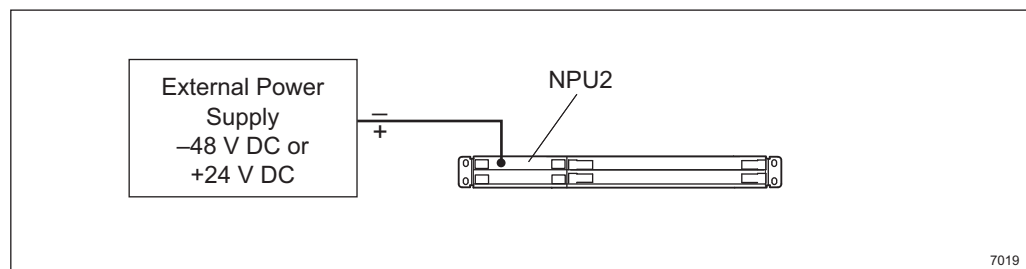
Figure 9   Power supply for AMM 2p

3.2.1.2   **Cooling**

AMM 2p can be used with or without forced air-cooling, depending on configuration. Forced air-cooling is provided by FAU4, placed vertically inside the AMM. FAU4 holds three internal fans.

If the indoor location has other fan units, which provide sufficient cooling through the AMM, the FAU4 can be omitted. However, air filters should be present in the cabinet door.

Complete rules for cooling are available in *MINI-LINK TN ETSI Product Specification* and the *Product Catalog.*
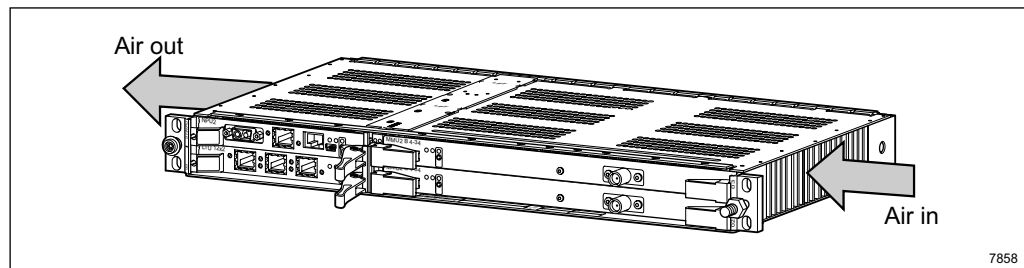
Figure 10   Cooling airflow in AMM 2p

The air enters at the right hand side of the AMM and exits at the left hand side of the AMM.

3.2.2 AMM 6p B

AMM 6p B is suitable for medium-sized hub sites. It has six full-height slots and two half-height slots. It houses one NPU1 B, one or two PFU3 (in one slot) and one FAU2.

The remaining slots are equipped with MMUs, LTUs or ETUs. Protected pairs, for example two MMUs in a protected (1+1) Radio Terminal, are positioned in adjacent slots starting with an even slot number.
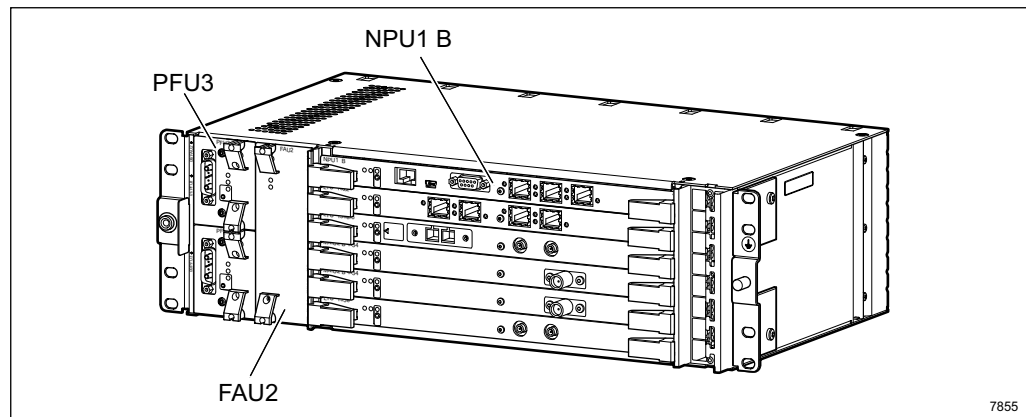
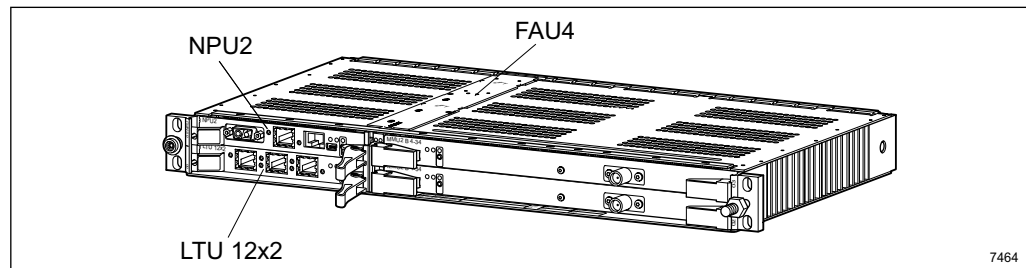*Figure 11   AMM 6p B*

3.2.2.1 Power Supply

AMM 6p B is power supplied by –48 V DC, connected to the PFU3. The power is distributed from the PFU3 to the other units, via the power bus in the backplane of the AMM.

The power system is made redundant using two PFU3s, utilizing the redundant power bus.

Using the PSU DC/DC kit enables connection to a +24 V DC power supply, see Section 7.2.
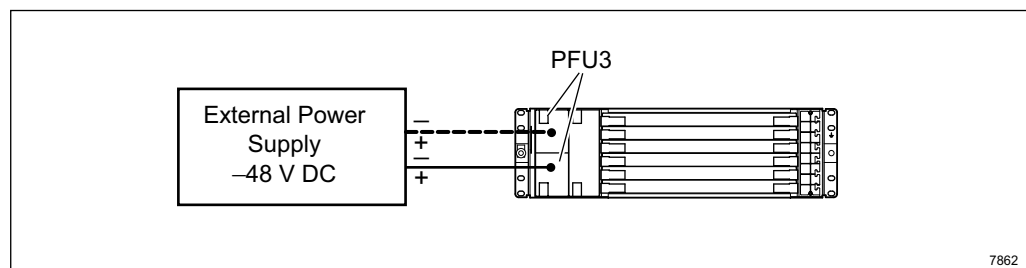
Figure 12   Power supply for AMM 6p B
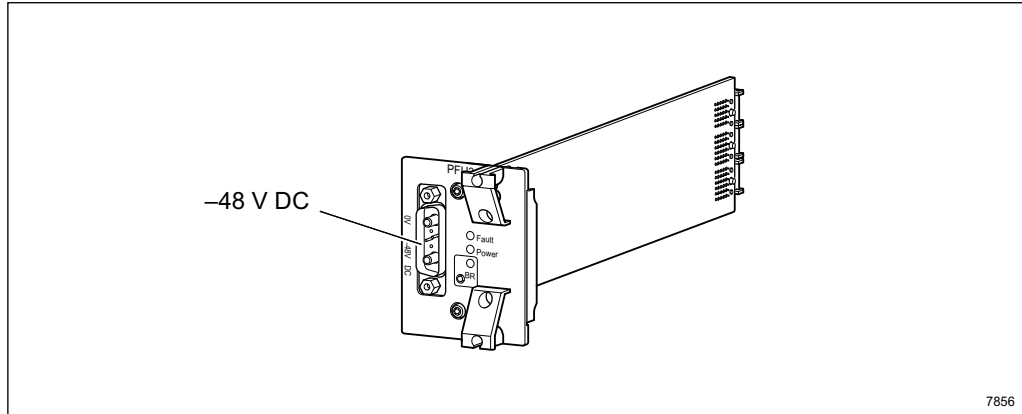
Figure 13   PFU3

PFU3 has one –48 V DC connector for external power supply.

PFU3 provides input under voltage protection, transient protection, soft start and electronic fuse to limit inrush currents at start-up, or over currents during short circuit.

3.2.2.2   Cooling

Forced air-cooling is always required and provided by FAU2, which holds two internal fans.
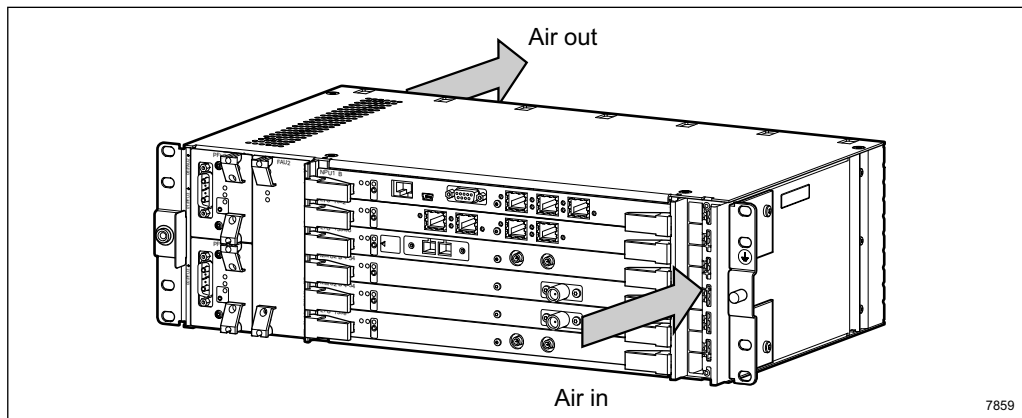
Figure 14   Cooling airflow in AMM 6p B

The air enters at the front on the right hand side of the AMM and exits at the rear on the left hand side of the AMM.

3.2.3 AMM 20p

The AMM 20p is suitable for large-sized hub sites, for example at the intersection between the optical network and the microwave network. It has 20 full-height slots and two half-height slots and it houses one NPU1 B and one or two PFU1.

The remaining slots are equipped with MMUs, LTUs or ETUs. Protected pairs, for example two MMUs in a protected (1+1) Radio Terminal, are positioned in adjacent slots starting with an even slot number.

A cable shelf is fitted directly underneath the AMM to enable neat handling of cables connected to the fronts of the plug-in units.

An FAU1 is fitted on top of the AMM unless forced air-cooling is provided. An air guide plate is fitted right above the FAU1.
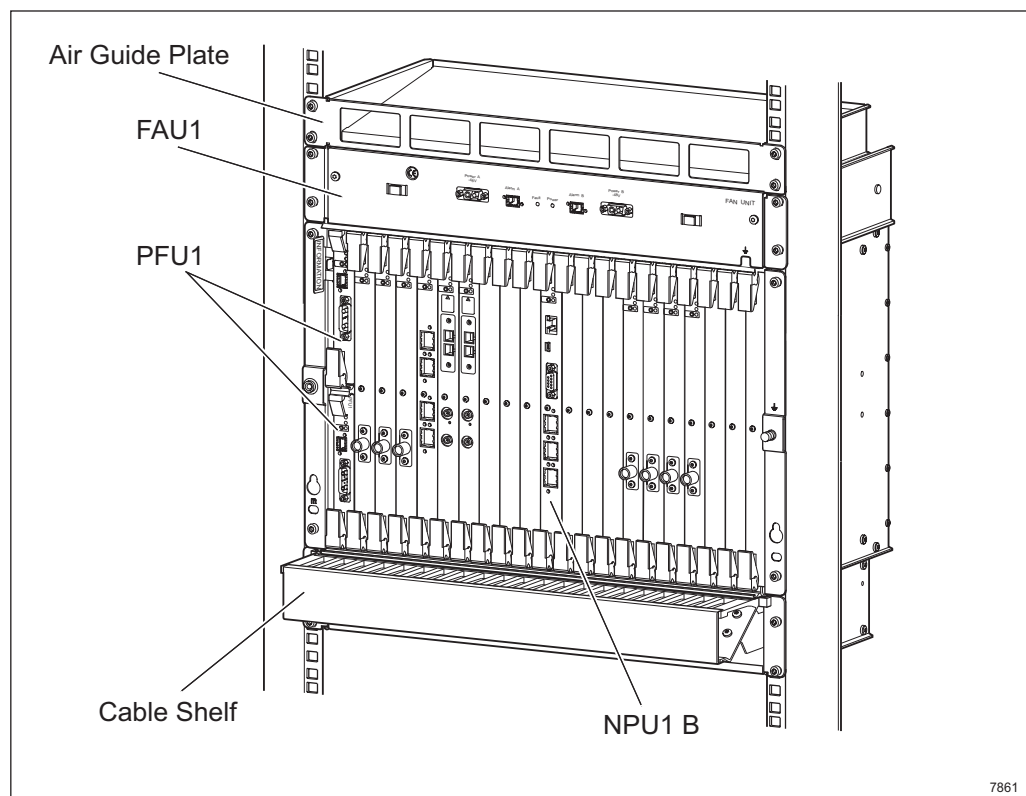
Figure 15   AMM 20p

3.2.3.1 Power Supply

AMM 20p is power supplied by –48 V DC, connected to the PFU1 or via an Interface Connection Field (ICF1). The power is distributed from the PFU1 to the plug-in units, via the power bus in the backplane of the AMM.

The power system is made redundant using two PFU1s, utilizing the redundant power bus.

Using the PSU DC/DC kit enables connection to +24 V DC power supply, see Section 7.2. The ICF1 is not used in this installation alternative.
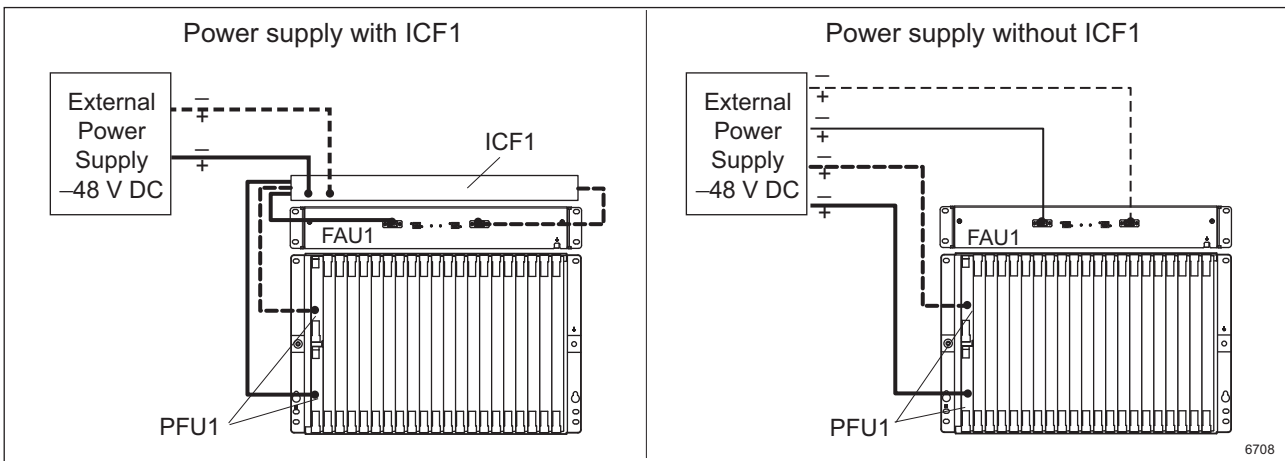
Figure 16   Power supply for AMM 20p
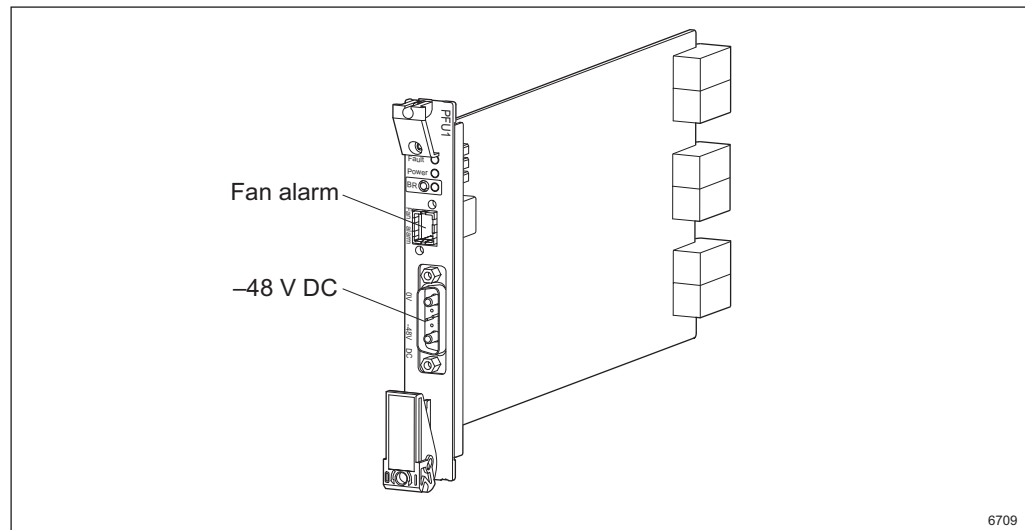
Figure 17   PFU1

PFU1 has one –48 V DC connector for external power supply and one connector for import of alarms from FAU1, since FAU1 is not connected to the AMM backplane.

PFU1 provides input under voltage protection, transient protection, soft start and electronic fuse to limit inrush currents at start-up, or over currents during short circuit.

A redundant PFU1 can be extracted or inserted without affecting the power system.

3.2.3.2 Cooling

Forced air-cooling is provided by FAU1, fitted directly above the AMM. The air enters through the cable shelf, flows directly past the plug-in units and exits at the top of the AMM through the air guide plate.

If the indoor location has other fan units, which provide sufficient cooling through the AMM, the FAU1 can be omitted. However, air filters should be present in the cabinet door.

Complete rules for cooling are available in *MINI-LINK TN ETSI Product Specification* and the *Product Catalog*.
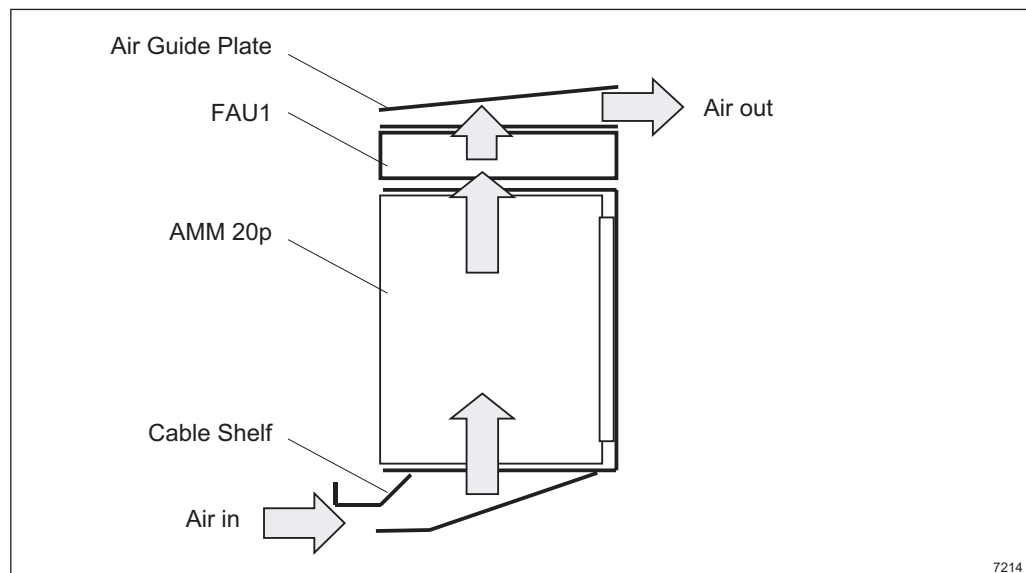
Figure 18   Side view of the airflow in AMM 20p
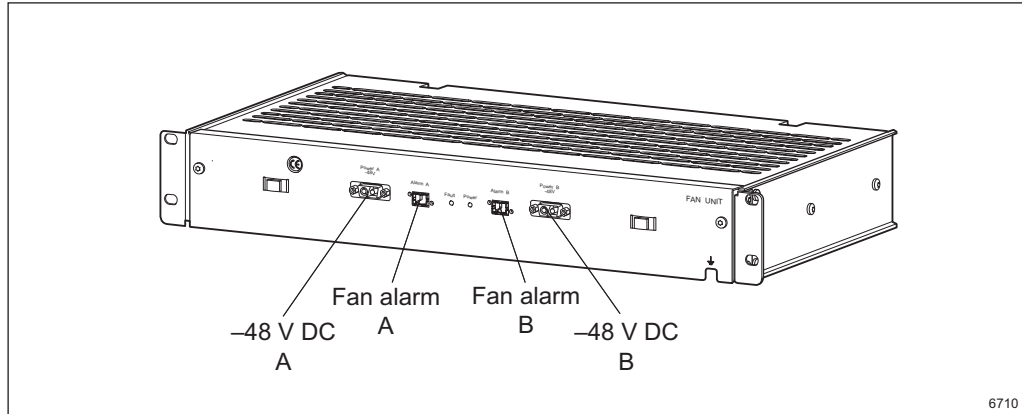
Figure 19   FAU1

FAU1 has an automatic fan speed control and holds three internal fans.

FAU1 has two –48 V DC connectors for redundant power supply. Two connectors are also available for export of alarms to PFU1.

3.3 Node Processor Unit (NPU)

3.3.1 Overview

The NPU implements the system's control functions. One NPU is always required in the AMM. The NPU also provides E1, DCN and management interfaces.

The following NPUs are available:

NPU2   Fits in an AMM 2p.

NPU1 B   Fits in an AMM 6p B and AMM 20p.
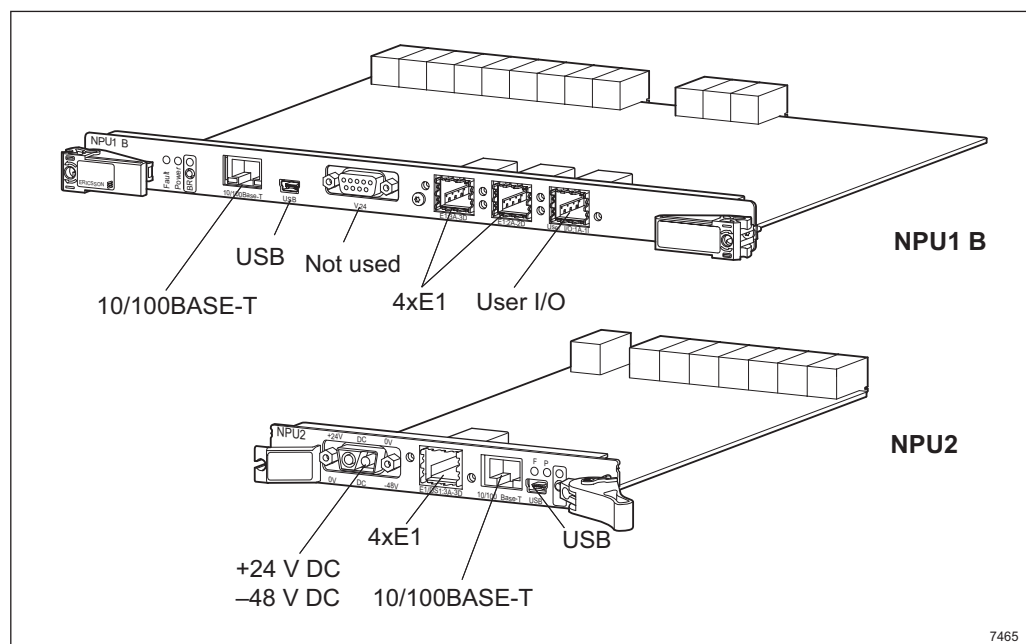
Figure 20   NPUs

The following summarizes the common functions of the NPUs:

- Traffic handling

- System control and supervision

- IP router for DCN handling

- SNMP Master Agent

- Ethernet interface for connection to a site LAN

- Storage and administration of inventory and configuration data

- USB interface for LCT connection

There are also some specific functions associated with each NPU type as summarized below.

