SIEMENS

Information

SURPASS hiT 7500-B 3.13

Technical Description (TED)

A42022-L5961-D251-2-7618

Important Notice on Product Safety

Elevated voltages are inevitably present at specific points in this electrical equipment. Some of the parts may also have elevated operating temperatures. Systems with forced ventilation have rotating items.

Non-observance of these conditions and the safety instructions can result in personal injury or in property damage.

The system complies with the standard EN 60950 / IEC 60950. All equipment connected has to comply with the applicable safety standards.

Mount the systems in areas with restricted access only. Only trained and qualified personnel may install, operate, and maintain the systems.

The same text in German:

Wichtiger Hinweis zur Produktsicherheit

In elektrischen Anlagen stehen zwangsläufig bestimmte Teile der Geräte unter Spannung. Einige Teile können auch eine hohe Betriebstemperatur aufweisen. Anlagen mit Zwangsbelüftung haben drehende Teile.

Eine Nichtbeachtung dieser Situation und der Warnungshinweise kann zu Körperverletzungen und Sachschäden führen.

Das System entspricht den Anforderungen der EN 60950 / IEC 60950. Angeschlossene Geräte müssen die zutreffenden Sicherheitsbestimmungen erfüllen.

Die Anlagen dürfen nur in Betriebsstätten mit beschränktem Zutritt aufgebaut werden. Die Anlagen dürfen nur durch geschultes und qualifiziertes Personal installiert, betrieben und gewartet werden.

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This document consists of a total of 122 pages. All pages are issue 2.

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Illustrations

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1 Notes on this documentation

This chapter gives a reference to the available SURPASS hiT 7500-B customer documentation and informs the reader about some formal aspects with this manual.

➜ An overview of the SURPASS hiT 7500-B documentation is given in the Documentation Guide. The documentation of SURPASS hiT 7500-B is available on CD-ROM.
For system requirements to install the CD-ROMs on your computer (under Windows® or UNIX®, see the file README.TXT in the root directory of the CD-ROMs.

1.1 Symbols used in this documentation

Chapters 1.1.1 and 1.1.2 show all symbols, however some of them may be not used in this manual.

1.1.1 Symbol for warnings

⚠ This symbol identifies notes which, if ignored, can result in personal injury or in permanent damage to the equipment.

1.1.2 Symbols for notes

i Information which extends beyond the immediate context.

➜ Cross reference to other chapters in this manual or reference to other manuals.

Help Reference to the online help system of the Element Manager software.

1.1.3 Symbols for menu displays and text inputs

Menu items or inputs to be entered by the user are displayed in their hierarchical sequence, separated by arrows:

Menu > Menu Item > Submenu Item >... > etc.

1.2 Notes on licensed software

This documentation may refer to various third-party software products that are integrated into the SURPASS hiT 7500-B system under a license agreement between Siemens and the software manufacturer. In case of problems with such software, please contact Siemens.

2 Introduction to SURPASS hiT 7500-B

This chapter gives a general introduction to the SURPASS hiT 7500-B functionality and to some typical applications.

For a more detailed description of important SURPASS hiT 7500-B functions, see Chapter 3.

2.1 General functionality

Siemens SURPASS hiT 7500-B combines high performance Dense Wavelength Division Multiplexing (DWDM) systems with a powerful multi-purpose transponder platform. SURPASS hiT 7500-B has the capacity required in regional and backbone networks to transport all kinds of services with highest efficiency.

The high capacity DWDM transmission of SURPASS hiT 7500-B allows up to 40 optical wavelengths to be transported over long haul distances via the same fiber. The transponder equipment of SURPASS hiT 7500-B serves as a multi-service gateway between the client signals and the DWDM transport network.

This combination of DWDM equipment and transponder equipment provides the required optical networking building blocks.

Fig. 2.1 gives a general overview of embedding SURPASS hiT 7500-B into a network environment.