NPU2
- 4xE1 for traffic connections
- Filters the external power and distributes the internal power
- The Ethernet interface can be used for Ethernet bridge applications

NPU1 B
- 8xE1 for traffic connections
- Three User Input ports
- Three User Output ports

3.3.2 Functional Blocks

This section describes the internal and external functions of the NPUs, based on the block diagrams in Figure 21 and Figure 22.
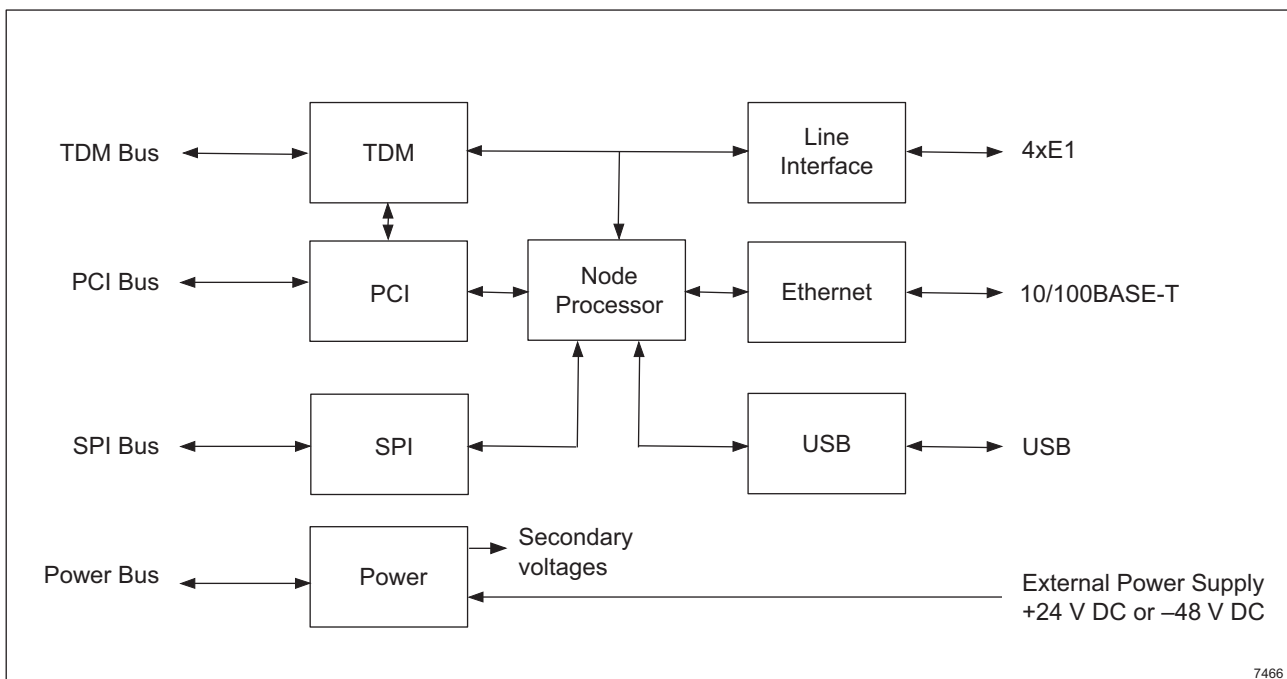
Figure 21 Block diagram for NPU2
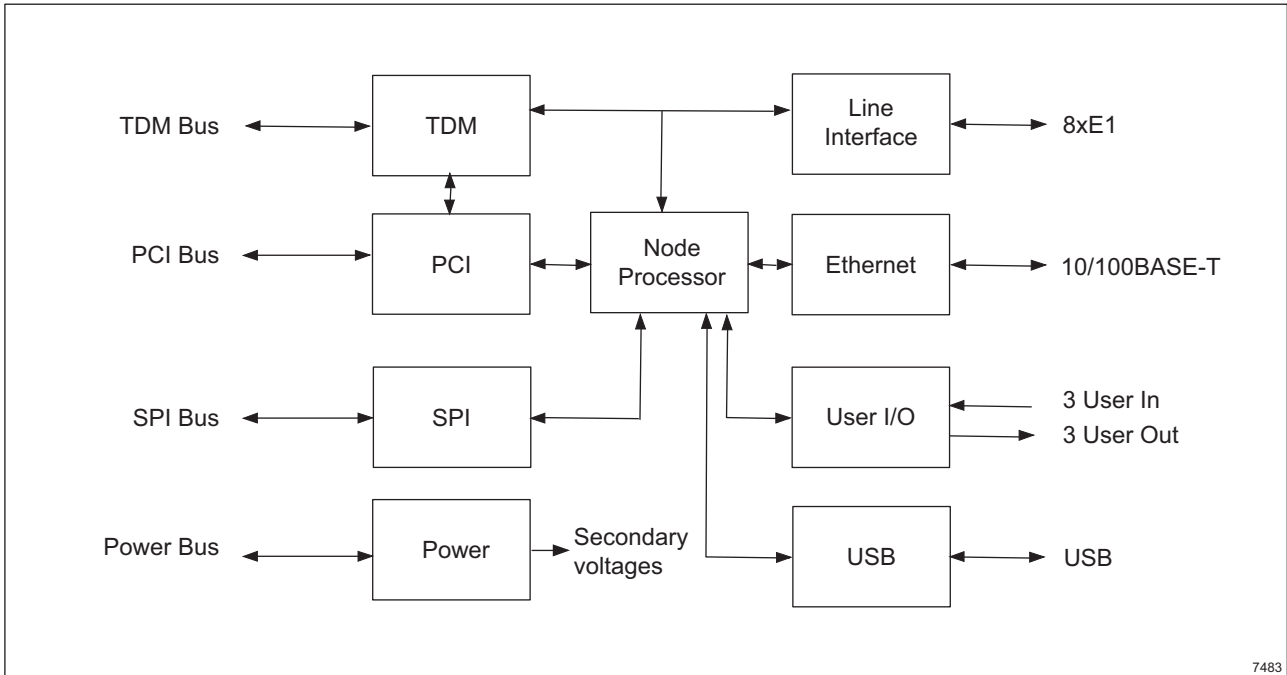
Figure 22   Block diagram for NPU1 B

3.3.2.1   TDM

This block interfaces the TDM bus by receiving and transmitting the traffic (nxE1) and DCN channels (nx64 kbit/s).

The Node Processor communicates with the TDM block via the PCI block.

3.3.2.2   PCI

This block interfaces the PCI bus used for control and supervision communication. The block communicates with the Node Processor, which handles control and supervision of the whole NE.

3.3.2.3   SPI

This block interfaces the SPI bus used for equipment status communication. The block communicates with the Node Processor, which handles equipment status of the whole NE.

Failure is indicated on LEDs on the front of the unit.

3.3.2.4 Power

This block interfaces the Power bus and provides secondary voltages for the unit. All plug-in units have a standard power module providing electronic soft start and short circuit protection, filter function, under voltage protection, DC/DC converter and a pre-charge function.

For NPU2, the external power, +24 V DC or –48 V DC, is connected to the unit. The block provides input under voltage protection, transient protection, soft start and electronic fuse to limit inrush currents at start-up, or over currents during short circuit.

3.3.2.5 Node Processor

The Node Processor is the central processor of the NE, responsible for the traffic and control functions listed in Section 3.3.1.

3.3.2.6 Line Interface

This block provides the E1 line interfaces for external connection.

3.3.2.7 Ethernet

This block provides a 10/100BASE-T connection to site LAN. For NPU2 it also handles the 10/100BASE-T traffic in Ethernet bridge applications. The Ethernet traffic is mapped on nxE1, where n≤16, using one inverse multiplexer.

An IP telephone can be connected to the Ethernet interface, enabling service personnel to make calls to other sites. This digital Engineering Order Wire (EOW) solution utilizes VoIP in the IP DCN. For more information on EOW for MINI-LINK, see *MINI-LINK Engineering Order Wire Feature Description*.

3.3.2.8 USB

This block provides the LCT connection for NPU. The equipment is accessed using a local IP address.

3.3.2.9 User I/O

This block handles the User In and User Out ports on the NPU1 B, see section 6.1.3.

3.4   E1 Interfaces

This section describes the plug-in units providing short haul 120 Ω balanced E1 (G.703) interfaces. In a mobile access network these are typically used for traffic connection to a radio base station or for connection to leased line networks.

3.4.1   NPU

The NPU2 provides four E1 interfaces and the NPU1 B provides eight E1 interfaces, see Section 3.3.

3.4.2   LTU

3.4.2.1   Overview

The following LTUs with E1 interfaces are available:

LTU 12x2   Fits in an AMM 2p. For sites where the four E1 interfaces on the NPU2 are insufficient, the LTU 12x2 provides 12 additional E1 interfaces.

LTU 16x2   Fits in an AMM 6p B and AMM 20p. For sites where the eight E1 interfaces on the NPU1 B are insufficient, the LTU 16x2 provides 16 additional E1 interfaces.
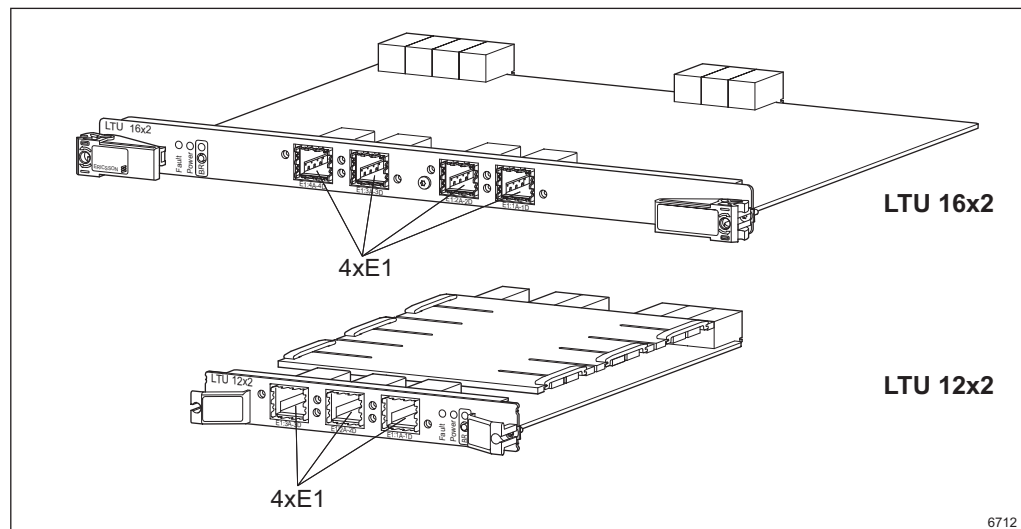
Figure 23   LTUs with E1 interfaces

3.4.2.2 Functional Blocks

This section describes the internal and external functions of the LTUs with E1 interfaces, based on the block diagram in Figure 24.

Figure 24   Block diagram for LTU 16x2 and LTU 12x2

3.4.2.2.1 TDM

This block interfaces the TDM bus by receiving and transmitting the traffic (nxE1).

3.4.2.2.2 Control and Supervision

This block interfaces the PCI bus and handles control and supervision. Its main functions are to collect alarms, control settings and tests.

The block communicates with the NPU over the PCI bus.

3.4.2.2.3 SPI

This block interfaces the SPI bus and handles equipment status. Failure is indicated on LEDs on the front of the unit.

3.4.2.2.4   Power

This block interfaces the Power bus and provides secondary voltages for the unit. All plug-in units have a standard power module providing electronic soft start and short circuit protection, filter function, under voltage protection, DC/DC converter and a pre-charge function.

3.4.2.2.5   Line Interface

This block provides the E1 line interfaces for external connection.

3.5 STM-1 Interface

3.5.1 Overview

The LTU 155 provides a channelized STM-1 Terminal Multiplexer (TM) interface. This interface terminates one STM-1 with 63xE1 mapped asynchronously into 63xVC-12.

There are two typical applications:

- At aggregation sites where the high capacity optical SDH network connects to the microwave network. The LTU 155 provides an effective interface using one STM-1 interconnection instead of nxE1.

- To build high capacity microwave networks, with for example ring topology, using MINI-LINK TN and MINI-LINK HC in combination.

Both electrical and optical interfaces are available.

The interface can be equipment and line protected using MSP 1+1, see Section 3.7.3.
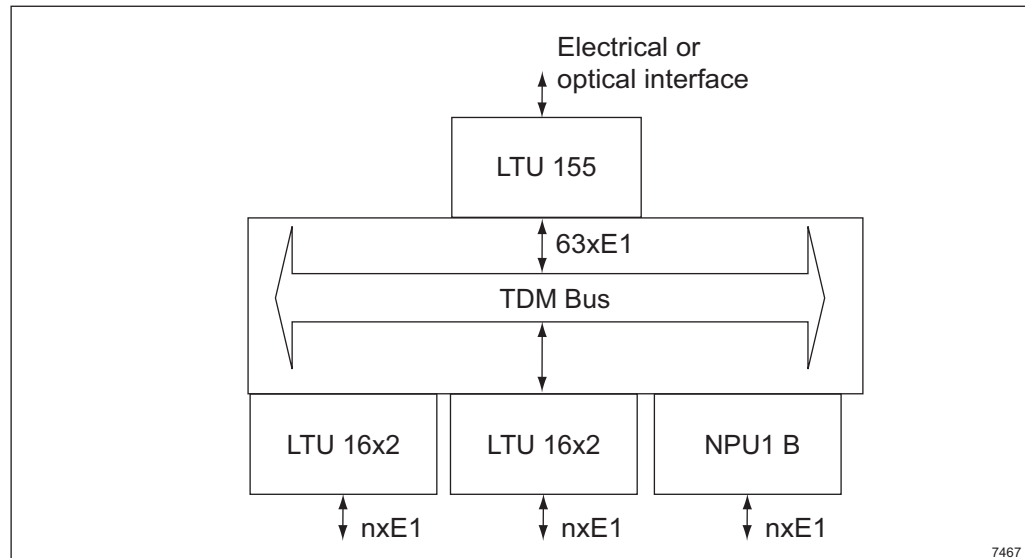
Figure 25   Principle usage of the STM-1 interface

3.5.2 LTU 155

The LTU 155 terminates one STM-1 connection with 63xE1 in the backplane for traffic routing to other plug-in units.

There are two versions of the LTU 155:

LTU 155e/o   Provides one optical interface (short haul S-1.1) and one electrical interface (G.703).

LTU 155e   Provides one electrical interface (G.703).

The LTU 155 fits in an AMM 6p B and AMM 20p.
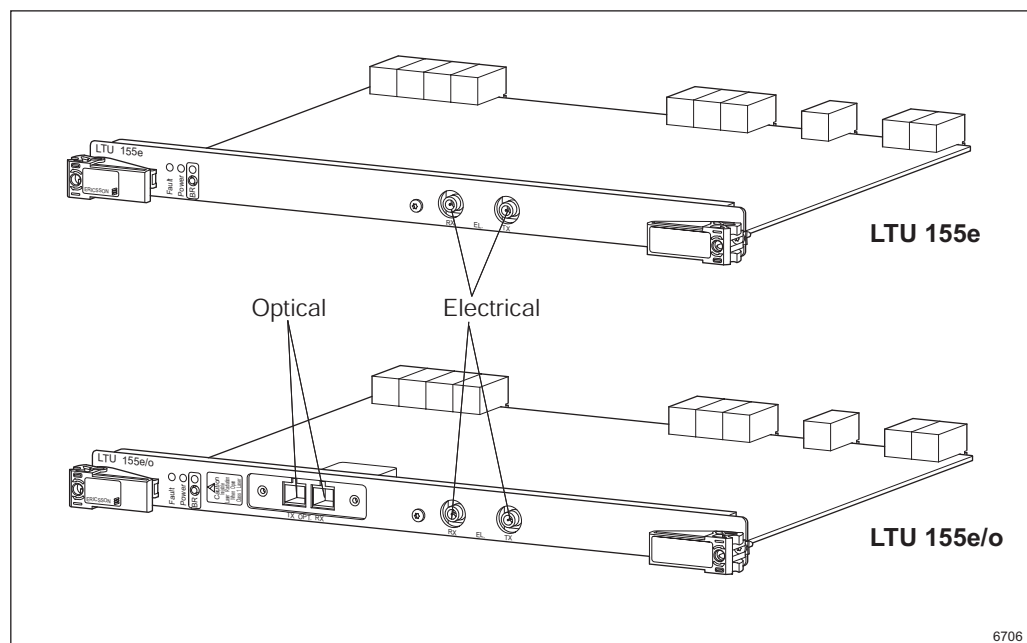
Figure 26   LTU 155

3.5.2.1 Functional Blocks

This section describes the internal and external functions of the LTU 155, based on the block diagram in Figure 27.
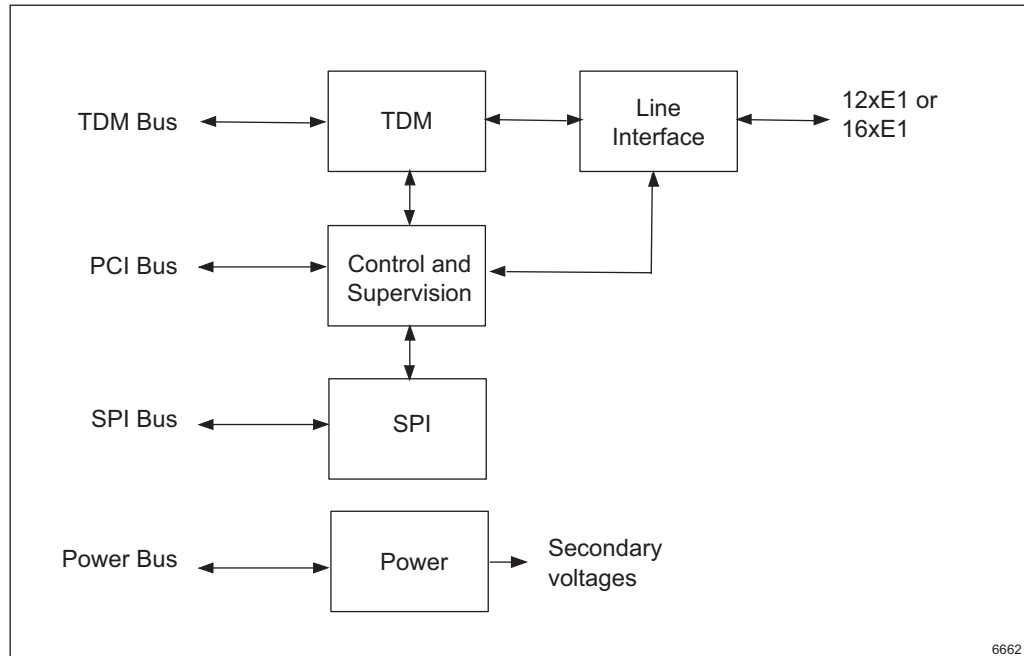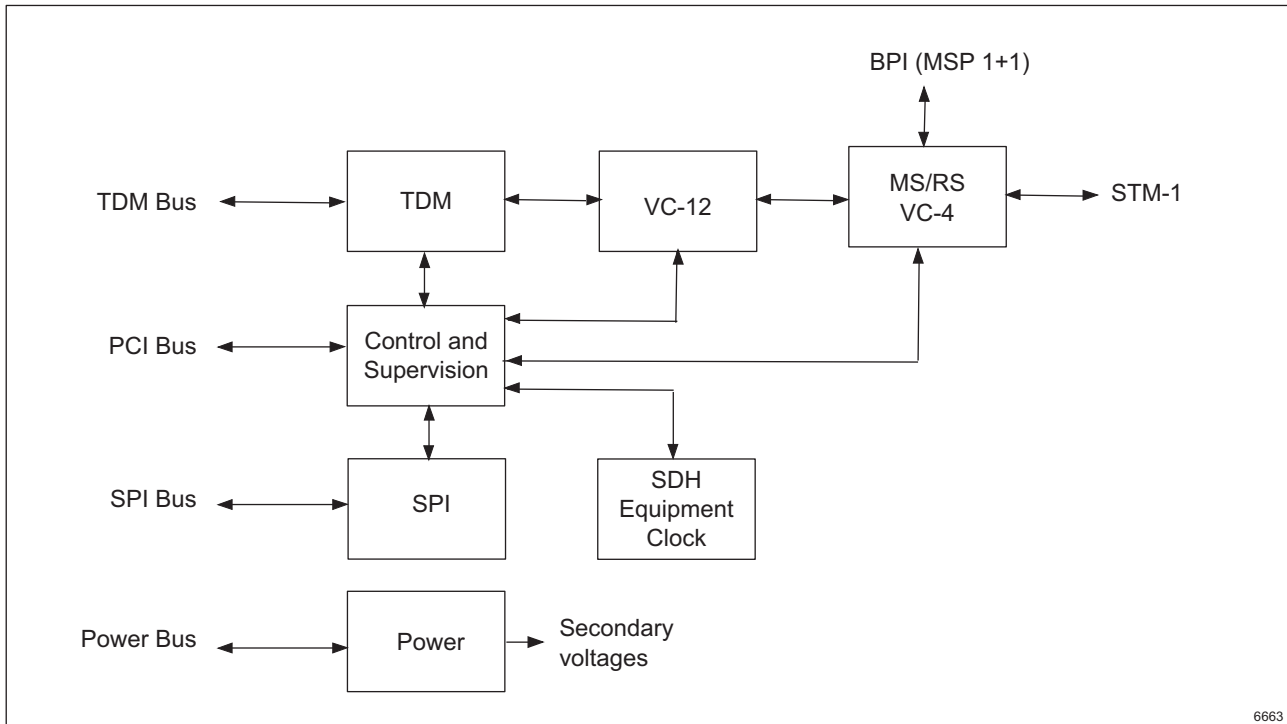

Figure 27   Block diagram for LTU 155

3.5.2.1.1 TDM

This block interfaces the TDM bus by receiving and transmitting the traffic (nxE1) and DCN channels (nx64 kbit/s).

3.5.2.1.2 Control and Supervision

This block interfaces the PCI bus and handles control and supervision. Its main functions are to collect alarms, control settings and tests. The block communicates with the NPU over the PCI bus.

The block holds a Device Processor (DP) running plug-in unit specific software.

3.5.2.1.3 SPI

This block interfaces the SPI bus and handles equipment status. Failure is indicated on LEDs on the front of the unit.

3.5.2.1.4 Power

This block interfaces the Power bus and provides secondary voltages for the unit. All plug-in units have a standard power module providing electronic soft start and short circuit protection, filter function, under voltage protection, DC/DC converter and a pre-charge function.

3.5.2.1.5 VC-12

This block maps 63xE1 to/from 63xVC-12 adding overhead bytes.

3.5.2.1.6 MS/RS VC-4

This block maps 63xVC-12 to/from one VC-4 adding path overhead.

The block provides the electrical and optical STM-1 line interfaces for external connection.

3.5.2.1.7 SDH Equipment Clock

This block handles timing and synchronization.

3.5.3   Synchronization

The LTU 155 is configured to run with loop timing or internal local oscillator as clock source for its STM-1 transmit clock. Figure 28 illustrates how the synchronization information is configured and propagated in the Rx and Tx parts of the STM-1 connection.
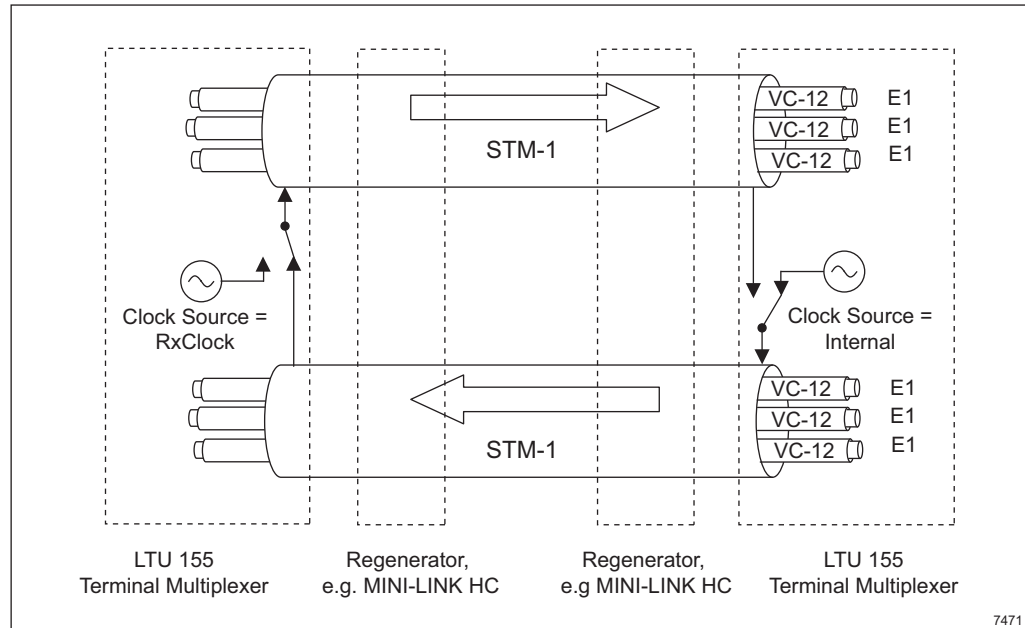
Figure 28   Synchronization

The STM-1 termination points can be either Terminal Multiplexer, like the LTU 155, or ADMs. One of the termination points is configured as master and provides synch internally from a local oscillator. The synch information is transported in the Tx part to the terminating end. The terminating end is configured to loop timing using the recovered receive clock (RxClock) on the outgoing link (Tx).

There may be multiple regenerator points between the two termination points, for example using MINI-LINK HC.

3.6 Traffic Routing

A microwave hub site's main function is to collect traffic carried over microwave radio links from many sites and to aggregate it into a higher capacity transmission link through the access network towards the core network. The transmission link northbound may be microwave or optical.

These hub sites have usually been realized by connecting individual microwave Radio Terminals with cables through Digital Distribution Frames (DDF) and external cross-connection equipment.

MINI-LINK TN provides a traffic routing function that facilitates the handling of traffic aggregation. This function enables interconnection of all traffic connections going through the NE. This means that an aggregation site can be realized using one AMM housing several Radio Terminals with all the cross-connections done in the backplane.

Each plug-in unit connects nxE1 to the backplane, where the traffic is cross-connected to another plug-in unit. The E1s are unstructured with independent timing.

One way of using this function at a large site is to cross-connect traffic from several Radio Terminals to one LTU 155 (63xE1) for further connection to the core network.

At a smaller site, it is possible to collect traffic from several Radio Terminals with a low traffic capacity into one with a higher traffic capacity.
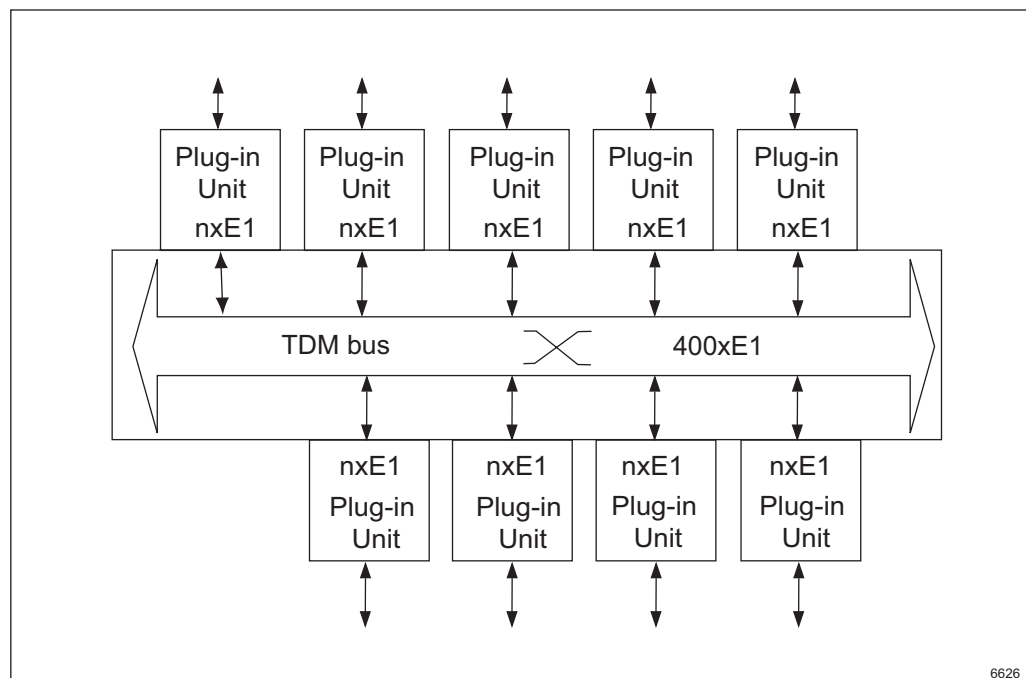
Figure 29   Traffic routing

The traffic routing function is controlled from the EEM, locally or remotely.

Traffic configuration can also be done using the SNMP interface.

3.6.1 MINI-LINK Connexion

The MINI-LINK Connexion application provides a way to provision end-to-end E1 connections in a network. The network can be planned in advance without the need for the actual network. When the pre-configured E1 connections are applied to the real network a consistency check is done.

All operations related to the E1 provisioning are done from a topology map with a graphical presentation of the E1 connections. Color codes are used to visualize alarm status. Detailed alarm info and status are obtained by clicking on a connection on the map.

A number of different reports can be extracted periodically or on demand to view performance data and statistics related to an E1 end-to-end connection.

For more information, see *MINI-LINK Connexion User Manual*.

3.7 Protection Mechanisms

This section describes the protection mechanisms provided by the Basic Node. Protection of the radio link is described in Section 4.5.

3.7.1 Overview

To ensure high availability, MINI-LINK TN provides protection mechanisms on various layers in the transmission network as illustrated in Figure 30.

- Network layer protection using the 1+1 E1 SNCP mechanism provides protection for the sub-network connection **a-b** in Figure 30. Network layer protection uses only signal failure as switching criterion.

- Physical link layer protection using MSP 1+1 indicated by the link **c** between two adjacent NEs **1** and **2** in Figure 30. Physical link layer protection uses both signal failure and signal degradation as switching criteria.

- By routing the protected traffic in parallel through different physical units, equipment protection can also be achieved. An example using two plug-in units is shown for the NEs **1** and **2** in Figure 30.
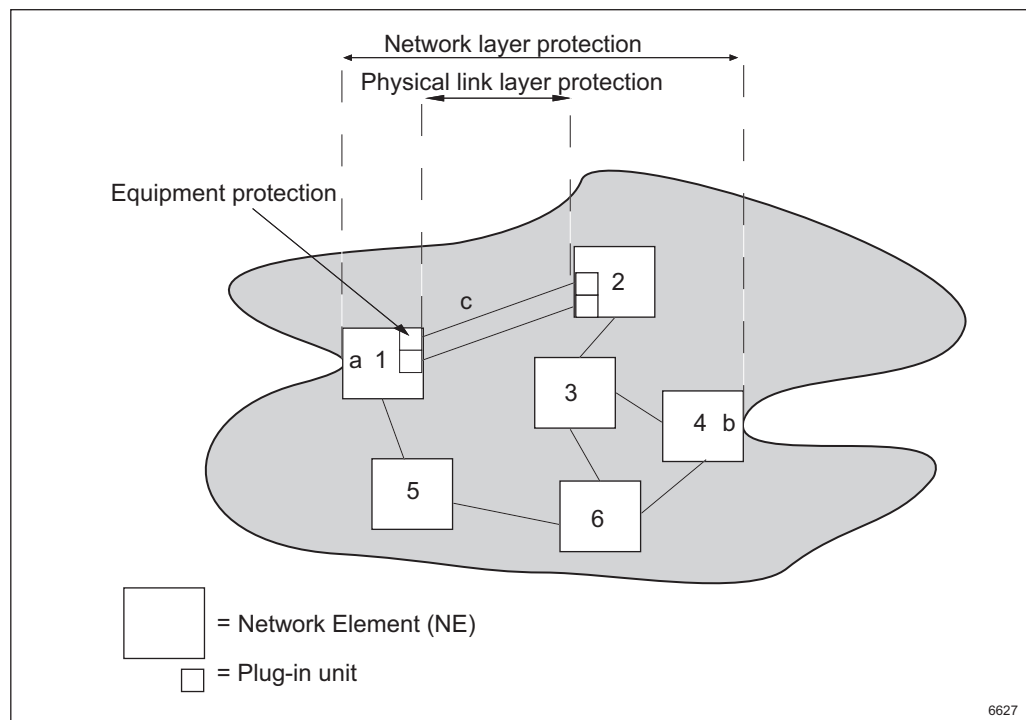
Figure 30   MINI-LINK TN provides high availability through various protection mechanisms

Network layer and physical link layer protection share the following characteristics:

Permanently Bridged	Identical traffic is transmitted on the active and the passive physical link/connection.
Uni-directional	Only the affected direction is switched to protection. The equipment terminating the physical link/connection in either end will select which line to be active independently.
Non-revertive	No switch back to the original link/connection is performed after recovery from failure. The original active link/connection is used as passive link/connection after the protection is re-established.
1+1	One active link/connection and one passive (standby) link/connection.
Automatic/Manual switching mode	In automatic mode, the switching is done based on signal failure or signal degradation. Switching can also be initiated from the management system provided that the passive link/connection is free from alarms.
	In manual mode, the switching is only initiated from the management system, regardless of the state of the links/connections.

3.7.2 Network Layer Protection

3.7.2.1 1+1 E1 SNCP

1+1 E1 Sub-Network Connection Protection (1+1 E1 SNCP) is a protection mechanism used for network protection on E1 level, between two MINI-LINK TN NEs. It is based on the simple principle that one E1 is transmitted on two separate E1 connections (permanently bridged).

The switching is performed at the receiving end where the two connections are terminated. It switches automatically between the two incoming E1s in order to use the better of the two. The decision to switch is based on signal failure of the signal received (LOS or AIS).

At each end of the protected E1 connection, two E1 connections must be configured to form a 1+1 E1 SNCP group.

An operator may also control the switch manually.

The connections may pass through other equipment in between, provided that AIS is propagated end-to-end.

The 1+1 E1 SNCP function is independent of the 1+1 radio protection and the MSP 1+1.
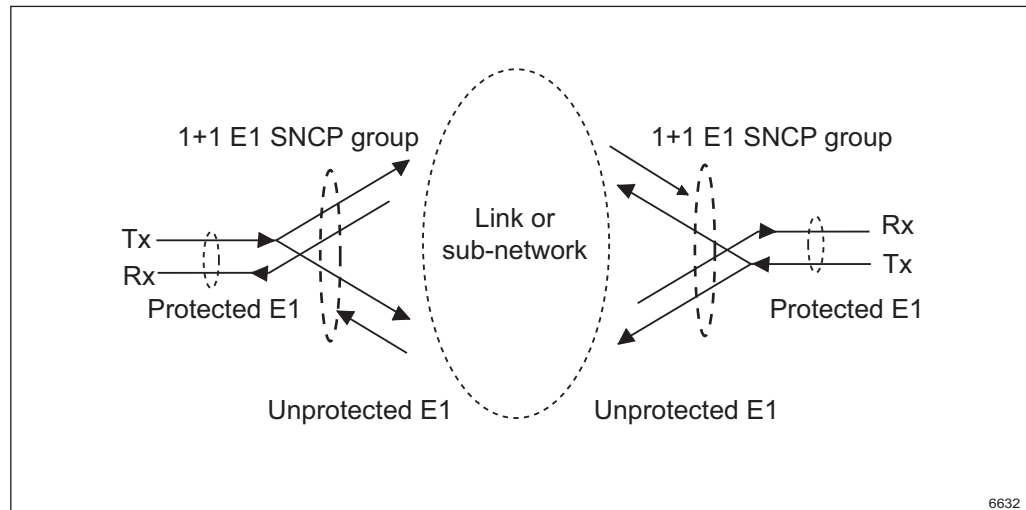
Figure 31   1+1 E1 SNCP principle

Performance data is collected and fault management is provided for unprotected as well as protected E1 interfaces (that is the 1+1 E1 SNCP group). This gives accurate information on the availability of network connections.

3.7.2.2 Ring Protection

Figure 32   Network topologies

The 1+1 E1 SNCP mechanism described in the previous section can be used to create protected ring structures in the microwave network. In a ring topology, all nodes are connected so that two nodes always have two paths between them.
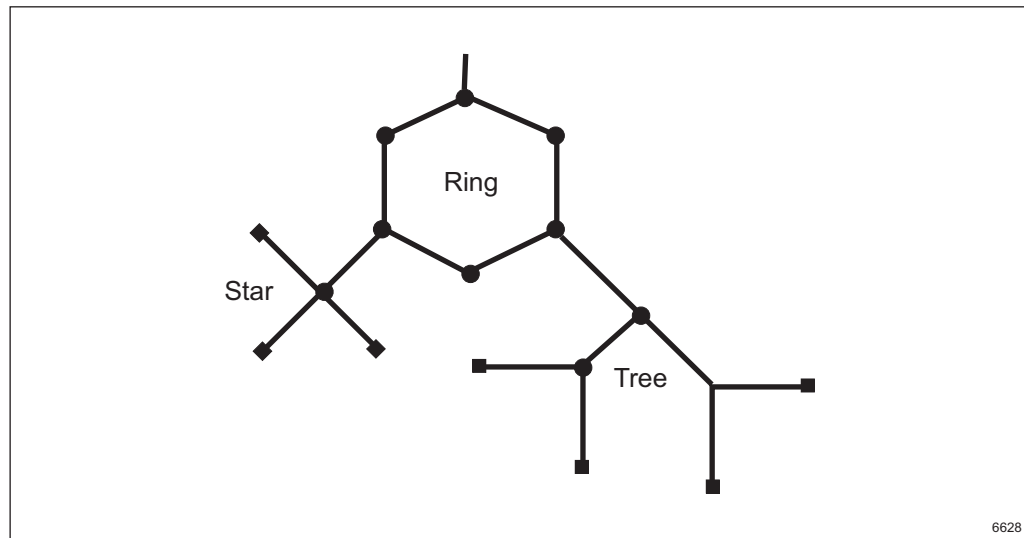
An E1 connection entering a ring at one point and exiting at another point can therefore be protected with a 1+1 E1 SNCP group configured at each end of the connection. The traffic is transmitted in both directions of the ring and the traffic is received from two directions at the termination point.

In this solution, the ring network can tolerate one failure without losing transmission. When the failure occurs, the affected connections are switched in the other direction.

In a MINI-LINK TN network, these ring structures can be built using Radio Terminals with capacities of up to 32x2 Mbit/s. Using a MINI-LINK HC terminal and the LTU 155 (STM-1 interface), ring structures can be constructed with 155 Mbit/s capacity.

Capacity is distributed from a common feeder node to the ring nodes where it is dropped off to star or tree structures as shown in Figure 33.

As an example, consider the nodes **A** and **E** in Figure 33. To protect the connection from **A** to **E** the two alternative connections from **A** to **E** must be defined as a 1+1 E1 SNCP group at **A** and as a 1+1 E1 SNCP group at **E**.

Similarly, to protect the connection from A to C, the two alternative connections between **A** and **C** must also be configured as two 1+1 E1 SNCP groups at **A** and **C**.
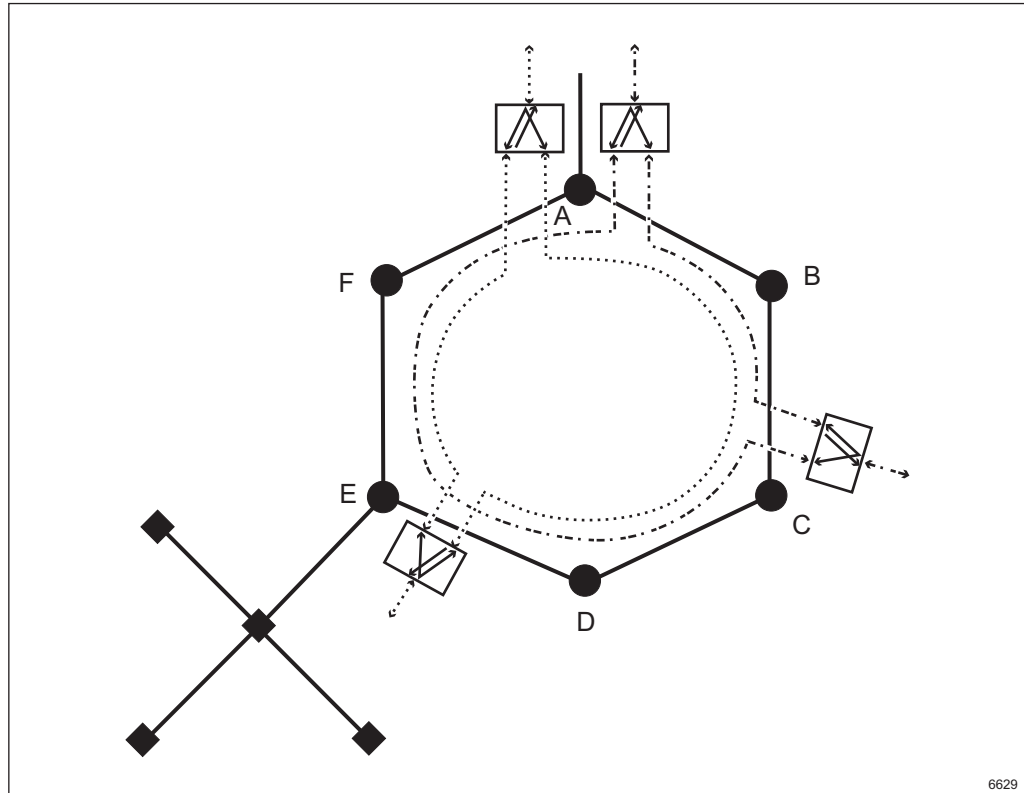
Figure 33   Example of ring protection with 1+1 E1 SNCP

The 1+1 E1 SNCP function can be used to build protection in more complex topologies than rings, using the same principle.

3.7.3 MSP 1+1

The STM-1 interface supports Multiplexer Section Protection (MSP) 1+1. This SDH protection mechanism provides both link protection and equipment protection. Its main purpose is to provide maximum protection at the interface between the microwave network and the optical network

MSP 1+1 requires two LTU 155 plug-in units configured to work in an MSP 1+1 pair, delivering only one set of 63xE1 to the backplane at a time as illustrated in Figure 34. The unit intercommunication is done over the BPI bus.

Figure 34   Two LTU 155e/o plug-in units in an MSP 1+1 configuration
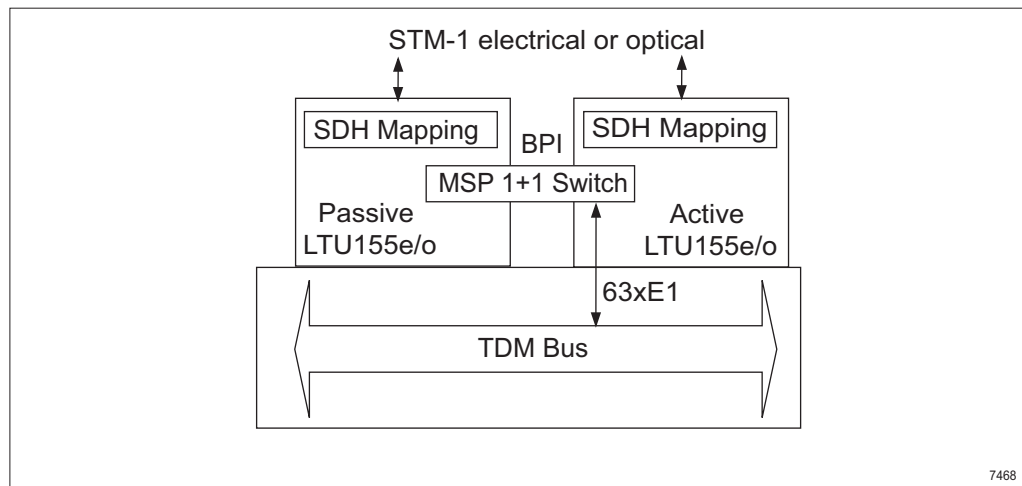
The switching is done automatically if the following is detected:

- Signal Failure (SF): LOS, LOF, MS-AIS or RS-TIM

- Signal Degradation (SD) based on MS-BIP Errors (BIP-24)

- Local equipment failure

The operator can also initiate the switching manually.

The switch logic for MSP 1+1 is handled by the unit's Device Processor.
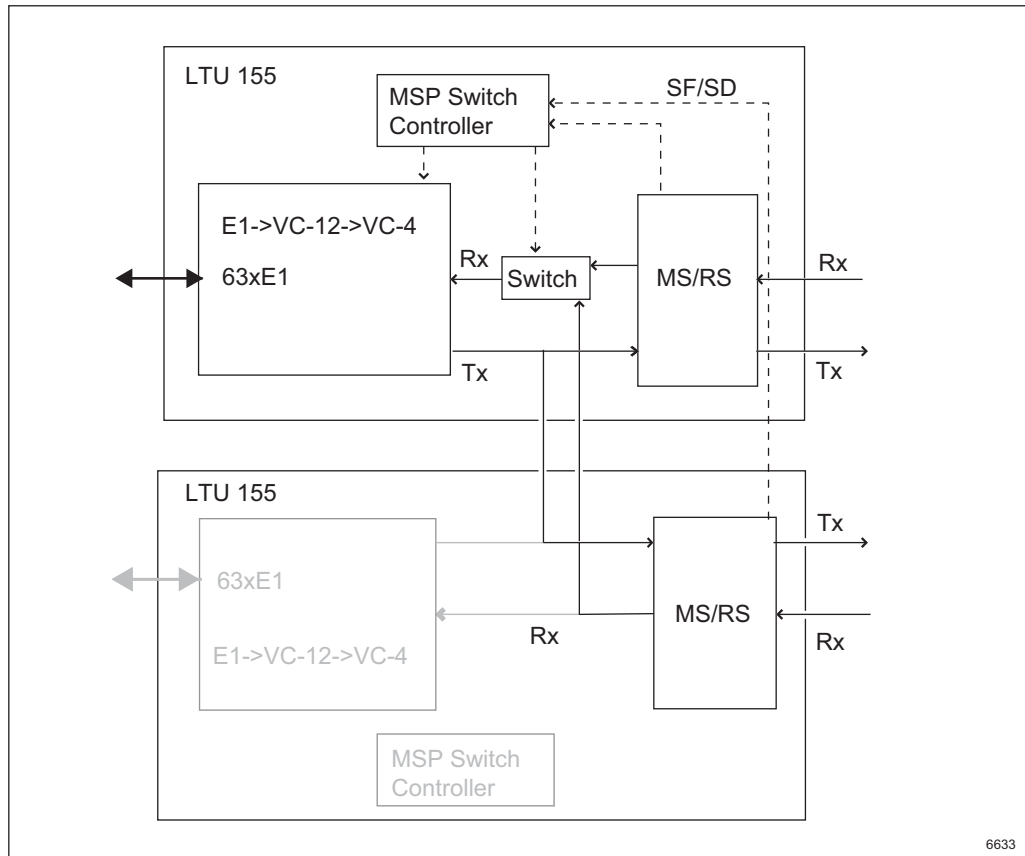
Figure 35   MSP 1+1 principle

3.8 Ethernet Traffic

3.8.1 Overview

MINI-LINK TN offers transmission of Ethernet traffic using the following units:

- ETU2 provides five 10/100BASE-T interfaces and one 10/100/1000BASE-T interface, see section 3.8.2

- NPU2 provides one 10/100BASE-T interface, see Section 3.3

- ATU provides one 10/100BASE-T interface, see Section 5

The Ethernet traffic is transported between NEs in multiple E1s, over a single hop or through a network. Figure 36 shows an example of how the different units can be used in a network.
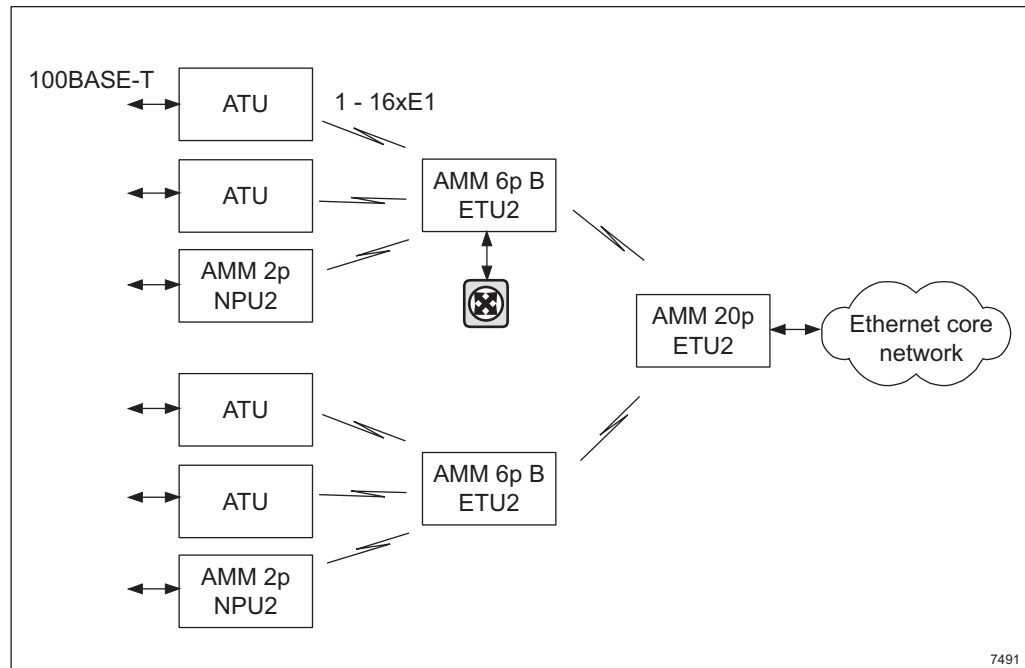
Figure 36   Ethernet traffic in a MINI-LINK TN network

The bandwidth of each Ethernet bridge connection is nxE1 per inverse multiplexer in the unit, where n≤16. NPU2 and ATU have one inverse multiplexer while ETU2 has six.

Ethernet traffic is connected to the units using RJ-45 connectors with support for shielded cable.

The Ethernet bridge connections have auto-negotiation 10/100Mbit/s speed and full/half duplex. Transparency to all kinds of traffic is supported, including IEEE 802.1Q VLAN, MAC address based VLAN, VLAN tag ID based and untagged frames, frames with up to 2 VLAN tags or frames with ICS tag.

The number of E1s in each connection is configured from the management system. The traffic is distributed over the E1s by an inverse multiplexer. The load sharing is seamless and independent of the Ethernet layer.

Figure 37 shows the protocol layers involved in an Ethernet bridge connection.

Figure 37   Protocol stack

3.8.2 Ethernet Interface Unit (ETU)

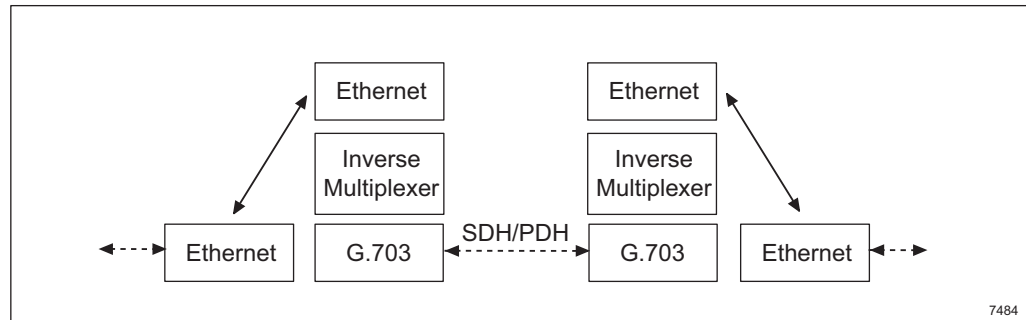The ETU2 fits in an AMM 6p B and AMM 20p. It provides five 10/100BASE-T interfaces and one 10/100/1000BASE-T Ethernet interface.
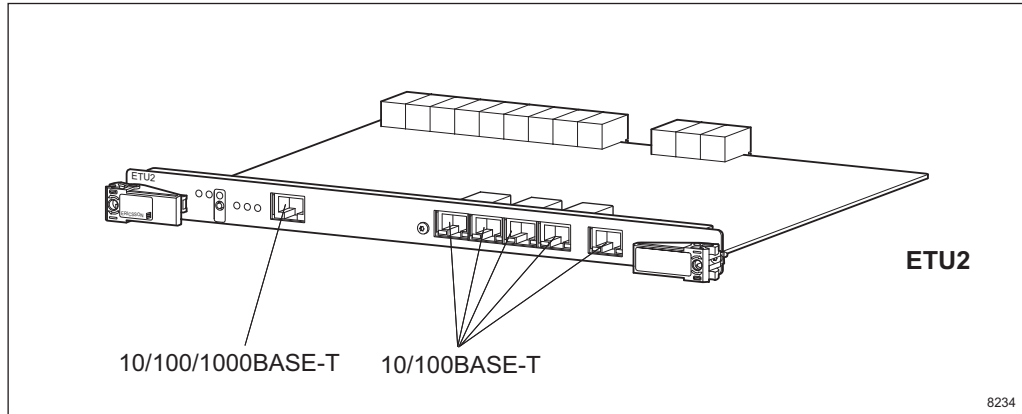

Figure 38   ETU2

3.8.2.1 Functional Blocks

This section describes the ETU2 based on the block diagram in Figure 39.
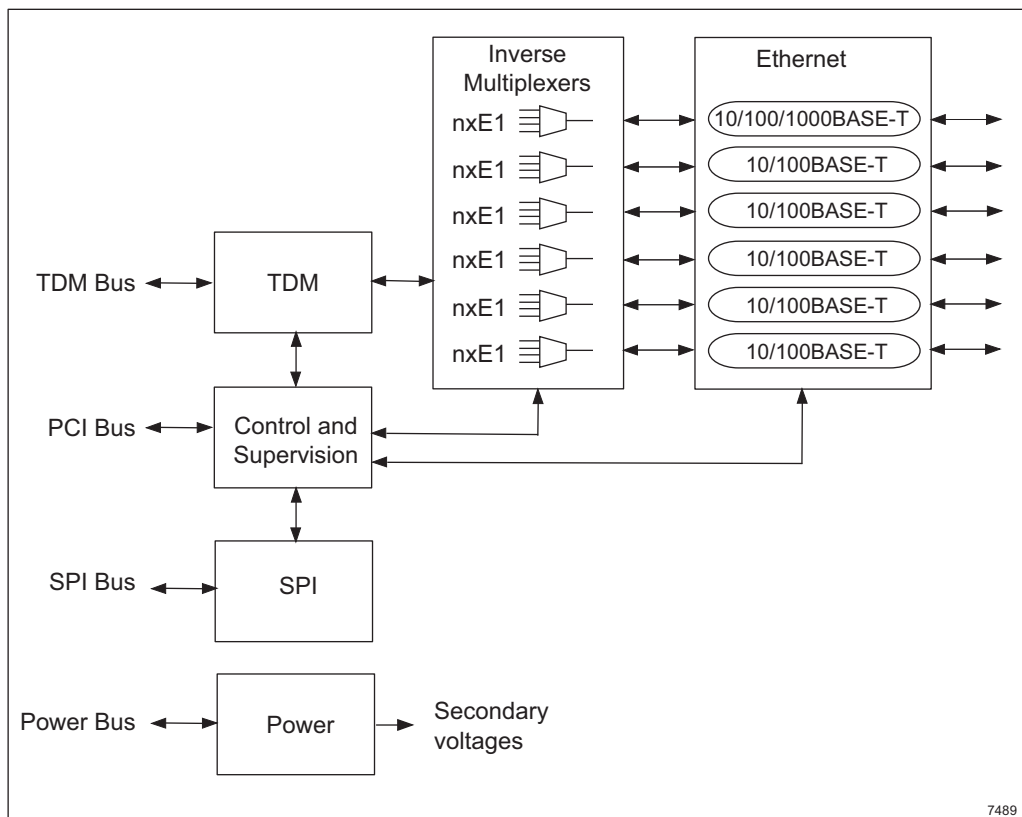
Figure 39   Block diagram for ETU2

3.8.2.1.1   TDM

This block interfaces the TDM bus by receiving and transmitting the E1s used to carry Ethernet traffic.

3.8.2.1.2   Inverse Multiplexers

Each inverse multiplexer converts one Ethernet connection into nxE1, where n≤16, transmitted to and received from the TDM block.

3.8.2.1.3   Ethernet

This block provides the unit's external Ethernet interfaces. Each interface is linked to one inverse multiplexer.

3.8.2.1.4   Control and Supervision

This block interfaces the PCI bus and handles control and supervision. Its main functions are to collect alarms, control settings and tests.

The block communicates with the NPU over the PCI bus.

3.8.2.1.5   SPI

This block interfaces the SPI bus and handles equipment status. Failure is indicated on LEDs on the front of the unit.

3.8.2.1.6   Power

This block interfaces the Power bus and provides secondary voltages for the unit. All plug-in units have a standard power module providing electronic soft start and short circuit protection, filter function, under voltage protection, DC/DC converter and a pre-charge function.

3.9 MINI-LINK E Co-siting

An SMU2 can be fitted in an AMM 6p B or AMM 20p to interface MINI-LINK E equipment on the same site. The following interfaces are provided:

- 1xE3 + 1xE1

- 1xE2 or 2xE2

- 2xE1

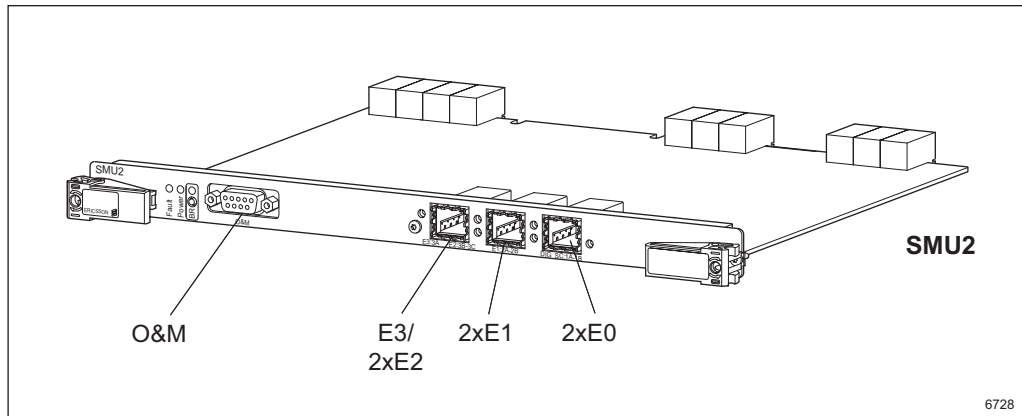- 2xE0 (2x64 kbit/s) used for IP DCN

- O&M (V.24) access server

Figure 40   SMU2

All the traffic capacities are multiplexed/demultiplexed to nxE1 for connection to the TDM bus.
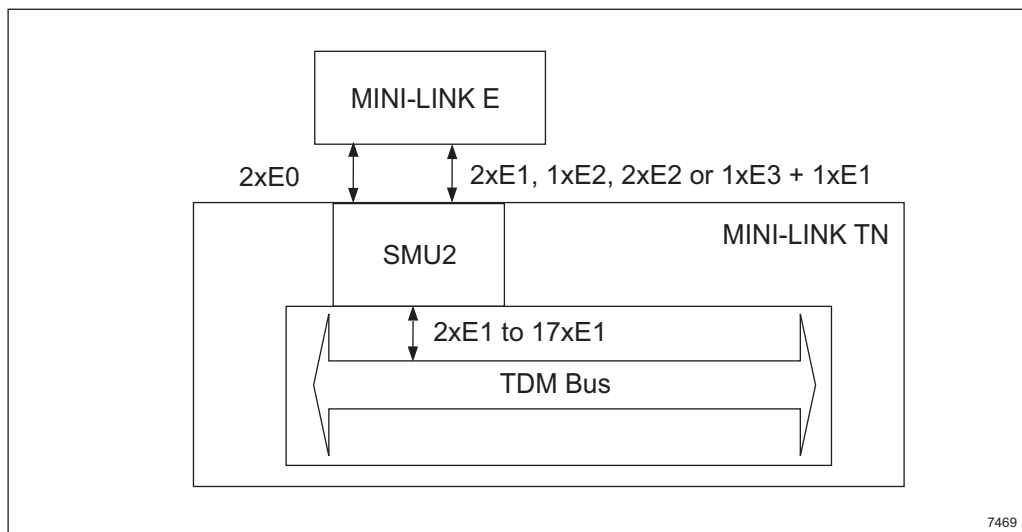

Figure 41   MINI-LINK E co-siting

3.10 Equipment Handling

The system offers several functions for easy operation and maintenance.

- Plug-in units can be inserted while the NE is in operation. This enables adding of new Radio Terminals or other plug-in units without disturbing existing traffic.

- Plug-in units can be removed from the NE while it is in operation.

- Each plug-in unit has a Board Removal button (BR). Pressing this button causes a request for removal to be sent to the control system.

- When changing a plug-in unit, the new plug-in unit automatically gets the same configuration as the previous one (provided the change occurs within 15 minutes).

- The system configuration is stored non-volatile on the NPU. The system can be backed up and restored using a local or central FTP server enabling NPU replacement.

- When an RAU is replaced, no new setup has to be performed.

- Various restarts can be ordered from the management system. A cold restart can be initiated for an NE or single plug-in unit. This type of restart is traffic disturbing. A warm restart is only available for the whole NE. This will restart the control system and will not affect the traffic. This is possible due to the separated control and traffic system.

- All plug-in units are equipped with temperature sensors. Overheated boards, which exceed limit thresholds, are put in reduced service or out of service by the control system. This is to avoid hardware failures in case of a fan failure. The plug-in unit is automatically taken into normal operation when temperature is back below the high threshold.
  There are two thresholds:

  - Crossing the high temperature threshold shuts down the plug-in unit's control system (reduced operation). The traffic function of the plug-in unit will still be in operation.

  - Crossing the excessive temperature threshold shuts down the entire plug-in unit (out of service).

- Access to inventory data like software and hardware product number, serial number and version. User defined asset identification is supported, enabling tracking of hardware.

4 Radio Terminals

4.1 Overview

A Radio Terminal provides microwave transmission from 2x2 to 32x2 Mbit/s, operating within the 7 to 38 GHz frequency bands, utilizing C-QPSK and 16 QAM modulation schemes. It can be configured as unprotected (1+0) or protected (1+1).
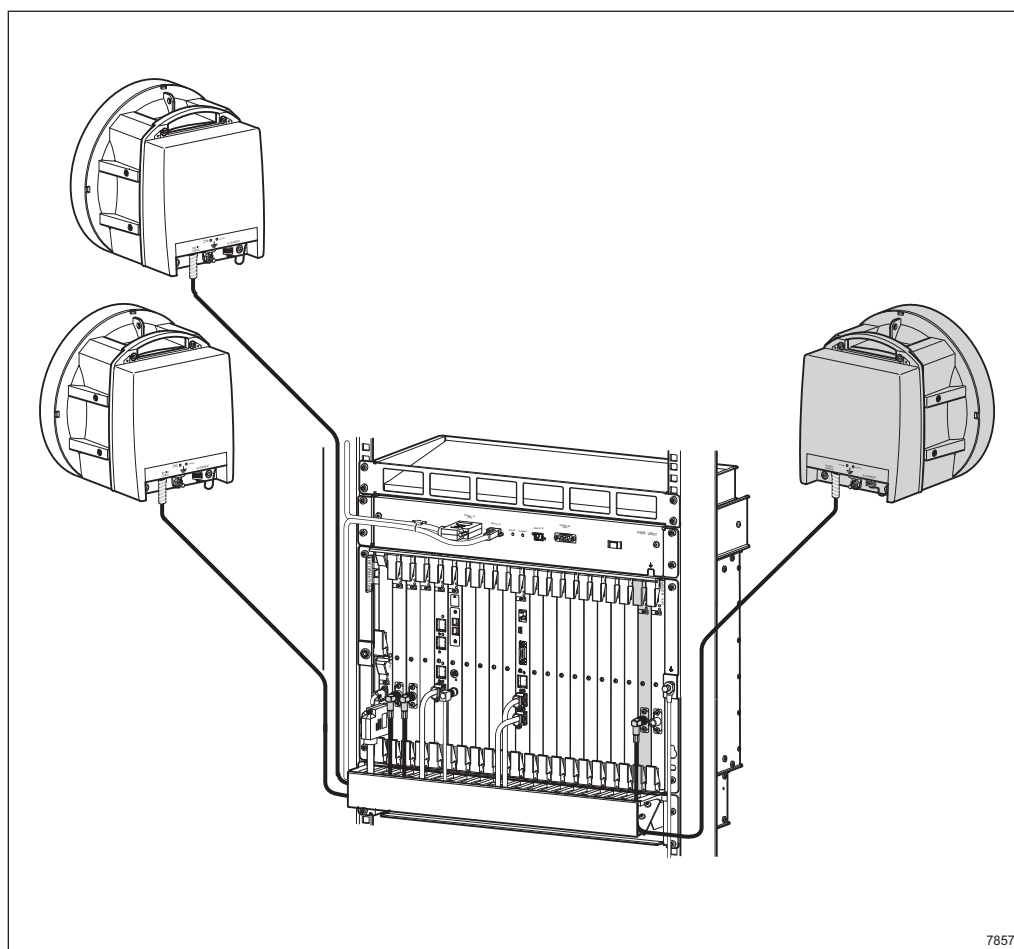
Figure 42   An unprotected (1+0) Radio Terminal (grayed)

An unprotected (1+0) Radio Terminal comprises:

- One RAU

- One antenna

- One MMU

- One radio cable for interconnection

A protected (1+1) Radio Terminal comprises:

- Two RAUs

- Two antennas or one antenna with a power splitter

- Two MMUs

- Two radio cables for interconnection

Automatic switching can be in hot standby or in working standby (frequency diversity). Receiver switching is hitless.

In hot standby mode, one transmitter is working while the other one is in standby, that is not transmitting but ready to transmit if the active transmitter malfunctions. Both RAUs are receiving signals and the best signal is used according to an alarm priority list.

In working standby mode, both radio paths are active in parallel using different frequencies.

For more information on 1+1 protection, see Section 4.5.

4.2 Modem Unit (MMU)

4.2.1 Overview

The MMU is the indoor part of the Radio Terminal and determines the traffic capacity and modulation scheme. It is available in the following types:

MMU2 B   A traffic capacity agile plug-in unit for C-QPSK modulation, used for the following traffic capacities in Mbit/s:

- 2x2, 4x2, 8x2, 17x2

MMU2 C   A traffic capacity and modulation agile plug-in unit, used for the following modulation schemes and traffic capacities in Mbit/s:

- C-QPSK: 2x2, 4x2, 8x2, 17x2
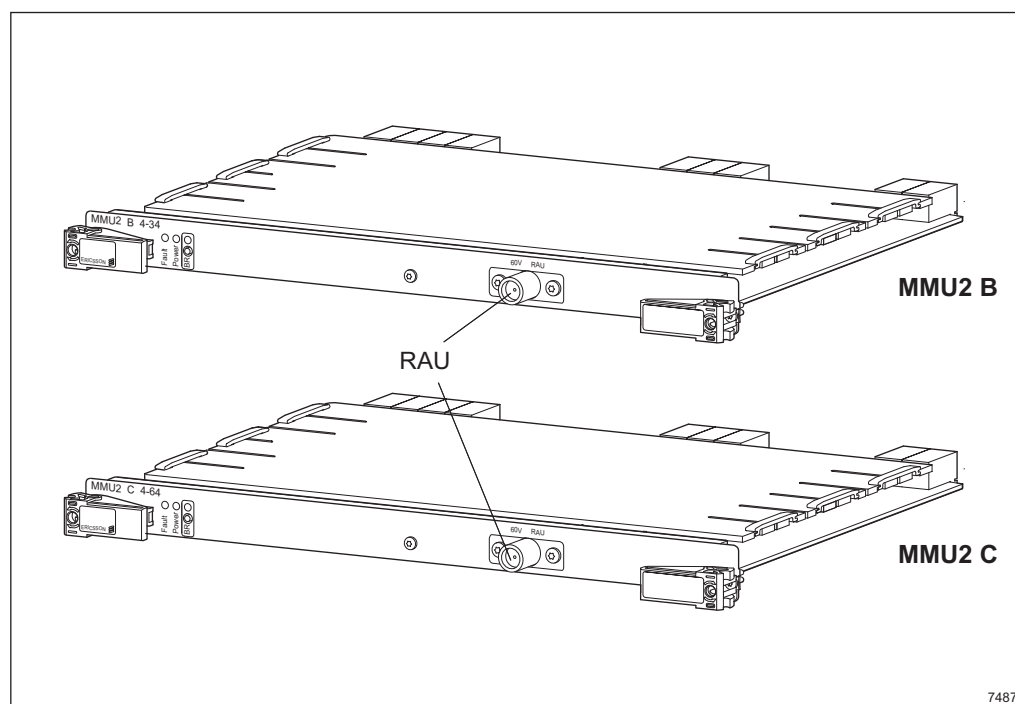
- 16 QAM: 8x2, 17x2, 32x2

Figure 43   MMUs

C-QPSK and 16 QAM MMUs have the same functionality regarding mechanics and interfaces. However, there is an important difference when it comes to RAU compatibility:

- C-QPSK MMUs are compatible with RAU1, RAU2, RAU1 N and RAU2 N

- 16 QAM MMUs are compatible with RAU1 N and RAU2 N

4.2.2   Functional Blocks

This section describes the internal and external functions of the MMU, based on the block diagram in Figure 44.
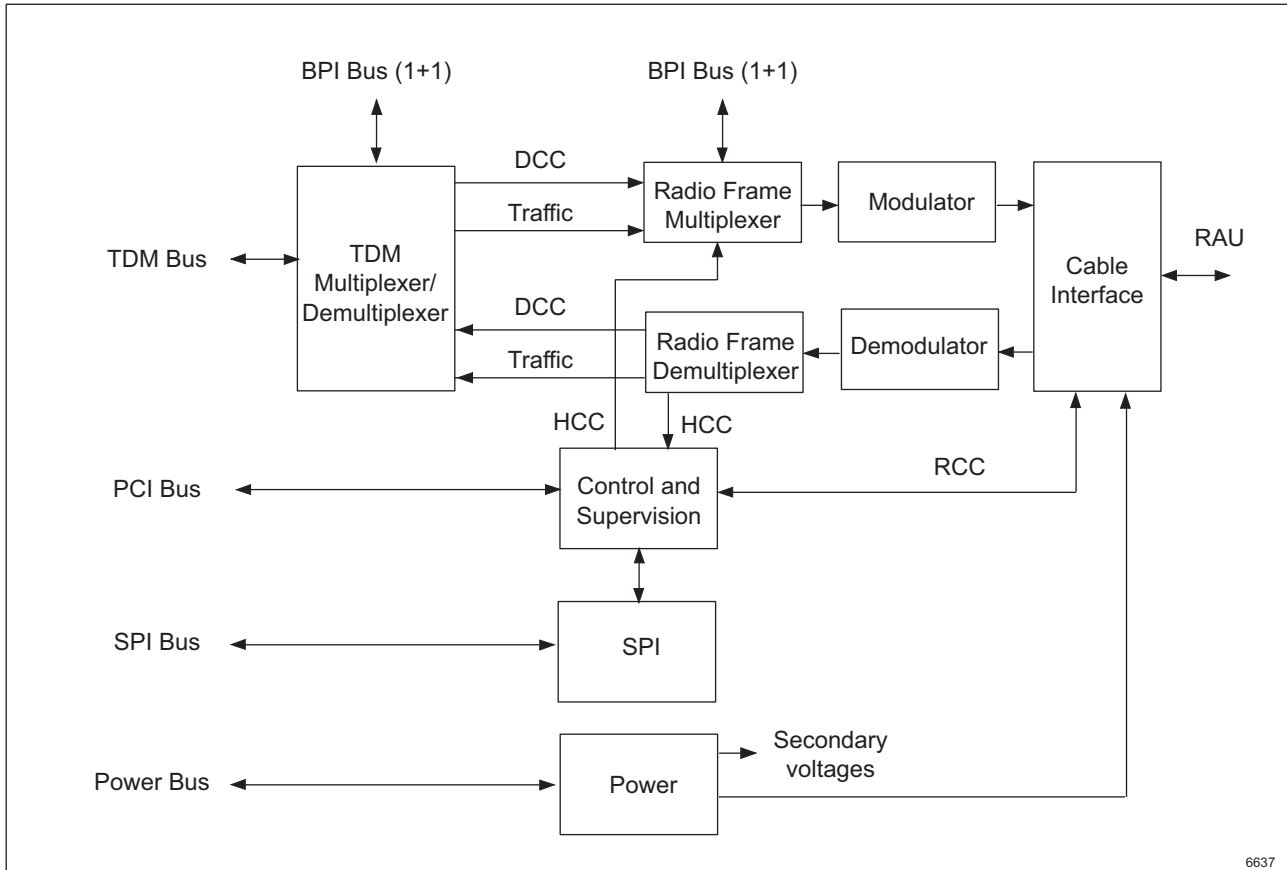
Figure 44   Block diagram for MMU

4.2.2.1   TDM Multiplexer/Demultiplexer

This block interfaces the TDM bus by receiving and transmitting the traffic (nxE1) and DCC.

It performs 2/8 and 8/34 multiplexing, depending on the traffic capacity, for further transmission to the Radio Frame Multiplexer.

In the receiving direction, it performs 34/8 and 8/2 demultiplexing, depending on the traffic capacity. The demultiplexed traffic and DCC are transmitted to the TDM bus.

In a protected system, the block interfaces the BPI bus, see Section 4.5.2.

4.2.2.2 Radio Frame Multiplexer

The Radio Frame Multiplexer handles multiplexing of different data types into one data stream, scrambling and FEC encoding.

In a protected system, the block interfaces the BPI bus, see Section 4.5.2.

The following data types are multiplexed into the composite data stream to be transmitted over the radio path:

- Traffic

- Data Communication Channel (DCC)

- Hop Communication Channel (HCC)

Traffic

The transmit traffic data is first sent to the multiplexer to assure data rate adaptation (stuffing). If no valid data is present at the input, an AIS signal is inserted at nominal data rate. This means that the data traffic across the hop is replaced with ones (1).

DCC

DCC comprises 2x64 kbit/s channels used for DCN communication over the hop.

HCC

The Hop Communication Channel (HCC) is used for exchange of control and supervision information between near-end and far-end MMUs.

Multiplexer

The three different data types together with check bits and frame lock bits are sent in a composite data format defined by the frame format that is loaded into a Frame Format RAM. The 12 frame alignment signal bits are placed at the beginning of the frame. Stuffing bits are inserted into the composite frame.

Scrambling and FEC Encoding

The synchronous scrambler has a length of $2^{17}- 1$ and is synchronized each eighth frame (super frame). For C-QPSK, the FEC bits are inserted according to the frame format and calculated using an interleaving scheme. Reed Solomon coding is used for 16 QAM.

4.2.2.3 Modulator

The composite data stream from the Radio Frame Multiplexer is modulated, D/A converted and pulse shaped in a Nyqvist filter to optimize transmit spectrum.

Two different modulations techniques are used:

- C-QPSK (Constant envelope offset Qaudrature Phase Shift Keying) is an offset QPSK modulating technique. It has a high spectrum efficiency compared to other constant envelope schemes.

- Square 16 QAM (Quadrature Amplitude Modulation), consisting of two independent amplitude modulated quadratures. The carrier is amplitude and phase modulated. The technique doubles the spectrum efficiency compared to C-QPSK.

The Modulator consists of a phase locked loop (VCO) operating at 350 MHz. For test purposes an IF loop signal of 140 MHz is generated by mixing with a 490 MHz signal.

4.2.2.4 Cable Interface

The following signals are frequency multiplexed in the Cable Interface for further distribution through a coaxial cable to the outdoor RAUs:

- 350 MHz transmitting IF signal

- 140 MHz receiving IF signal

- DC power supply

- Radio Communication Channel (RCC) signal as an Amplitude Shift Keying (ASK) signal

In addition to the above, the cable interface includes an over voltage protection circuit.

4.2.2.5 Demodulator

The received 140 MHz signal is AGC amplified and filtered prior to conversion to I/Q baseband signals. The baseband signals are pulse shaped in a Nyqvist filter and A/D converted before being demodulated.

4.2.2.6   **Radio Frame Demultiplexer**

On the receiving side the received composite data stream is demultiplexed and FEC corrected. The frame alignment function searches and locks the receiver to the frame alignment bit patterns in the received data stream.

Descrambling and FEC Decoding

For C-QPSK, error correction is accomplished using FEC parity bits in combination with a data quality measurement from the Demodulator. A Reed Solomon decoder is used for 16 QAM.

The descrambler transforms the signal to its original state enabling the Demultiplexer to properly distribute the received information to its destinations.

Demultiplexing

Demultiplexing is performed according to the used frame format. The Demultiplexer generates a frame fault alarm if frame synchronization is lost. The number of errored bits in the traffic data stream is measured using parity bits. These are used for BER detection and performance monitoring. Stuffing control bits are processed for the traffic and service channels.

Traffic

On the receiving side the following is performed to the traffic data:

- AIS insertion (at signal loss or BER $\leq 10^{-3}$)

- AIS detection

- Elastic buffering and clock recovery

- Data alignment compensation and measurement (to enable hitless switching)

- Hitless switching (for 1+1 protection)

DCC

On the receiving side, elastic buffering and clock recovery is performed on the DCC.

HCC

The Hop Communication Channel (HCC) is used for exchange of control and supervision information between near-end and far-end MMUs.

4.2.2.7 Control and Supervision

This block interfaces the PCI bus and handles control and supervision. Its main functions are to collect alarms, control settings and tests. The block communicates with the NPU over the PCI bus.

The block holds a Device Processor (DP) running plug-in unit specific software. It handles BER collection and communicates with processors in the RAU through the RCC.

Exchange of control and supervision data over the hop is made through the HCC.

4.2.2.8 SPI

This block interfaces the SPI bus and handles equipment status. Failure is indicated on LEDs on the front of the unit.

4.2.2.9 Power

This block interfaces the Power bus and provides secondary voltages for the unit. All plug-in units have a standard power module providing electronic soft start and short circuit protection, filter function, under voltage protection, DC/DC converter and a pre-charge function.

Furthermore, this block provides a stable voltage for the RAU, distributed in the radio cable.

4.3 Radio Unit (RAU)

4.3.1 Overview

The basic function of the Radio Unit (RAU) is to generate and receive the RF signal and convert it to/from the signal format in the radio cable, connecting the RAU and the MMU. It can be combined with a wide range of antennas in integrated or separate installation. The RAU connects to the antenna at the waveguide interface. Disconnection and replacement of the RAU can be done without affecting the antenna alignment.

DC power to the RAU is supplied from the MMU through the radio cable.

The RAU is a weatherproof box painted light gray, with a handle for lifting and hoisting. There are also two hooks and catches to guide it for easier handling, when fitting to or removing from an integrated antenna. It comprises a cover, vertical frame, microwave sub-unit, control circuit board and filter unit.

The RAU is independent of traffic capacity. The operating frequency is determined by the RAU only and is set on site using the LCT. Frequency channel arrangements are available according to ITU-R and ETSI recommendations. For detailed information on frequency versions, see the *Product Catalog* and *MINI-LINK TN ETSI Product Specification*.
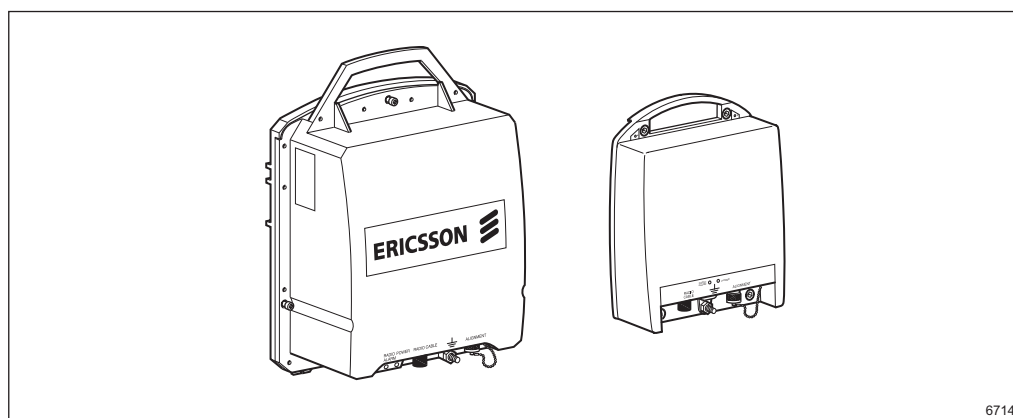
Two types of mechanical design exist, RAU1 and RAU2.

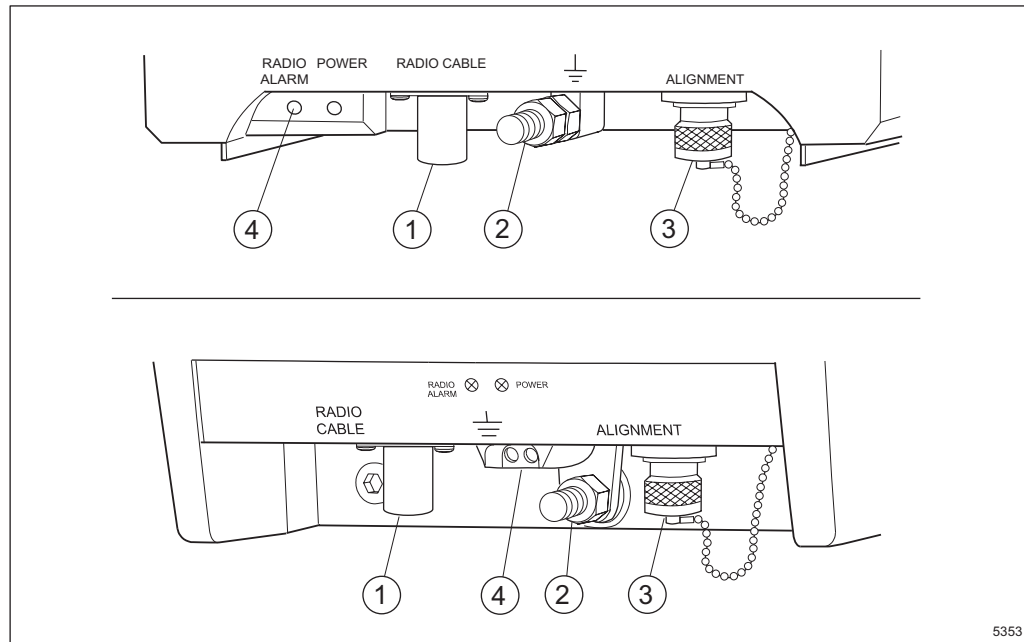*Figure 45   RAU1 and RAU2 mechanical design*

4.3.2   External Interfaces

Figure 46   External interfaces, RAU1 and RAU2 mechanical design

Item	Description
1	Radio cable connection to the MMU, 50 Ω N-type connector. The connector is equipped with gas discharge tubes for lightning protection.
2	Protective ground point for connection to mast ground.
3	Test port for antenna alignment.
4	Red LED: Unit alarm. Green LED: Power on.

4.3.3   RAU Types

An RAU is designated as *RAUX Y F*, for example *RAU2 N 23*. When ordering, additional information about frequency sub-band and output power version is necessary. The letters have the following significance:

- *X* indicates mechanical design *1* or *2*

- *Y* indicates MMU compatibility as follows:

    - "blank", for example *RAU2 23*, indicates compatibility with a C-QPSK MMU

    - *N*, for example *RAU2 N 23*, indicates compatibility with a C-QPSK MMU and a QAM MMU. This means that this type of RAU can be used in MINI-LINK TN, MINI-LINK HC and MINI-LINK E systems.

- *F* indicates frequency band

4.3.4 Functional Blocks

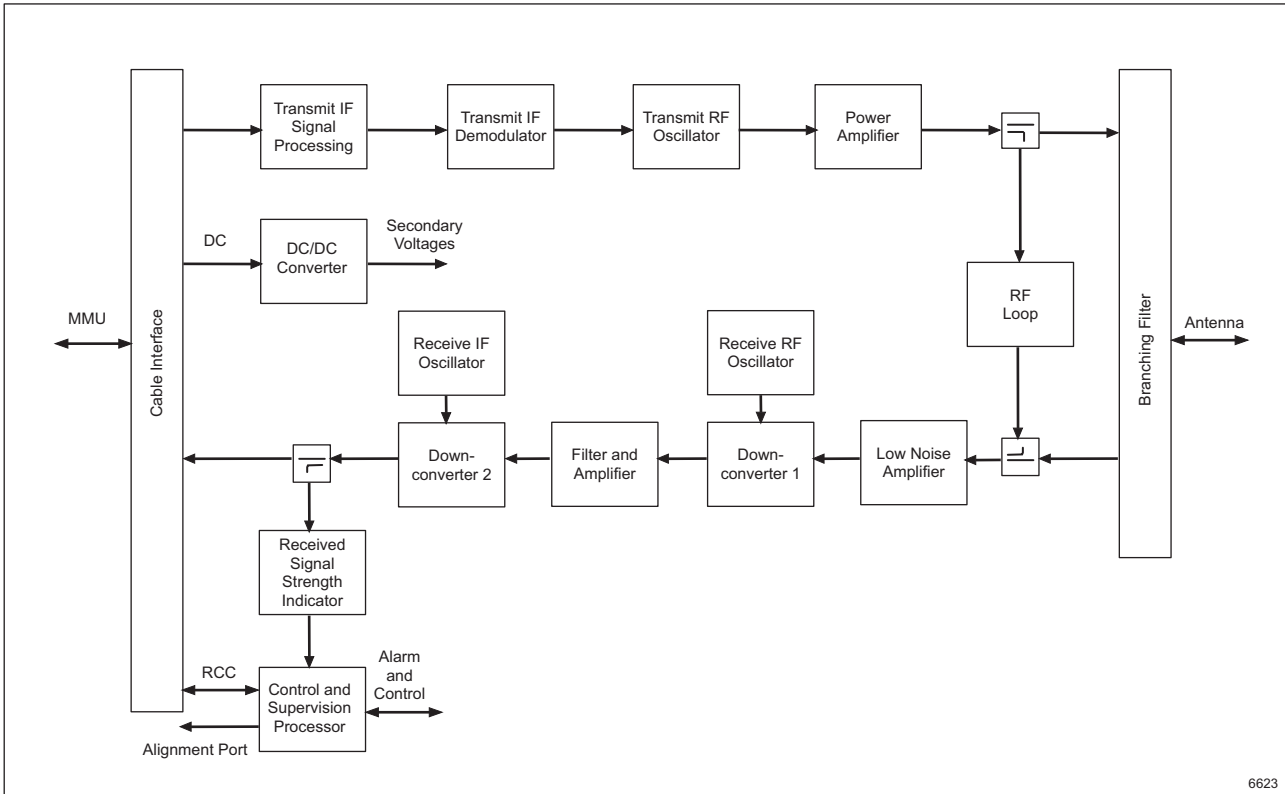This section describes the RAU internal and external functions based on the block diagrams in Figure 47 and Figure 48.

Figure 47   Block diagram for RAU1 and RAU2
(RAU1 7/8 is designed in accordance with Figure 48)
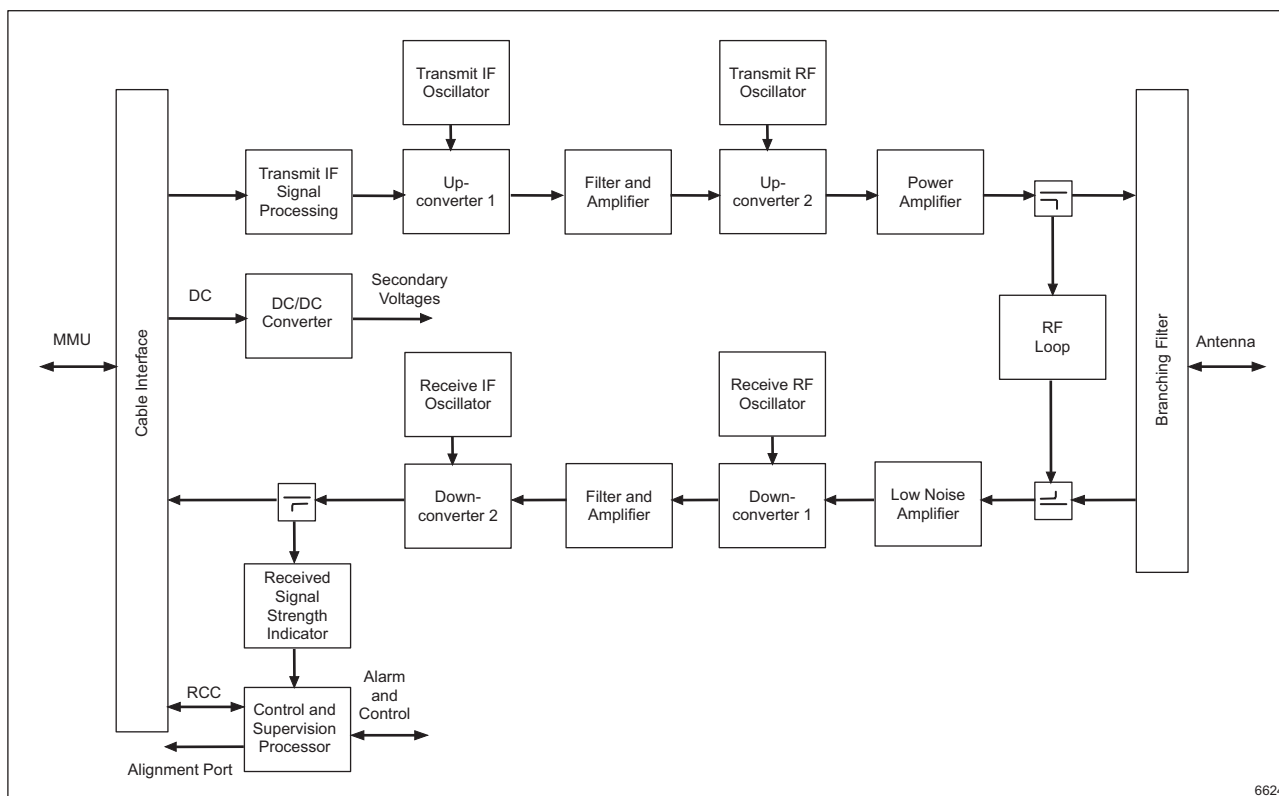
Figure 48   Block diagram for RAU1 N and RAU2 N

4.3.4.1   Cable Interface

The incoming composite signals from the MMU are demultiplexed in the Cable Interface and forwarded for further processing in the RAU. The signals are:

- Transmit IF signal, a modulated signal with a nominal frequency of 350 MHz

- Up-link Radio Communication Channel (RCC), an Amplitude Shift Keying (ASK) modulated command and control signal with a nominal frequency of 6.5 MHz

- DC supply voltage to the RAU

Similarly, the outgoing signals from the RAU are multiplexed in the Cable Interface:

- Receive IF signal, which has a nominal frequency of 140 MHz

- Down-link RCC, an ASK modulated command and control signal with a nominal frequency of 4.5 MHz

In addition to the above, the Cable Interface includes an over voltage protection circuit.

4.3.4.2 Transmit IF Signal Processing

The input amplifier is automatically gain-controlled so that no compensation is required due to the cable length between the indoor and outdoor equipment. The level is used to generate an alarm, indicating that the transmit IF signal level is too low due to excessive cable losses.

4.3.4.3 Transmit IF Demodulator

The transmit IF signal is amplified, limited and demodulated. The demodulated signal is fed to the Transmit RF Oscillator onto the RF carrier.

4.3.4.4 Transmit IF Oscillator

The frequency of the transmitter is controlled in a Phase Locked Loop (PLL), including a Voltage Control Oscillator (VCO). An unlocked VCO loop generates a transmitter frequency alarm.

4.3.4.5 Upconverter 1

The transmit IF signal is upconverted to a second transmit IF of approximately 2 GHz.

4.3.4.6 Filter and Amplifier

The converted signal is amplified and fed through a bandpass filter.

4.3.4.7 Transmit RF Oscillator

This oscillator is implemented in the same way as the Transmit IF Oscillator.

4.3.4.8 Upconverter 2

The transmit IF signal is amplified and upconverted to the selected radio transmit frequency.

4.3.4.9 Power Amplifier

The transmitter output power is controlled by adjustment of the gain in the Power Amplifier. The output power is set in steps of 1 dB from the LCT. It is also possible to turn the transmitter on or off utilizing the Power Amplifier.

The output power signal level is monitored enabling an output power alarm.

4.3.4.10 RF Loop

The RF Loop is used for test purposes only. When the loop is set, the transmitter frequency is set to receiver frequency and the transmitted signal in the Branching Filter is transferred to the receiving side.

4.3.4.11 Branching Filter

On the transmitting side, the signal is fed to the antenna through an output branching filter. The signal from the antenna is fed to the receiving side through an input branching filter. The antenna and both branching filters are connected with an impedance T-junction.

4.3.4.12 Low Noise Amplifier

The received signal is fed from the input branching filter into a Low Noise Amplifier.

4.3.4.13 Receive RF Oscillator

The frequency of the receiver is controlled in a PLL, including a VCO. An unlocked VCO loop generates a receiver frequency alarm.

4.3.4.14 Downconverter 1

The first downconverter gives the IF of approximately 1 GHz.

4.3.4.15 Receive IF Oscillator

This oscillator is used for the second downconversion to 140 MHz and consists of a PLL, including a VCO. The VCO is also used for adjustment of the received 140 MHz signal (through a control signal setting the division number in the IF PLL). A frequency error signal from the MMU is used to shift the receiver oscillator in order to facilitate an Automatic Frequency Control (AFC) loop.

4.3.4.16 Downconverter 2

The signal is downconverted a second time to the IF of 140 MHz.

4.3.4.17 Received Signal Strength Indicator (RSSI)

A portion of the 140 MHz signal is fed to a calibrated detector in the RSSI to provide an accurate receiver input level measurement. The measured level is accessible either as an analog voltage at the alignment port or in dBm from the management software.

The RSSI signal is also used for adjustment of the output power by means of the Automatic Transmit Power Control (ATPC).

4.3.4.18 Control and Supervision Processor

The Control and Supervision Processor has the following main functions:

- Collected alarms and status signals from the RAU are sent to the indoor MMU processor. Summary status signals are visualized by LEDs on the RAU.

- Commands from the indoor units are executed. These commands include transmitter activation/deactivation, channel frequency settings, output power settings and RF loop activation/deactivation.

- The processor controls the RAU's internal processes and loops.

4.3.4.19 DC/DC Converter

The DC/DC Converter provides a stable voltage for the RAU.

4.4   Antennas

4.4.1   Description

The antennas range from 0.2 m up to 3.7 in diameter, in single and dual polarized versions. All antennas are "compact", that is the design is compact with a low profile. The antennas are made of aluminum and painted light gray. All antennas have a standard IEC 154 type B waveguide interface that can be adjusted for vertical or horizontal polarization.

All high performance antennas have an integrated radome.

4.4.2   Installation

4.4.2.1   Integrated Installation

For a 1+0 configuration, the RAU is fitted directly to the rear of the antenna in integrated installation. Single polarized antennas up to 1.8 m in diameter are normally fitted integrated with the Radio Unit (RAU).
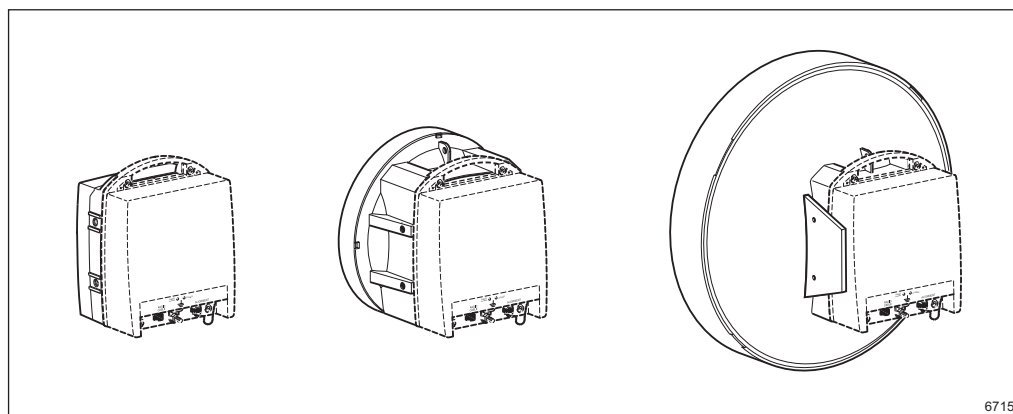
Figure 49   0.2 m, 0.3 m and 0.6 m compact antennas integrated with RAU2
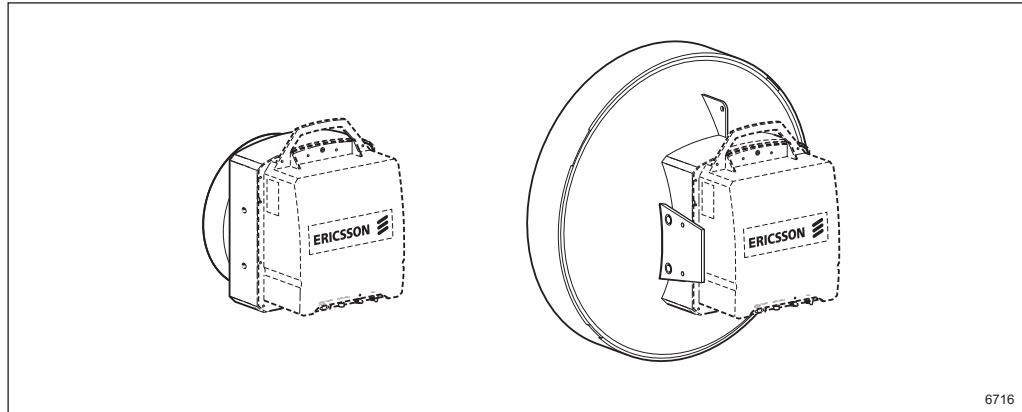
Figure 50   0.3 m and 0.6 m compact antennas integrated with RAU1

For a 1+1 configuration the RAU2 can be fitted directly to an integrated power splitter. A similar solution is available for RAU1, using a waveguide between the power splitter and the antenna.

A symmetrical power splitter version, with equal attenuation in both channels, is used in the majority of the installations.
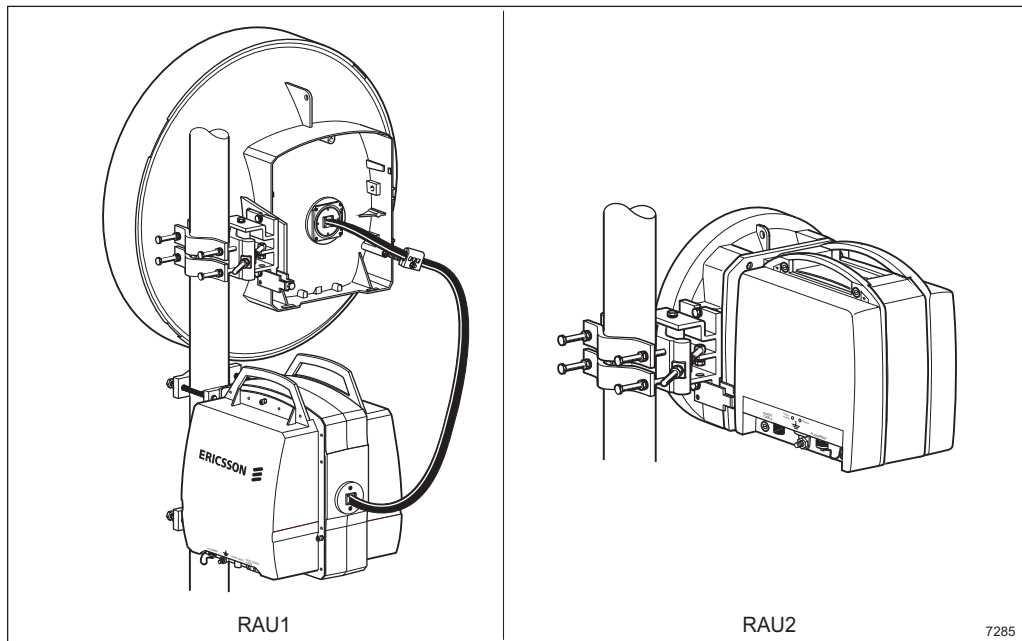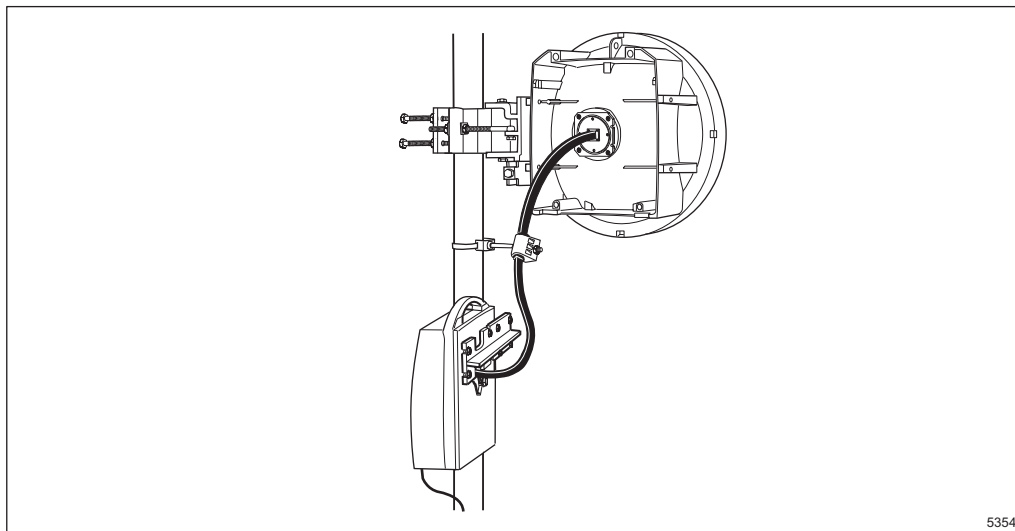

*Figure 51   RAUs fitted to integrated power splitters*

4.4.2.2   Separate Installation

All antennas with IEC 154 Type B waveguide interface can be installed separately, by using a flexible waveguide to connect to the RAU. The dual polarized antennas and the 2.4-3.7 m antennas are always installed separately.

Figure 52   Separate installation in a 1+0 configuration

In case of a protected terminal, the two RAUs can be connected to a common antenna. In a separate installation the RAUs are connected by waveguides to a power splitter, fitted to the antenna.

A symmetrical power splitter version, with equal attenuation in both channels, is used in the majority of the installations.
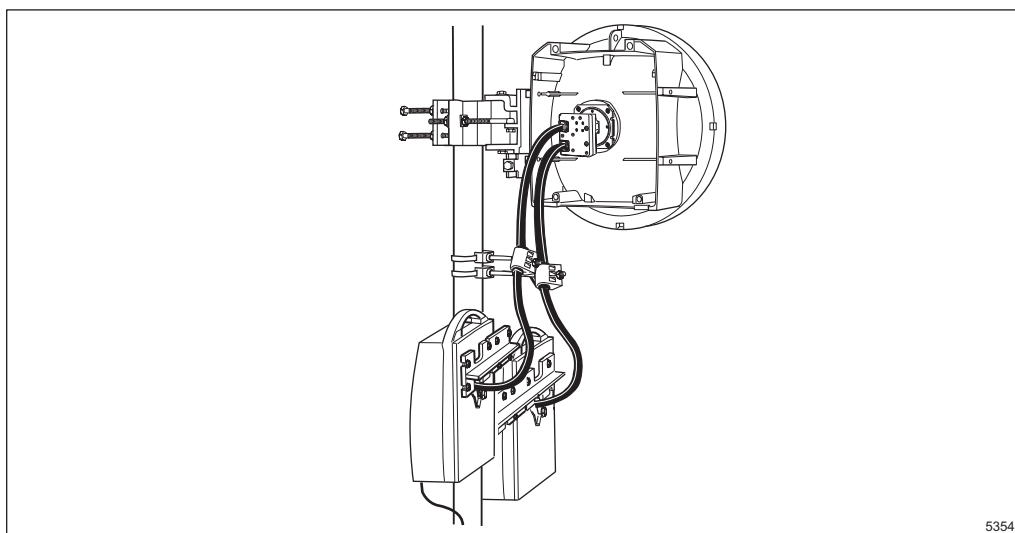

Figure 53   Separate installation in a 1+1 configuration
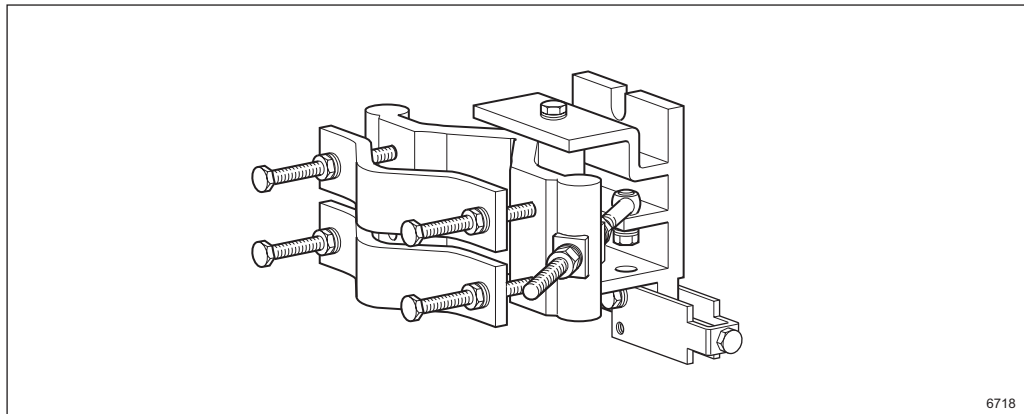
4.4.3 Mounting Kits

This section describes the mounting kits used for the 0.2 m, 0.3 m and 0.6 m antennas. A mounting kit consists of two rigid, extruded aluminum brackets connected with two stainless steel screws along the azimuth axis. The brackets are anodized and have threaded and unthreaded holes to provide adjustment of the antenna in azimuth and elevation.

The support can be clamped to poles with a diameter of 50 - 120 mm or on L-profiles 40x40x5 – 80x80x8 mm with two anodized aluminum clamps. All screws and nuts for connection and adjustment are in stainless steel. NORD-LOCK washers are used to secure the screws.

6717
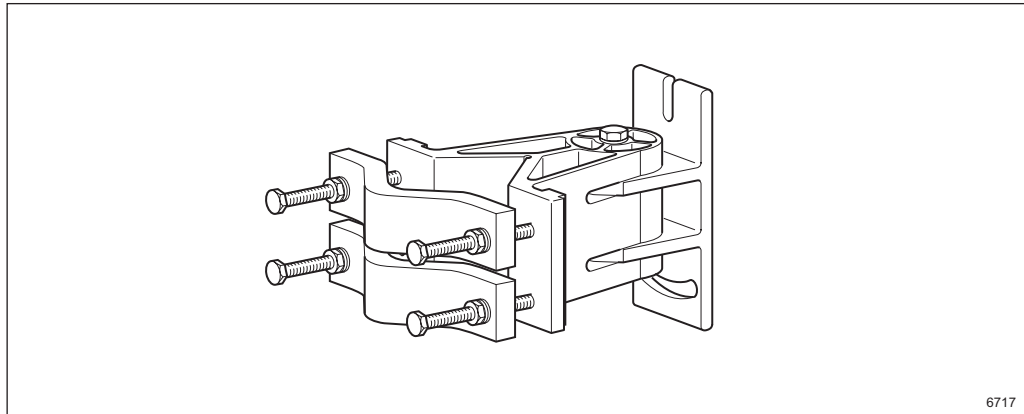
Figure 54   Mounting kit for the 0.2 m compact antenna

The 0.2 m compact antenna mounting kit can be adjusted by ±13° in elevation and by ±90° in azimuth.

6718

Figure 55   Mounting kit for the 0.3 m and 0.6 m compact antennas

The mounting kit for 0.3 m and 0.6 m compact antenna can be adjusted by ±15° in elevation and ±40° in azimuth. Both elevation and azimuth have a mechanism for fine adjustment.

4.5   1+1 Protection

4.5.1   Overview

A Radio Terminal can be configured for 1+1 protection. This configuration provides propagation protection and equipment protection on the MMU, RAU and antenna. Propagation protection may be used on radio links where fading due to meteorological and/or ground conditions make it difficult to meet the required transmission quality.

Configurations for 1+1 protection can be in hot standby or working standby. In hot standby mode, one transmitter is working while the other one, tuned to the same frequency is in standby, not transmitting but ready to transmit if the active transmitter malfunctions. Both RAUs receive signals. When using two antennas, they can be placed for space diversity with a mutual distance where the impact of fading is reduced.

In working standby mode, both radio paths are active in parallel using different frequencies, realizing frequency diversity. Using two different frequencies improves availability, because the radio signals fade with little correlation to each other. Space diversity can be implemented as for hot standby systems.
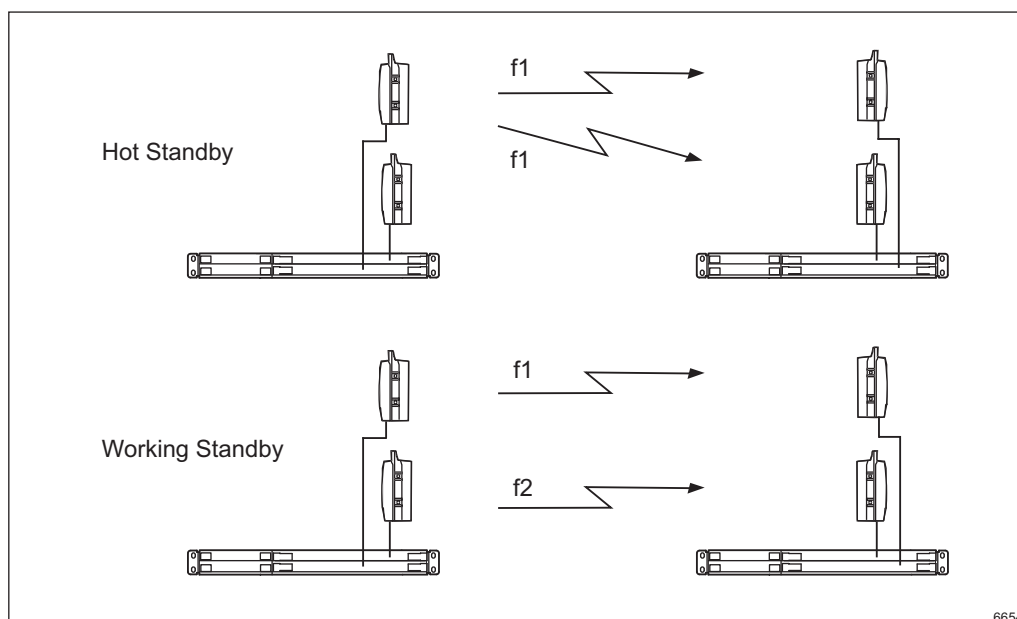

Figure 56   Radio link protection modes

4.5.2 Functional Description

The following different protection cases can be identified:

- Tx Equipment Protection Working Standby

- Tx Equipment Protection Hot Standby

- Radio Segment Protection

- Rx Equipment Protection

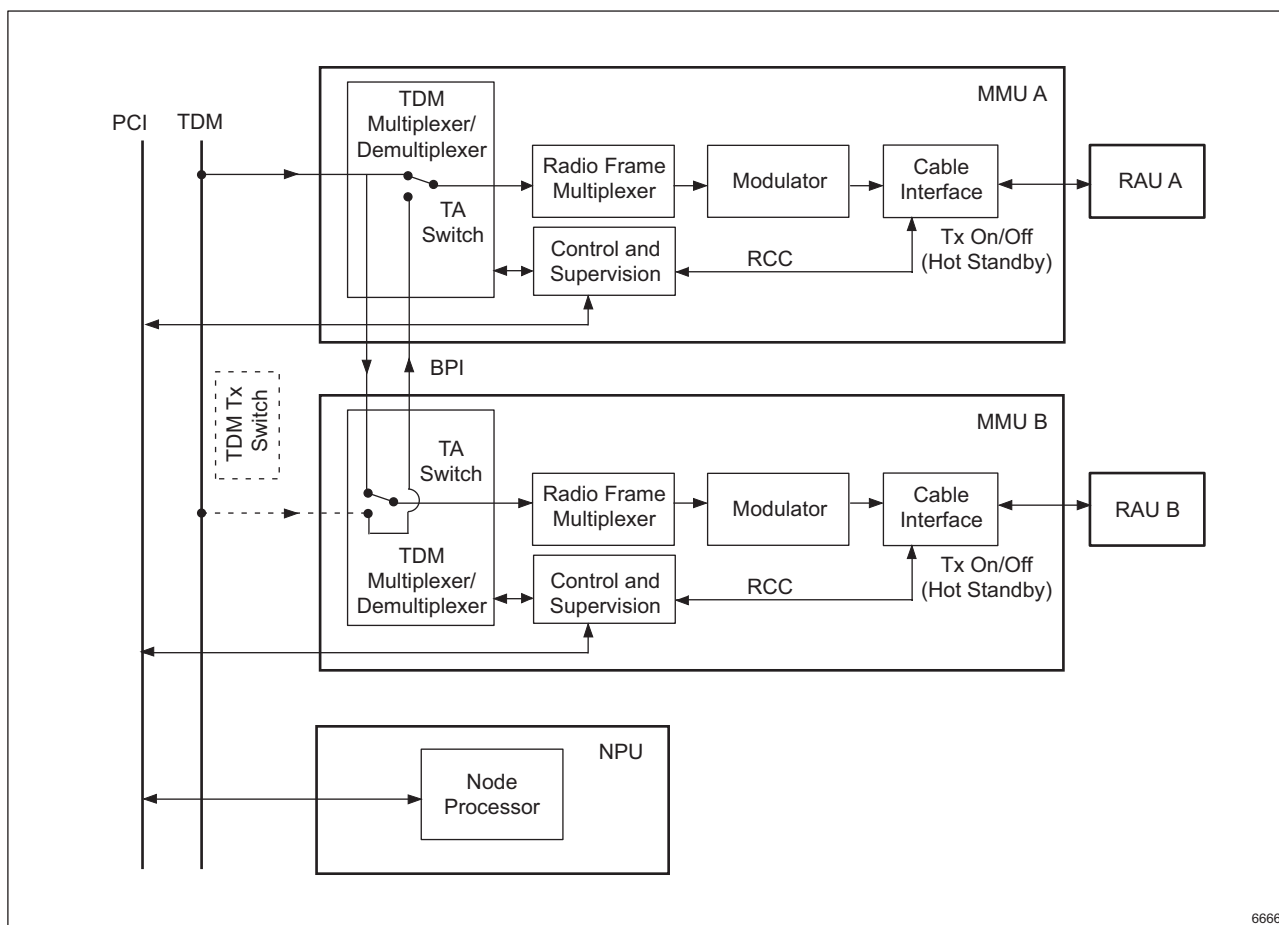#### 4.5.2.1 Tx Equipment Protection Working Standby

This protection case involves two types of switch, TDM Tx switch and Traffic Alignment (TA) switch.

The TDM Tx switch is a logical switch used to switch over the traffic to the redundant MMU, in case of a failure in the TDM Multiplexer part of the active MMU. This is accomplished by the NPU configuring the MMUs to listen to a certain TDM bus slot.

The TA switch is used to feed the multiplexed traffic signals to the Radio Frame Multiplexer block in both MMUs, which is a condition for being able to perform hitless switching in the receiving end.

Alarms generated in the RAU and MMU are monitored by the NPU, which based on the alarm severity commands the TDM and TA switches as appropriate.

The switching principles are illustrated in Figure 57.

Figure 57   Tx Equipment Protection, Working and Hot Standby

4.5.2.2   **Tx Equipment Protection Hot Standby**

This protection case also involves the TDM Tx switch and the TA switch. The difference from Tx Equipment Working Standby is that only one RAU is active. Hence, Tx must be switched off in the malfunctioning Radio Terminal and switched on in the standby. This is controlled by the DP in the Control and Supervision block and communicated in the RCC.

Alarms generated in the RAU and MMU are monitored by the NPU, which based on the alarm severity commands the TDM and TA switches as appropriate.

The switching principles are illustrated in Figure 57.

4.5.2.3 Radio Segment Protection

This protection case involves a Diversity switch in each MMU, providing hitless and error free traffic switching in case of radio channel degradation. It is also used as equipment protection in case of a signal failure in the RAU Rx parts.

The Diversity switches will work autonomous and are controlled by the switch logic in the active MMU Rx. The switch logic is implemented as software in the DP in the Control and Supervision block.

The Diversity switch will react on the Early Warning (EW) signals, Input Power threshold alarm and FEC error alarm. The switch logic in one MMU needs information from the other MMU, which is sent over the BPI bus.

Note that this switching is done under no fault conditions.

The switching principles are illustrated in Figure 58.
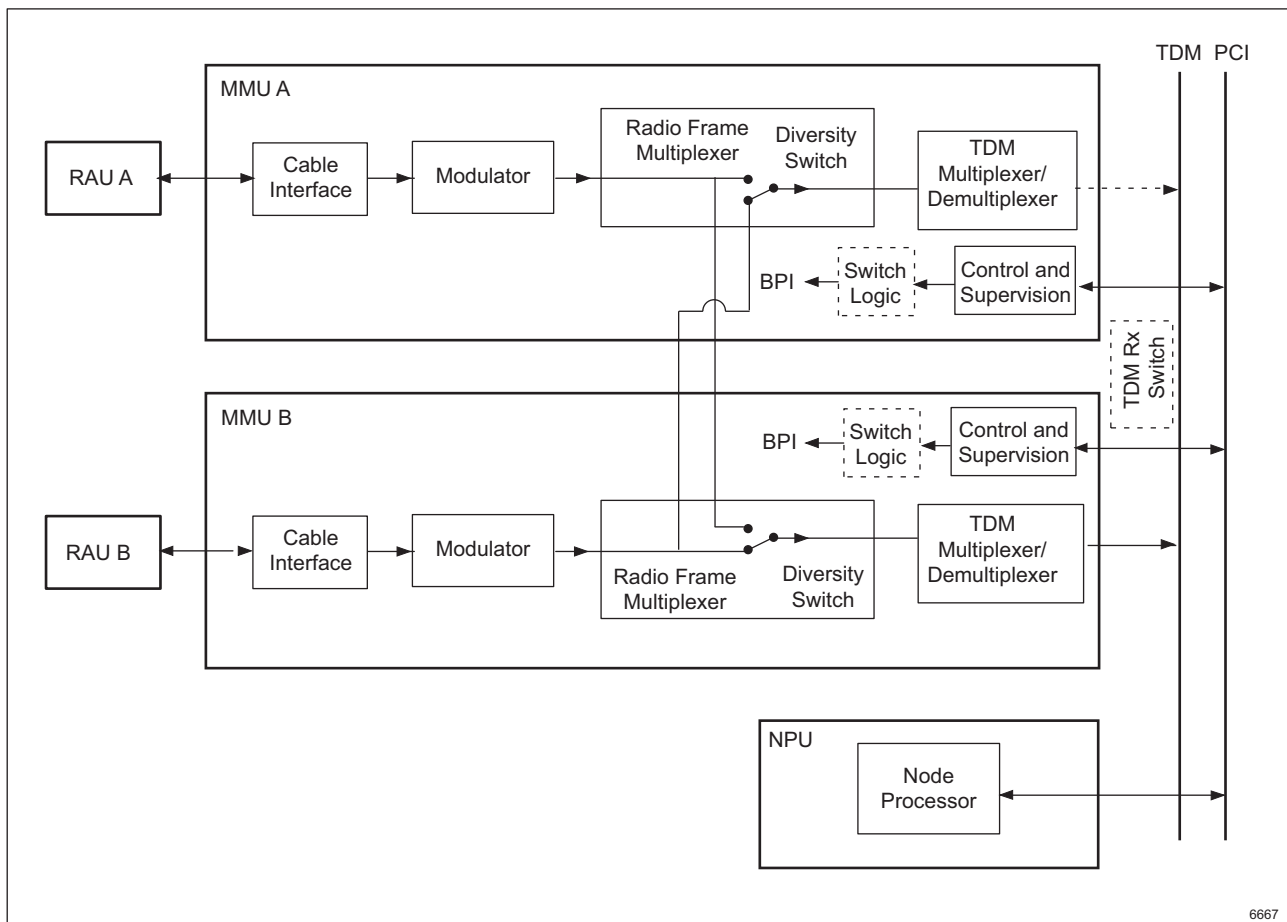
Figure 58   Radio Segment Protection and Rx Equipment Protection

4.5.2.4 Rx Equipment Protection

This protection case involves two types of switch, TDM Rx switch and Diversity switch.

The TDM Rx switch is a logical switch used to switch over the traffic to the redundant MMU, in case of a failure in the TDM Demultiplexer part of the active MMU. This is accomplished by the NPU configuring the MMUs to listen to a certain TDM bus slot.

The Diversity switches will work autonomous and is controlled by the switch logic in the active MMU Rx. This is in accordance with the Radio Segment Protection case, with the difference that signal failure alarms have a higher priority level than the EW signals.

Alarms generated in the RAU and MMU are monitored by the NPU, which based on the alarm severity commands the TDM switch as appropriate.

The switching principles are illustrated in Figure 58.

4.6   Transmit Power Control

The radio transmit power can be controlled in Remote Transmit Power Control (RTPC) or Automatic Transmit Power Control (ATPC) mode, selectable from the management system including setting of associated parameters. In ATPC mode the transmit power can be increased rapidly during fading conditions and allows the transmitter to operate at less than the maximum power during normal path conditions. The normally low transmit power allows more efficient use of the available spectrum while the high transmit power can be used as input to path reliability calculations, such as fading margin and carrier-to-interference ratio.

The transmitter can be turned on or off from the management system.
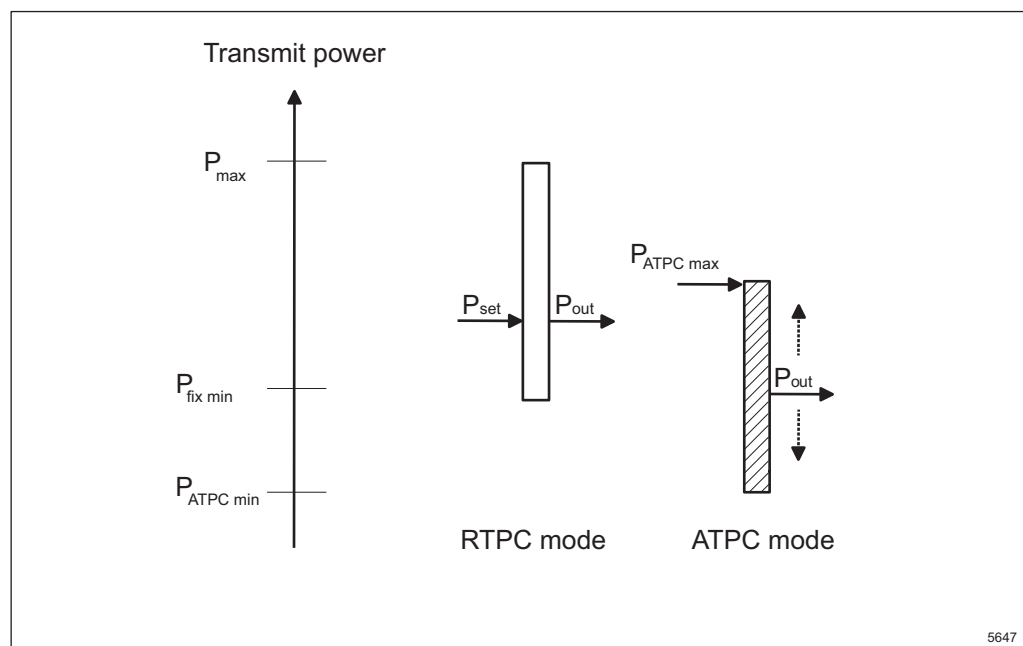
Figure 59   Transmit power control

4.6.1   RTPC Mode

In RTPC mode the transmit power (P_{out}) ranges from a minimum level ($P_{fix\ min}$) to a maximum level (P_{max}). The desired value (P_{set}) can be set in 1 dB increments.

4.6.2   ATPC Mode

ATPC is used to automatically adjust the transmit power (P_{out}) in order to maintain the received input level at the far-end terminal at a target value. The received input level is compared with the target value, a deviation is calculated and sent to the near-end terminal to be used as input for possible adjustment of the transmit power. ATPC varies the transmit power, between a selected maximum level ($P_{ATPC\ max}$) and a hardware specific minimum level ($P_{ATPC\ min}$).

5 Access Termination Unit (ATU)

5.1 Overview

This section describes the ATU, which implements the indoor part of an NE dedicated as an edge node for microwave transmission in a mobile network. It can also be used for transmission of Ethernet traffic, see Section 3.8.

The ATU is a self-contained unit for installation in 19" racks and cabinets. It can also be mounted on a wall.

The ATU provides unprotected (1+0) microwave transmission, within the 7 to 38 GHz frequency bands using C-QPSK modulation, when connected to an RAU with antenna.

The available traffic capacity, 2x2, 4x2, 8x2 and 17x2 Mbit/s, is shared between:

- PDH traffic with a maximum of 8xE1

- Ethernet traffic over a maximum of 16xE1
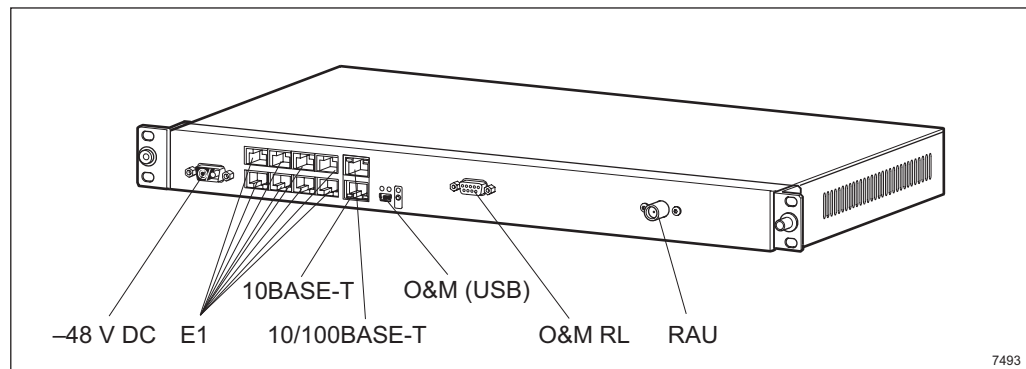
Figure 60   ATU

Note: The first release of the ATU uses the O&M RL port only for software upgrade using the Local Upgrade application.

An NE with ATU utilizes the same outdoor part as an NE with AMM. In addition to this section, the following sections provide important information:

- Radio Unit (RAU), see Section 4.3

- Antennas (1+0 configuration), see Section 4.4

- Transmit Power Control, see Section 4.6

The following summarizes the ATU functions:

- Eight E1 interfaces

- One 10BASE-T Ethernet interface for connection to a site LAN

- One 10/100BASE-T Ethernet interface for Ethernet traffic.

- System control and supervision

- IP router for DCN handling

- SNMP Master Agent

- USB interface for LCT connection

- Filtering of the external power, providing secondary voltages and power supply to the RAU

- Storage and administration of inventory and configuration data

- Multiplexing and modulation of traffic signals in the transmitting direction

- Demodulation and demultiplexing of traffic signals in the receiving direction

5.2 Functional Blocks

This section describes the functions of the ATU based on the block diagram in Figure 61.
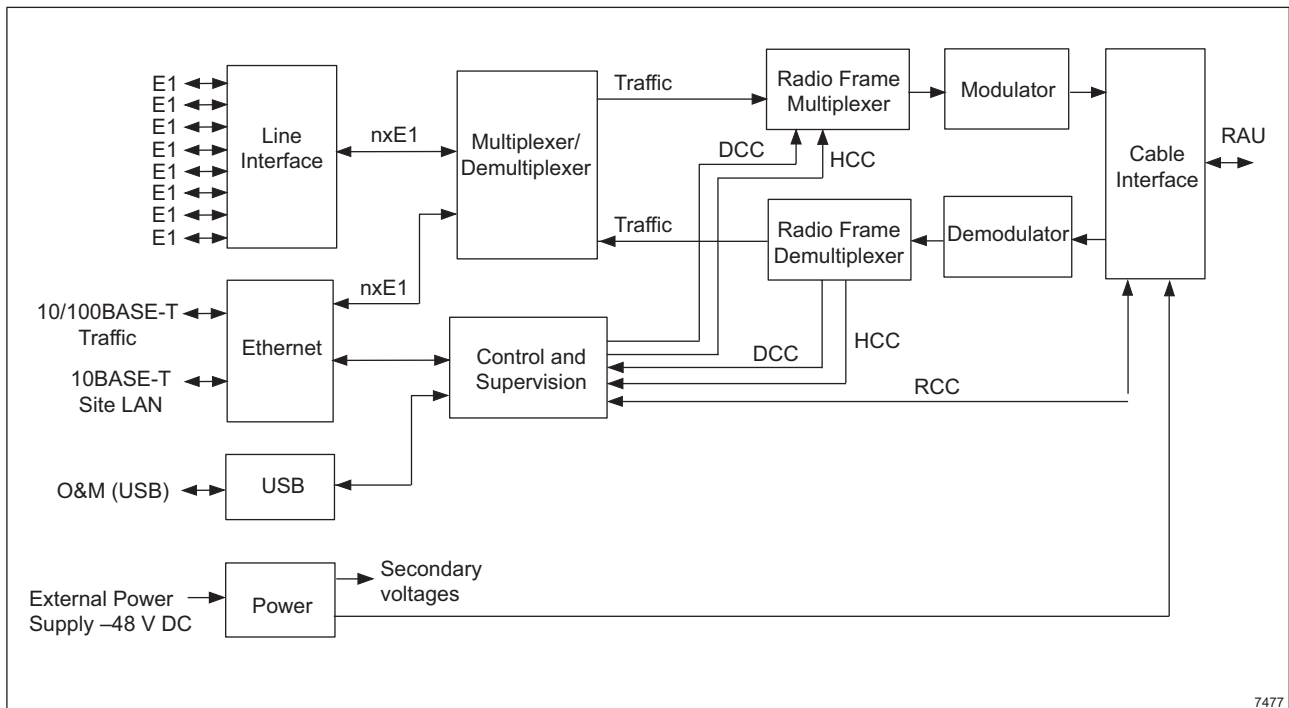
Figure 61   Block diagram for the ATU

5.2.1   Line Interface

This block provides the eight E1 line interfaces for connection of PDH traffic. It interfaces the Multiplexer/Demultiplexer block by transmitting and receiving the traffic (nxE1).

5.2.2   Ethernet

This block provides the 10BASE-T interface for connection to a site LAN and the 10/100BASE-T interface for Ethernet traffic in Ethernet bridge applications.

The Ethernet traffic is mapped on nxE1, where n≤16, using one inverse multiplexer. The E1s are transmitted to and received from the Multiplexer/Demultiplexer block.

5.2.3   USB

This block provides the LCT connection. The equipment is accessed using a local IP address.

5.2.4   Power

The external power supply, –48 V DC, is connected to the unit.

This block provides secondary voltages for the unit and a stable voltage for the RAU, distributed in the radio cable. It also provides input under voltage protection, transient protection, soft start and electronic fuse to limit inrush currents at start-up, or over currents during short circuit.

5.2.5   Multiplexer/Demultiplexer

This block interfaces the Line Interface and the Ethernet blocks by receiving and transmitting the traffic.

It performs 2/8 and 8/34 multiplexing, depending on the traffic capacity, for further transmission to the Radio Frame Multiplexer.

In the receiving direction, it performs 34/8 and 8/2 demultiplexing, depending on the traffic capacity. The demultiplexed traffic is transmitted to the Line Interface and the Ethernet blocks.

5.2.6   Control and Supervision

This block handles system control and supervision. Its main functions are to collect alarms, control settings and tests. It also holds an IP router for DCN handling.

For the traffic over the hop it handles BER collection and communicates with processor in the RAU through the RCC.

Exchange of control and supervision data over the hop is made through the HCC.

5.2.7 Radio Frame Multiplexer

The Radio Frame Multiplexer handles multiplexing of different data types into one data stream, scrambling and FEC encoding.

The following data types are multiplexed into the composite data stream to be transmitted over the radio path:

- Traffic

- Data Communication Channel (DCC)

- Hop Communication Channel (HCC)

Traffic

The transmit traffic data is first sent to the multiplexer to assure data rate adaptation (stuffing). If no valid data is present at the input, an AIS signal is inserted at nominal data rate. This means that the data traffic across the hop is replaced with ones (1).

DCC

DCC comprises 2x64 kbit/s channels used for DCN communication over the hop.

HCC

The Hop Communication Channel (HCC) is used for exchange of control and supervision information between the near-end and far-end.

Multiplexer

The three different data types together with check bits and frame lock bits are sent in a composite data format defined by the frame format that is loaded into a Frame Format RAM. The 12 frame alignment signal bits are placed at the beginning of the frame. Stuffing bits are inserted into the composite frame.

Scrambling and FEC Encoding

The synchronous scrambler has a length of $2^{17}-1$ and is synchronized each eighth frame (super frame). The FEC bits are inserted according to the frame format and calculated using an interleaving scheme.

5.2.8 Modulator

The composite data stream from the Radio Frame Multiplexer is modulated, D/A converted and pulse shaped in a Nyqvist filter to optimize transmit spectrum.

C-QPSK (Constant envelope offset Qaudrature Phase Shift Keying), an offset QPSK modulating technique, is used. It has a high spectrum efficiency compared to other constant envelope schemes.

The Modulator consists of a phase locked loop (VCO) operating at 350 MHz. For test purposes an IF loop signal of 140 MHz is generated by mixing with a 490 MHz signal.

5.2.9 Cable Interface

The following signals are frequency multiplexed in the Cable Interface for further distribution through a coaxial cable to the outdoor RAU:

- 350 MHz transmitting IF signal

- 140 MHz receiving IF signal

- DC power supply

- Radio Communication Channel (RCC) signal as an Amplitude Shift Keying (ASK) signal

In addition to the above, the cable interface includes an over voltage protection circuit.

5.2.10 Demodulator

The received 140 MHz signal is AGC amplified and filtered prior to conversion to I/Q baseband signals. The baseband signals are pulse shaped in a Nyqvist filter and A/D converted before being demodulated.

5.2.11 Radio Frame Demultiplexer

On the receiving side the received composite data stream is demultiplexed and FEC corrected. The frame alignment function searches and locks the receiver to the frame alignment bit patterns in the received data stream.

Descrambling and FEC Decoding

Error correction is accomplished using FEC parity bits in combination with a data quality measurement from the Demodulator. The descrambler transforms the signal to its original state enabling the Demultiplexer to properly distribute the received information to its destinations.

Demultiplexing

Demultiplexing is performed according to the used frame format. The Demultiplexer generates a frame fault alarm if frame synchronization is lost. The number of errored bits in the traffic data stream is measured using parity bits. These are used for BER detection and performance monitoring. Stuffing control bits are processed for the traffic and service channels.

Traffic

On the receiving side the following is performed to the traffic data:

- AIS insertion (at signal loss or BER $\leq 10^{-3}$)

- AIS detection

- Elastic buffering and clock recovery

DCC

On the receiving side, elastic buffering and clock recovery is performed on the DCC.

HCC

The Hop Communication Channel (HCC) is used for exchange of control and supervision information between near-end and far-end.

6 Management

The management functionality described in this section can be accessed from the management tools and interfaces as described in Section 6.7. Shortly these are:

- Embedded Element Manager (EEM) accessed using a Web browser

- MINI-LINK Manager for remote O&M

- Simple Network Management Interface (SNMP)

6.1 Fault Management

All software and hardware in operation is monitored by the control system. The control system locates and maps faults down to the correct replaceable hardware unit. Faults that cannot be mapped to one replaceable unit result in a fault indication of all suspect units (this may be the whole NE).

Hardware errors are indicated with a red LED found on each plug-in unit and RAU.

The control system will generally try to repair software faults by performing warm restarts on a given plug-in unit or on the whole NE.

6.1.1 Alarm Handling

MINI-LINK TN uses SNMP traps to report alarms to MINI-LINK Manager or any other SNMP based management system. To enable a management system to synchronize alarm status, there is a notification log (alarm history log) where all traps are recorded. There is also a list of current active alarms. Both these can be accessed by the management system using SNMP or from the EEM. The alarm status of specific managed objects can also be read.

In general, alarms are correlated to prevent alarm flooding. This is especially important for high capacity links like STM-1 where a defect on the physical layer can result in many alarms at higher layer interfaces like VC-12 and E1. Correlation will cause physical defects to suppress alarms, like AIS, at these higher layers.

Alarm notifications can be enabled/disabled for an entire NE, for an individual plug-in unit and for individual interfaces. Disabling alarm notification means that no new alarms or event notifications are sent to the management system.

Alarm and event notifications are sent as SNMP v2c/v3 traps with a format according to Ericsson's Alarm IRP SNMP solution set version 1.2. The following fields are included in such a notification:

- Notification identifier: uniquely identifies each notification

- Alarm identifier: only applicable for alarms, identifies all alarm notifications that relate to the same alarm

- Managed object class: identifies the type of the source (E1, VC-4 etc)

- Managed object instance: identifies the instance of the source like 1/11/1A for an E1 on the NPU

- Event time: time when alarm/event was generated

- Event type: X.73x compliant alarm/event type like communications alarm and equipment alarm

- Probable cause: M.3100 and X.733 compliant probable cause, for example Loss Of Signal (LOS)

- Perceived severity: X.733 compliant severity, for example critical or warning.

- Specific problem: free text string detailing the probable cause

The system can also be configured to send SNMP v1 traps. These traps are translated from the IRP format using co-existence rules for v1 and v2/v3 traps (RFC 2576).

For a full description of alarms, see *MINI-LINK TN ETSI Operation Manual*.

6.1.2 Loops

Loops can be used to verify that the transmission system is working properly or they can be used to locate a faulty unit or interface.

The following loops are available on all units that carry traffic.

Connection Loop This loop can be initiated for an E1. The traffic connection is looped in the TDM bus back to its origin, see Figure 62. If an E1 interface is traffic routed an AIS is sent to the other interface in the traffic routing.

A Connection Loop can be used in combination with a BERT in another NE to test a network connection including the termination plug-in unit, in case a Local Loop cannot be used due to the lack of a traffic routing.

The following loops are available on units with a line interface
(MS/RS, E3, E2 and E1).

Line Loop Loops an incoming line signal back to its origin. The loop is done in the plug-in unit, close to the line interface, Figure 62. An AIS is sent to the TDM bus.

A Line Loop in combination with a BERT in an adjacent NE is used to test the transmission link between the two NEs.

Local Loop Loops a line signal received from the TDM bus back to its origin, see Figure 62. An AIS is sent to the line interface.

A Local Loop in combination with a BERT in another NE can be used to test a connection as far as possible in the looped NE.

The following loop is only supported on the MMU.

Rx Loop This loop is similar to the Connection Loop but the loop is done in the plug-in unit close to the TDM bus, where a group of E1s in the traffic connection is looped back to its origin, Figure 62.

An Rx Loop can be used on the far-end MMU to verify the communication over the radio path, see Figure 63.
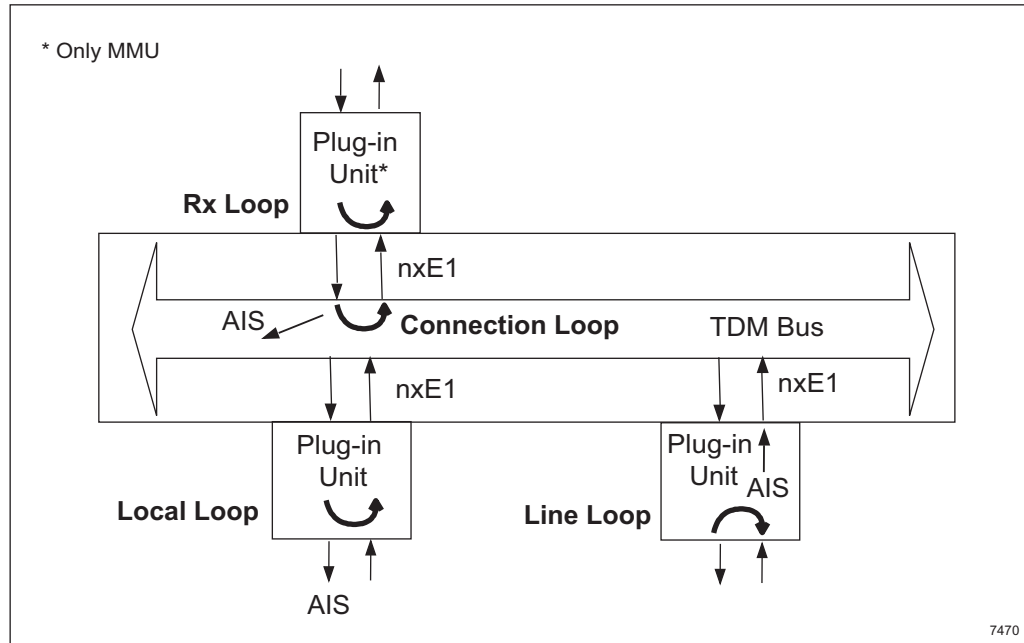
Figure 62   Loops

The following loops on the near-end Radio Terminal are supported in order to find out if the MMU or RAU is faulty.

IF Loop   In the MMU the traffic signal to be transmitted is, after being modulated, mixed with the frequency of a local oscillator and looped back for demodulation (on the receiving side).

RF Loop   In the RAU a fraction of the RF signal transmitted is shifted in frequency and looped back to the receiving side.
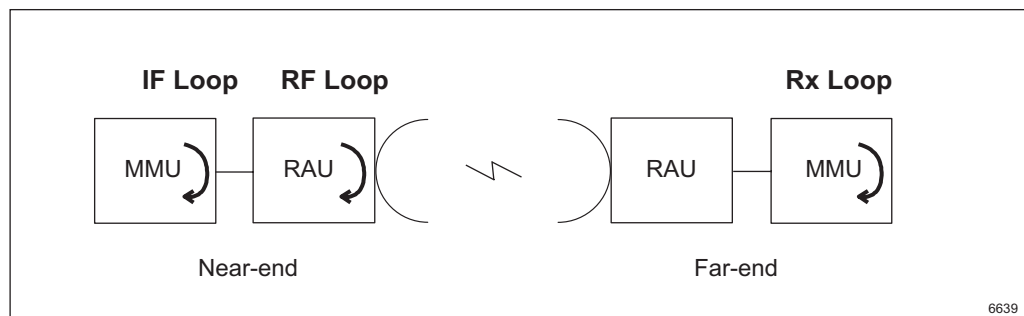
Figure 63   Radio Terminal loops

6.1.3 User Input/Output

The NPU1 B provides three User Input and three User Output ports.

The User Input ports can be used to connect user alarms to the MINI-LINK management system. Applications like fire alarms, burglar alarms and low power indicator are easily implemented using these input ports. The User Input ports can be configured to be normally open or normally closed.

User Output ports can be used to export summary alarms of the accumulated severity in the NE to other equipment's supervision system. The User Output ports can be controlled by the operator or triggered by one or several alarm severities.

The setup of the User Input/Output is done in the EEM.

6.2 Configuration Management

The configuration can be managed locally and from the O&M center provided that the DCN is set up. The following list gives examples of configuration areas:

- Transmission interface parameters, such as PM alarm thresholds

- Traffic routing

- Traffic protection, such as 1+1 E1 SNCP, MSP 1+1

- DCN parameters, such as host name, IP address

- Security parameters, such as enabling telnet, adding new SNMP users

- Radio Terminal parameters, such as frequency, output power, ATPC and protection

6.3   Software Management

Software can be upgraded both locally and remotely. Software upgrade utilizes a local or remote FTP server to distribute the software to the NE. An FTP server is provided on the MINI-LINK Service Software CD used when installing software on site.

The MINI-LINK TN system software consists of different software modules for different applications.

All traffic continues while the software is being loaded. During the execution of the software download a progress indication is provided in the user interface.

When the download is completed, the new software and the previous software version are stored on the unit.

Performing a warm restart of the NE activates the new software version. A warm restart only affects the control system. This restart can be performed immediately or scheduled at a later time. The restart, depending on the new functionality, may influence the traffic. When the warm restart with the new software is completed, the NE will wait for a "Commit" command from the management system. When "Commit" is received, the software upgrade process is completed.

The previous software revision remains stored on the unit in case a fallback is required. This may be the case if something goes wrong during the software upgrade or if no "Commit" is received within 15 minutes after the restart.

If plug-in units with old software versions are inserted into the NE, they can be automatically upgraded.

6.4 Performance Management

6.4.1 General

Performance management consists mainly of monitoring line and radio transmission quality. MINI-LINK TN supports performance management according to ITU-T recommendation G.826 02/99.

The following performance counters are used:

- Errored Seconds (ES)

- Severely Errored Seconds (SES)

- Background Block Error (BBE)

- Unavailable Seconds (UAS)

- Elapsed Time

The performance counters are available for both 15 minutes as well as 24 hours intervals. The start time of a 24 hours interval is configurable.

The following counters are stored in the NE:

- Current 15 minutes and 24 hours counter

- One 24 hours previous and 96 x 15 minutes previous intervals

Performance data is stored in volatile memory, so that a restart will lose all gathered data.

6.4.2 Bit Error Testing

Each NE has a built-in Bit Error Ratio Tester (BERT) in all plug-in units carrying traffic. The BERT is used for measuring performance on E1 interfaces according to ITU standard O.151. A Pseudo Random Bit Sequence (PRBS) with a test pattern $2^{15} - 1$ is sent on the selected interface.

As with loop tests, bit error testing may be used for system verification or for fault location.
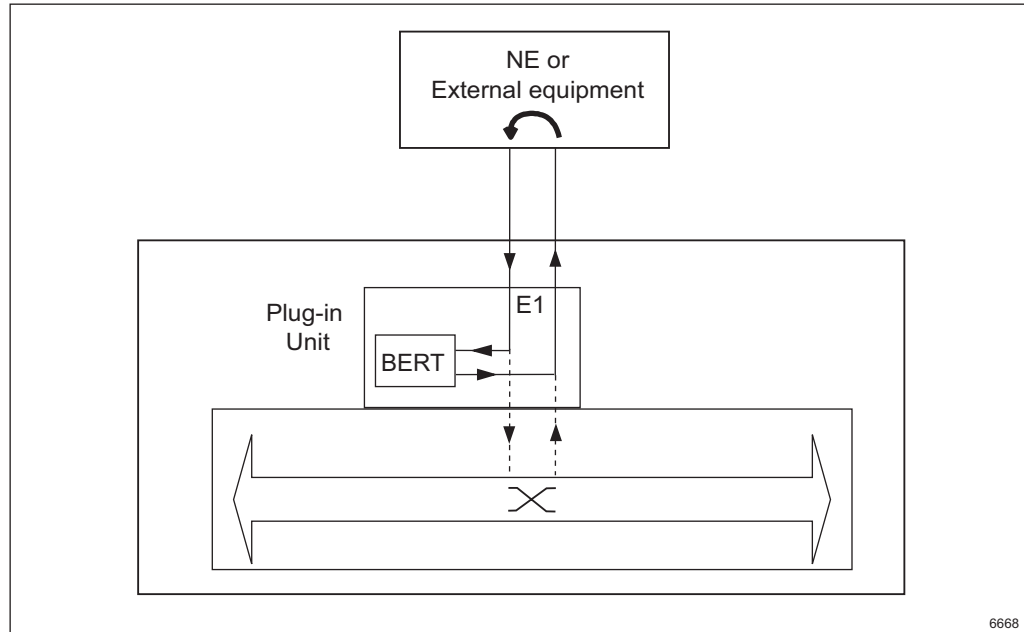
Figure 64   BERT in combination with an external loop

The BERT is started and stopped by the operator and the bit error rate as a function of the elapsed time is the test result. The test can be started and stopped locally or remotely using the management system.

Several BERTs can be executed concurrently with the following limitations:

- One BERT per plug-in unit

- One BERT on a protected 1+1 E1 SNCP interface per NE

6.5 Security Management

All management access to the MINI-LINK TN system is protected by a user name and a password. The following user types are defined:

- *view_user* with read only access

- *control_user* with read and write access

Both user types have an associated password. Passwords can only be changed by the control_user using the EEM or the SNMP v3 interface.

The following security mechanisms are used on the various O&M interfaces:

- Local and remote EEM access requires a user name and password. A default password is used for the local USB connection.

- For SNMP v3 access the regular user name and password protection is used. In addition to this the User-based Security Model (USM) and View-based Access Model (VACM) are supported. This means that additional users and passwords might be defined by external SNMP v3 managers. The security level is authentication/no privacy where MD5 is used as hash algorithm for authentication.

- For SNMP v1/v2c access the regular user name and password protection does not apply. Instead a community based access protection is used. As default, a public and a private community are configured. The public community enables default read-access and the private community provides read and write access to MIB-II system information. These privileges can be extended through either the EEM or SNMP v3 interface. The SNMP v1/v2c interface may by disabled.

- Access to the telnet port using CLI commands is protected by the regular user name and password protection. The telnet port can be disabled from the EEM.

6.6 Data Communication Network (DCN)

This section covers the DCN functions provided by MINI-LINK TN. The *MINI-LINK DCN Guideline ETSI* gives recommendations on DCN implementation, covering the different MINI-LINK product families.

6.6.1 IP Services

The following standard external IP network services are supported:

- All clocks, used for example for time stamping alarms and events, can be synchronized with a Network Time Protocol (NTP) server.

- File Transfer Protocol (FTP) is used as a file transfer mechanism for software upgrade, and for backup and restore of system configuration.

- Domain Name System (DNS) enables the use of host names.

- Dynamic Host Configuration Protocol (DHCP) is used to allocate IP addresses in the DCN. The NE has a DHCP relay agent for serving other equipment on the site LAN.
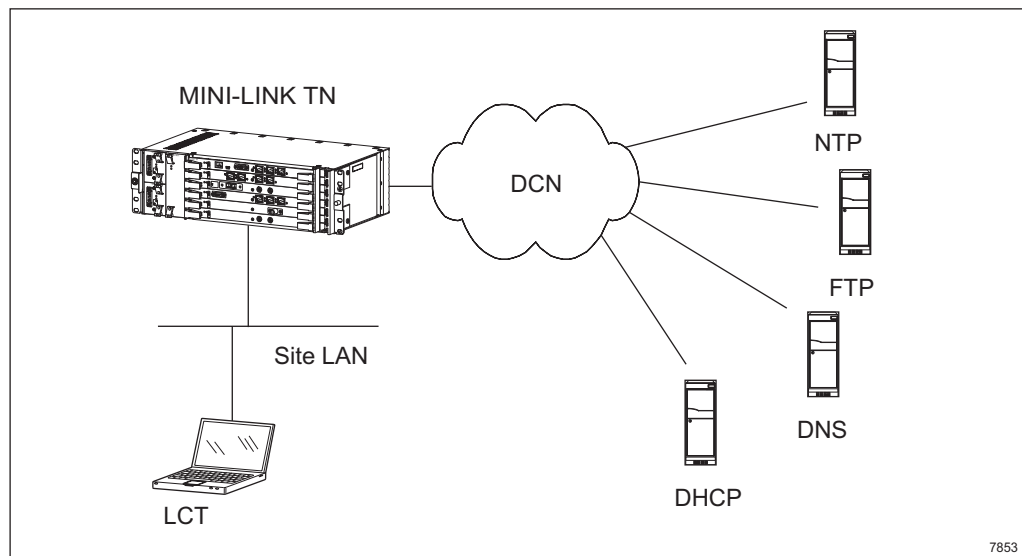
Figure 65   IP services

6.6.2   DCN Interfaces

MINI-LINK TN provides an IP based DCN for transport of its O&M data. Each NE has an IP router for handling of the DCN traffic. A number of different alternatives to connect and transport DCN traffic are supported. This diversity of DCN interfaces provides the operator with a variety of options when deploying a DCN. Figure 66 illustrates the different options, including ways of connecting to the equipment for DCN configuration.
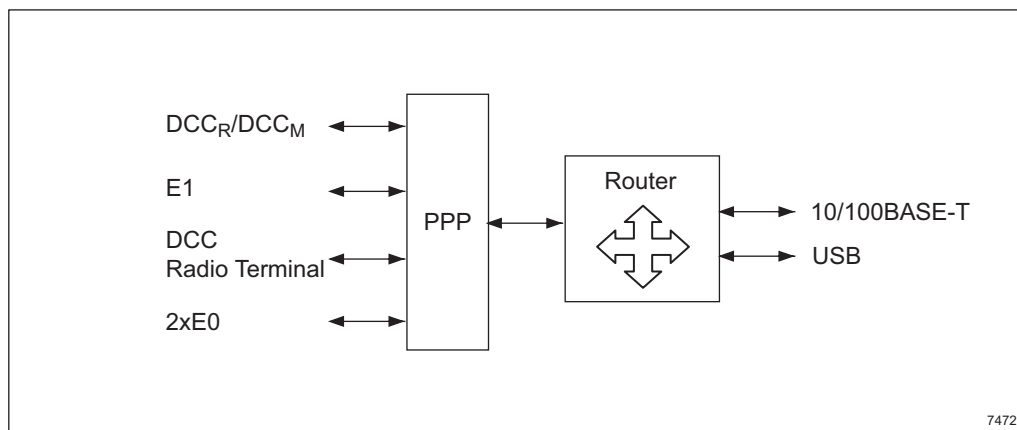
Figure 66   DCN interfaces

The internal IP traffic is transported on nx64 kbit/s channels in the TDM bus in the backplane. The internal channels are automatically established at power up.

6.6.2.1   DCC$_R$/DCC$_M$

The DCC$_R$/DCC$_M$ overhead sections in the STM-1 frame can be used to transport DCN traffic. A PPP connection is established over the overhead segments between two end points. The default bandwidth is automatically established to DCC$_R$=192 kbit/s and DCC$_M$=192 kbit/s. DCC$_M$ is configurable to 384 kbit/s and 576 kbit/s.

The implementation of the DCN transport over the overhead sections requires a MINI-LINK TN NE both ends. DCC$_R$/DCC$_M$ can be used to connect to another MINI-LINK TN NE, while DCC$_R$ can be used to connect to MINI-LINK HC.

6.6.2.2   E1

One unstructured E1 can be terminated for transport of DCN traffic. It can be a fixed E1 connected to an NPU or LTU, an E1 transported in an STM-1 frame or an E1 transported over a radio link. The E1 is terminated in a router in the other end in the operator's O&M network.

This PPP channel has to be established manually.

6.6.2.3 DCC Radio Terminal

Each Radio Terminal provides a DCC of 2x64 kbits, transported in the radio frame overhead.

6.6.2.4 2xE0

The SMU2 provides 2xE0 (2x64 kbit/s) for DCN. The interface can be used for connection to MINI-LINK E equipment or external equipment.

6.6.2.5 10/100BASE-T

Each NE has an 10/100BASE-T Ethernet interface on the NPU for connection to a site LAN. This interface offers a high speed DCN connection and is the recommended way to connect to an external DCN.

The interface is also used at sites holding MINI-LINK HC and MINI-LINK E with SAU IP(EX).

6.6.2.6 USB

The USB interface is located on the NPU and is used for LCT connection using a local IP address.

6.6.3 IP Addressing

MINI-LINK TN supports both numbered and unnumbered IP addresses. Numbered IP addresses are used for the Ethernet interface and IP interfaces configured as ABR. All other IP interfaces should be set up with unnumbered IP addresses.

The IP interfaces with unnumbered IP address inherit the characteristics of the Ethernet interface.

The use of unnumbered interfaces has several advantages:

- The use of IP addresses is limited. Using numbered interfaces for the PPP links would normally require using one IP subnet with two addresses for each radio hop. For a large aggregation site, this would imply a lot of addresses.

- The planning of the IP addresses is simplified.

- The amount of configuration is reduced because only one IP address is configured upon installation.

6.6.4 IP Router

The IP router supports the following routing mechanisms:

- Open Short Path First (OSPF), which is normally used for routers within the MINI-LINK domain.

- Static routing

There are two different ways to configure the IP router. The idea is that the most common configurations are done using the EEM. When complex router configuration and troubleshooting is required, a Command Line Interface (CLI) is used, see Section 6.7.4.

6.6.4.1 OSPF Features

The following summarizes the OSPF features:

- An NE can be a part of a non-stub area, stub area or totally stub area.

- An NE can act as an Internal Router (IR) or an Area Border Router (ABR).

- Virtual links are supported, which is useful when an area needs to be split in two parts.

- Link summarization is supported, which is used in the ABR to minimize the routing information distributed to the backbone and/or other areas.

6.7   Management Tools and Interfaces

This section gives a brief overview of the management tools and interfaces used for MINI-LINK TN.
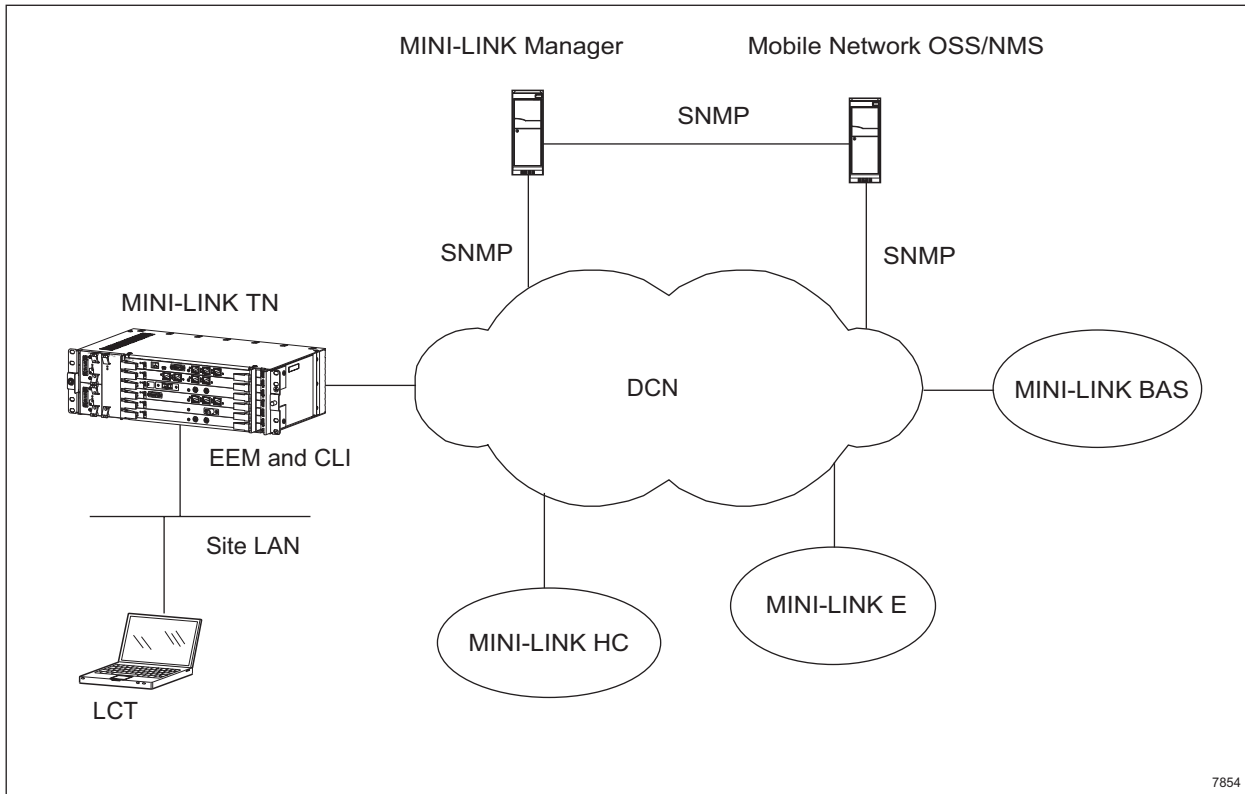
Figure 67   Management tools and interfaces

6.7.1   Embedded Element Manager (EEM)

The element management function is implemented as an Embedded Element Manager (EEM) application. The EEM is accessed using a standard web browser.

The EEM provides tools for on site installation, configuration management, fault management, performance management and software upgrade. It is also used to configure the traffic routing function, protection and DCN.

For local management a Local Craft Terminal (LCT) is used, that is the EEM is accessed locally by connecting a PC to the NPU, with a USB cable

The EEM can also be accessed over the site LAN or remotely over the DCN, by entering an IP address as URL in the web browser. If DNS is available, the NE name is entered as a URL.

A thorough description of the EEM functions is available as online Help and in the *MINI-LINK TN Operation Manual.*
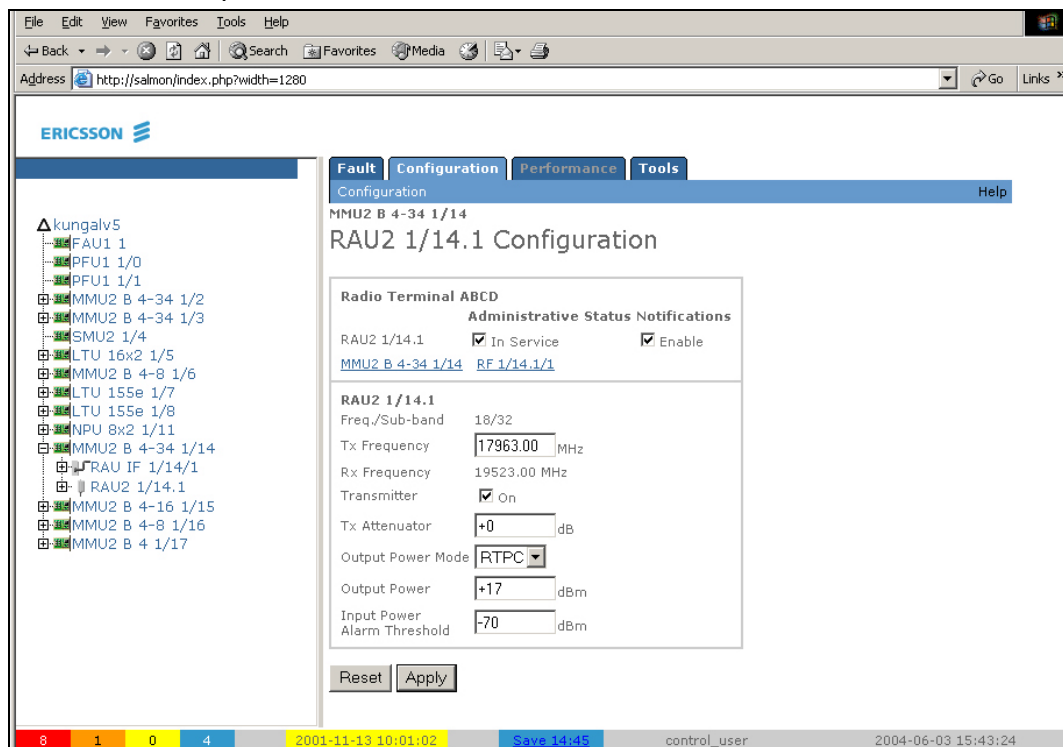
Figure 68   EEM

6.7.2   MINI-LINK Manager

MINI-LINK TN is typically managed remotely using the MINI-LINK Manager. This is the network management tool for the whole MINI-LINK microwave network. It provides a single point of access with a complete and comprehensive network view. The system provides:

- Fault Management

- Configuration Management

- Performance Management

- Security Management

- Software Management

MINI-LINK Manager has interfaces with higher level management systems such as Ericsson Mobile Network OSS. For more information, see *MINI-LINK Manager Product Description*.

MINI-LINK Manager supervises MINI-LINK TN using SNMP. The EEM is launched to access a single NE.
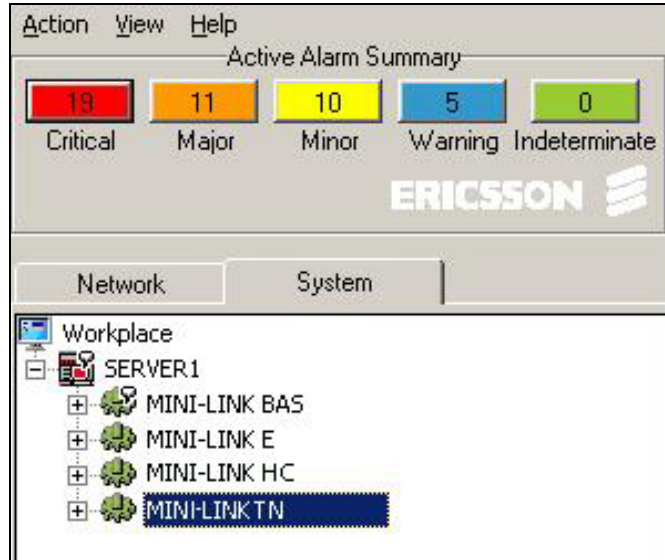
Figure 69   MINI-LINK Manager

6.7.3   SNMP
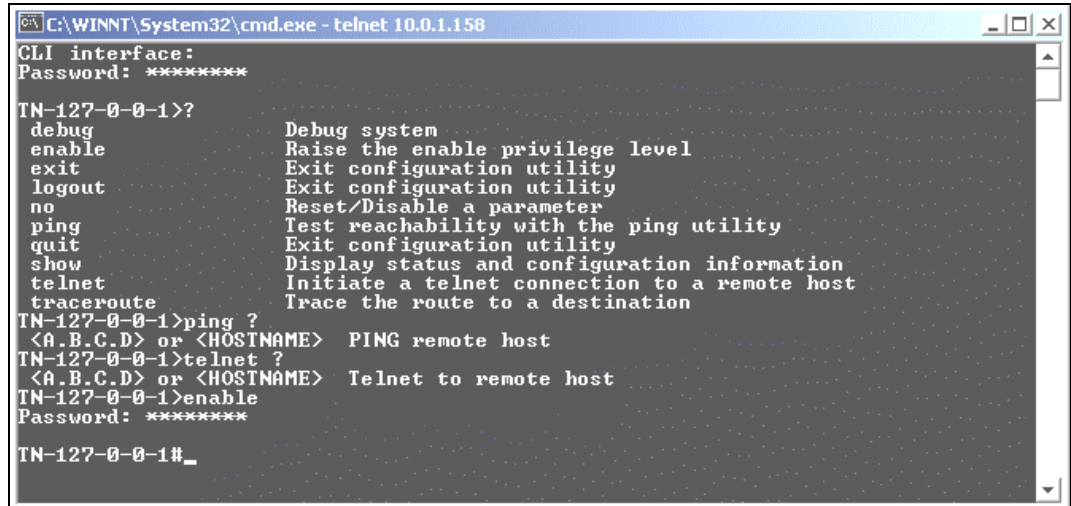
Each NE provides an SNMP agent enabling easy integration with any SNMP based management system. The SNMP agent can be configured to support SNMP v1/v2c/v3 for get and set operations. SNMP v3 is default. The SNMP agent sends SNMP v1, SNMP v2c and SNMP v3 traps.

The system is built on standard MIBs as well as some private MIBs.

6.7.4   Command Line Interface (CLI)

A CLI is provided for advanced IP router configuration and troubleshooting. This interface is similar to Cisco's industry standard router configuration and is accessed from a Command Prompt window using telnet.

The CLI functions are described in the online Help and the *MINI-LINK TN Operation Manual.*

Figure 70   CLI

Management

7 Accessories

The product program contains a comprehensive set of accessories for installation and operation. This section gives additional technical information for some accessories.

7.1 Interface Connection Field (ICF)

MINI-LINK TN uses SOFIX connectors for 120 Ω E1 traffic connections on the plug-in units. SOFIX is a high-density connector holding four E1s per connector. It is optimized to occupy minimal space on the plug-in unit fronts, which enables very compact site solutions.

D-sub connectors are used for connection of power supply and User I/O.

For further details on connectors, see *MINI-LINK TN ETSI Product Specification* and *MINI-LINK TN ETSI Indoor Installation Manual*.

Instead of connecting directly to the front of the units in the AMM, an Interface Connection Field (ICF) can be used. The ICF holds pre-assembled cables with a connector in one end, and one or several connectors fitted on the ICF in the other end. The ICF is fitted above or below the AMM.

The ICFs are available with 120 Ω (9-pin D-sub) or 75 Ω (SMZ) E1 traffic connectors.

Different ICFs are available for AMM 6p B and AMM 20p.

The number of connectors per ICF is illustrated in the following figures.
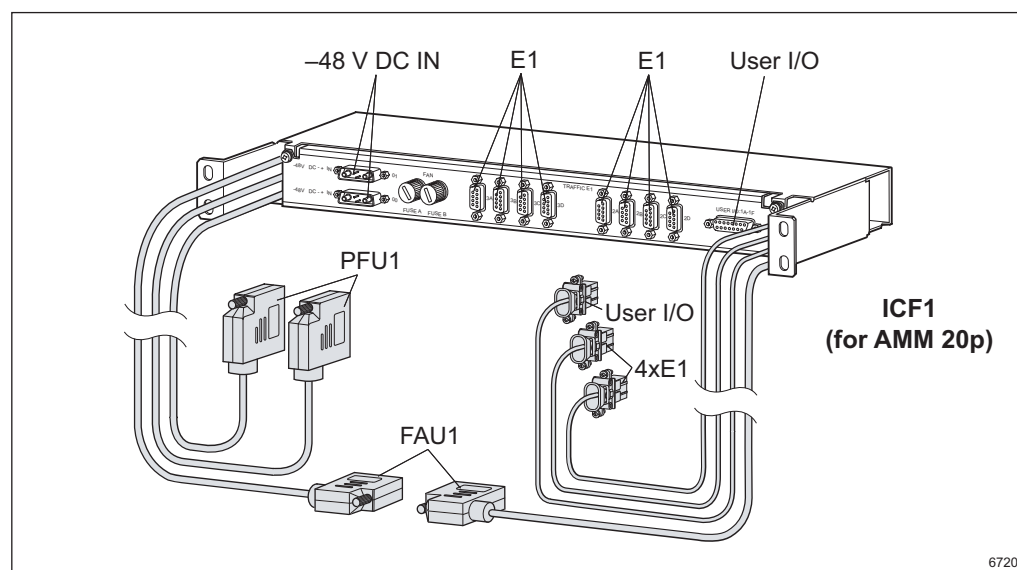
Figure 71   ICF1 120 Ω for AMM 20p
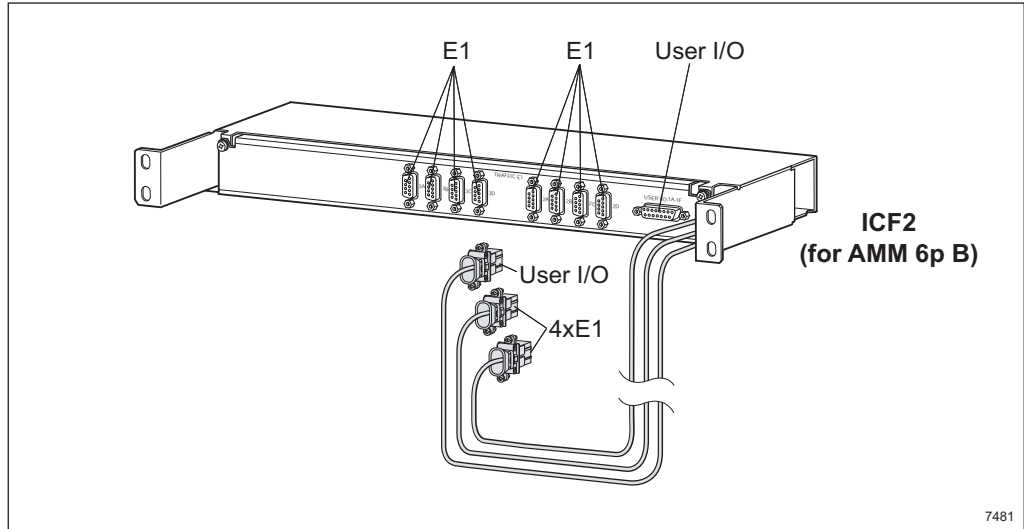
Figure 72   ICF2 120 Ω for AMM 6p B

Figure 73   ICF 16x2 120 Ω for AMM 6p B and AMM 20p

1/1555-CSH 109 32/1 Rev B 2005-06-28
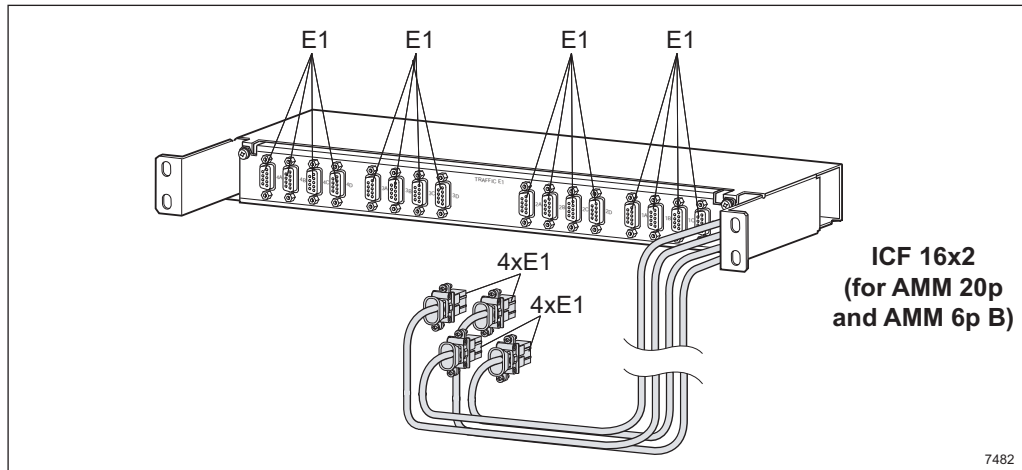
7.2 PSU DC/DC Kit

The PSU DC/DC kit is used for AMM 6p B or AMM 20p, converting +24 V DC to –48 V DC. It consists of a sub-rack, one or two Power Supply Units (PSU) and a FAU3. Two PSUs are used for redundant power systems.

The +24 V DC external power supply is connected to the PSU front.

The sub-rack provides two –48 V DC connectors for PFU connection. Two fused –48 V DC connectors for FAU1 connection are also available.
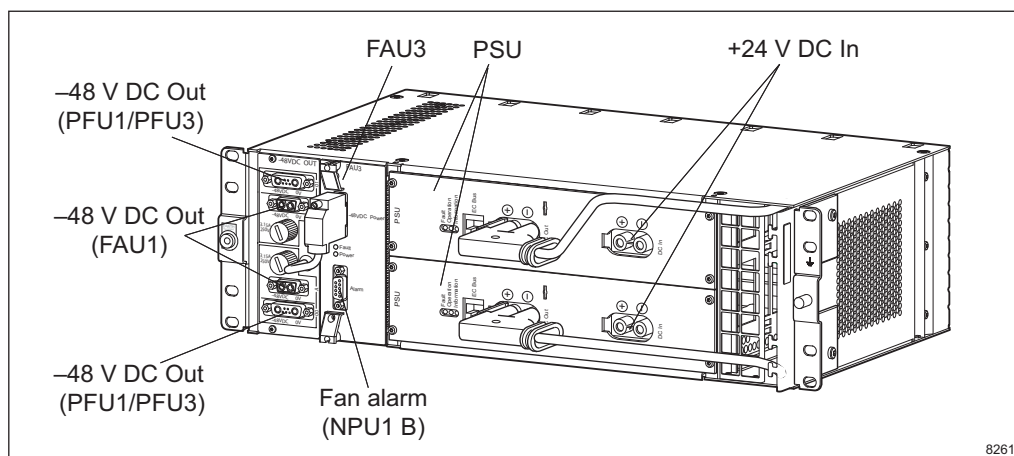
Figure 74   PSU DC/DC kit

7.2.1 Cooling

Forced air-cooling is always required and provided by FAU3, which holds two internal fans. It is power supplied by an internal pre-assembled cable connected to the front. A connector for alarm export to the NPU1 B is also available.
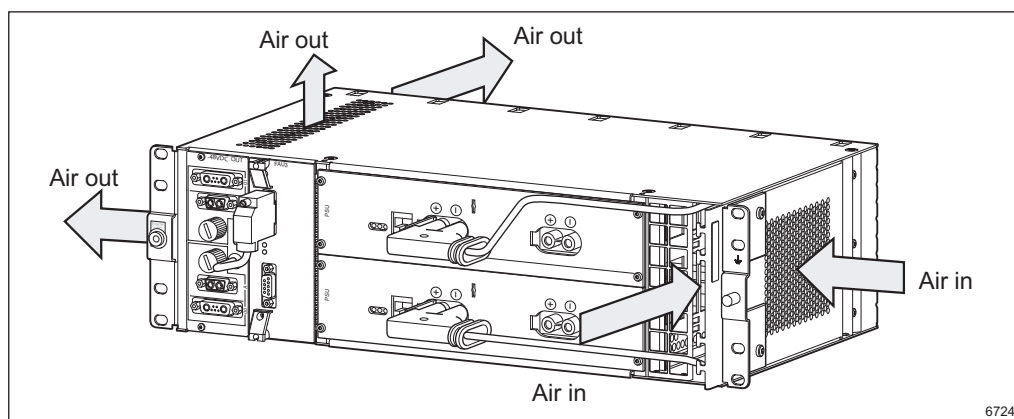
Figure 75   Cooling airflow in the PSU DC/DC kit

The air enters at the front and gable on the right hand side of the sub-rack, flows past the plug-in units and exits at the rear, top and gable on the left hand side of the sub-rack.

8   Glossary

ABR

Area Border Router

ADM

Add Drop Multiplexer

AFC

Automatic Frequency Control

AGC

Automatic Gain Control

AIS

Alarm Indication Signal

AMM

Access Module Magazine

ASK

Amplitude Shift Keying

ATPC

Automatic Transmit Power Control

ATU

Access Termination Unit

BER

Bit Error Ratio

BPI

Board Pair Interconnect

BR

Board Removal

C-QPSK

Constant envelope offset - Quadrature Phase Shift Keying

CLI

Command Line Interface

DC

Direct Current

DCC$_M$

Digital Communication Channel, Multiplexer Section

DCC$_R$

Digital Communication Channel, Regenerator Section

DCN

Data Communication Network

DDF

Digital Distribution Frame

DHCP

Dynamic Host Configuration Protocol

DNS

Domain Name System

DP

Device Processor

E0

PDH traffic at 2x64 kbit/s

E1

PDH traffic at 2 Mbit/s (2 048 kbit/s)

E2

PDH traffic at 8 Mbit/s (8 448 kbit/s)

E3

PDH traffic at 34 Mbit/s (34 368 kbit/s)

EEM

Embedded Element Manager

ETU

Ethernet Interface Unit

ES

Errored Second

ETSI

European Telecommunications Standards Institute

EW

Early Warning

Far-end

The terminal with which the near-end terminal communicates

FAU

Fan Unit

FEC

Forward Error Correction

FTP

File Transfer Protocol

HCC

Hop Communication Channel

HDLC

High-Level Data Link Control

Hop

A radio link connection with a pair of communicating terminals

I/Q

Inphase and Quadrature

ICS

Internet Connection Sharing

ICF

Interface Connection Field

IEEE

Institute of Electrical and Electronics Engineers

IF

Intermediate Frequency

IP

Internet Protocol

IR

Internal Router

IRP

Integrated Reference Point

ITU

International Telecommunication Union

LAN

Local Area Network

LCT

Local Craft Terminal.

LED

Light Emitting Diode

LOS

Loss Of Signal

LTU

Line Termination Unit

MAC

Media Access Control

MIB

Management Information Base

MINI-LINK E

Product family for microwave transmission at 2x2 to 17x2 Mbit/s

MINI-LINK HC

Product family for microwave transmission at 155 Mbit/s

MINI-LINK TN

Product family for microwave transmission at 2x2 to 32x2 Mbit/s featuring comprehensive traffic handling functions

MMU

Modem Unit

MS

Multiplexer Section

MSP

Multiplexer Section Protection

NE

Network Element

Near-end

The selected terminal

NPU

Node Processor Unit

NTP

Network Time Protocol

O&M

Operation and Maintenance

OSPF

Open Shortest Path First

OSS

Operations Support System

PCI

Peripheral Component Interconnect

PDH

Plesiochronous Digital Hierarchy

PFU

Power Filter Unit

PLL

Phase Locked Loop

PPP

Point-to-Point Protocol. Used for IP transport over serial links.

PSU

Power Supply Unit

QAM

Quadrature Amplitude Modulation

Radio link

Two communicating Radio Terminals

Radio Terminal

One side of a radio link

RAU

Radio Unit

RCC

Radio Communication Channel

RSSI

Received Signal Strength Indicator

RTPC

Remote Transmit Power Control

SAU

Service Access Unit

SDH

Synchronous Digital Hierarchy

SES

Severely Errored Second

SMU

Switch Multiplexer Unit

SNCP

Subnetwork Connection Protection.
1+1 E1 SNCP is used to create a protected
E1 interface from two unprotected E1
interfaces.

SNMP

Simple Network Management Protocol

SPI

Serial Peripheral Interface

STM-1

Synchronous Transport Module 1 (155 Mbit/s)

TCP/IP

Transmission Control Protocol/Internet
Protocol

TDM

Time Division Multiplexing

TM

Terminal Multiplexer

URL

Uniform Resource Locator

USB

Universal Serial Bus

V.24

Serial data interface

VC-12

Virtual Container 12 (2 Mbit/s)

VC-4

Virtual Container 4 (155 Mbit/s)

VLAN

Virtual Local Area Network

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