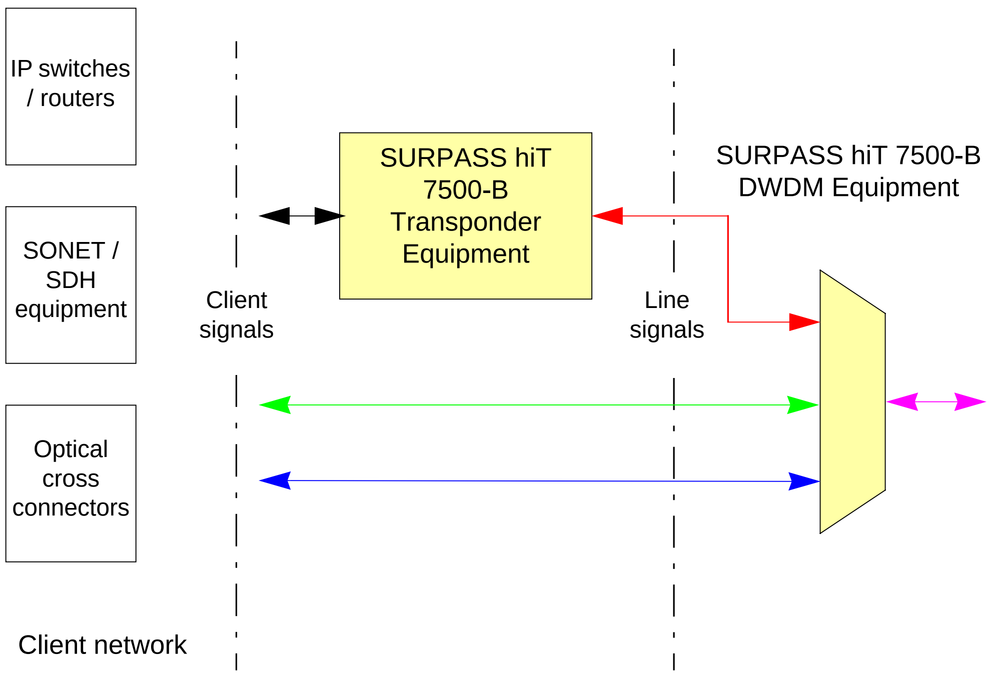


Fig. 2.1 SURPASS hiT 7500-B in network environment

2.2 Highlights

- Maximum transmission capacity (400 Gbit/s [40 x 10 Gbit/s]) per fiber with channel spacing 100 GHz.
- Long haul networking with extended reach (up to 2500 km), achieved with:
  - Super Forward Error Correction (S-FEC)
  - Optional Raman amplification
  - Powerful link control software to manage the channel power levels
- Modularity from 1 to 40 channels in C band, in 1-channel increments
- 1+1 optical protection switching per channel against fiber or equipment failure
- Compactness
- Sophisticated optical control, including:
  - Dynamic gain and output power control to adjust for gain and power fluctuations
  - Spectral gain control to adjust for gain tilt variations (particularly Raman gain tilt variations)
  - End-to-end preemphasis for fine tuning of power variations
  - Integrated ASE (Amplified Spontaneous Emissions) filter, gain flattening filter and adjustable tilt filter
- Integrated optical performance analyzer (optional)
- Fiber type flexibility, e.g.:
  - Standard Single Mode Fiber (SSMF)
  - Non Zero Dispersion Shifted Fiber (NZDSF)
  - Dispersion Shifted Fiber (DSF)
- Service flexibility to meet all customer traffic requirements:
  - SDH / SONET
  - IP / ATM
- Tunable lasers for wavelength changes without the need to swap plug-in cards, thus enabling simplified installation and commissioning and easier spare part handling
- Network management by:
  - TNMS CT
  - @CT
  - TNMS Core/CDM
- TransNet planning tool for simplified but comprehensive network design on a geographical map, including cost optimization

2.3 Applications

Fig. 2.2 shows a general SURPASS hiT 7500-B network application scenario.

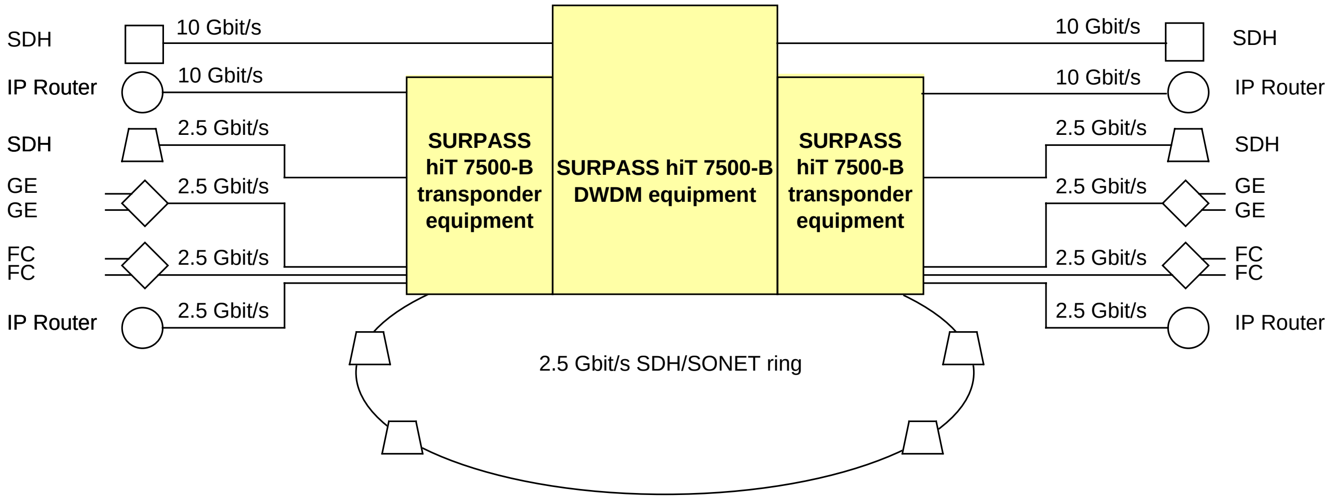


Fig. 2.2 SURPASS hiT 7500-B general network application scenario

The network element types are explained in Chapter 4.

SURPASS hiT 7500-B can be used in any kind of network architecture, including:

- Transparent photonic chains, i.e., point-to-point topologies with maximum 8 optical add/drop multiplexers
- Meshed networks

SURPASS hiT 7500-B can be used for the following layers of the transport network:

– Long haul DWDM reaches up to 2500 km
– Regional DWDM applications with path lengths starting at 200 km and for high traffic volumes. These networks are often used as regional collector networks to feed into long haul portions of the network. Regional DWDM networks have typical link lengths up to 800 km.

The SURPASS hiT 7500-B **DWDM** system has an integral optical add-drop multiplexer for up to 12 wavelengths at 10 Gbit/s each.

Basically, five different network element types exist:

– Optical Transport Terminal **OTTB**
– Optical Add-drop Multiplexer **OADMB**
– Optical Line Repeater **OLRB**
– Channel Connection Unit **CCU**
– Optical Channel Unit **OCU**

Fig. 2.3 shows a sample basic structure of a SURPASS hiT 7500-B optical network system.

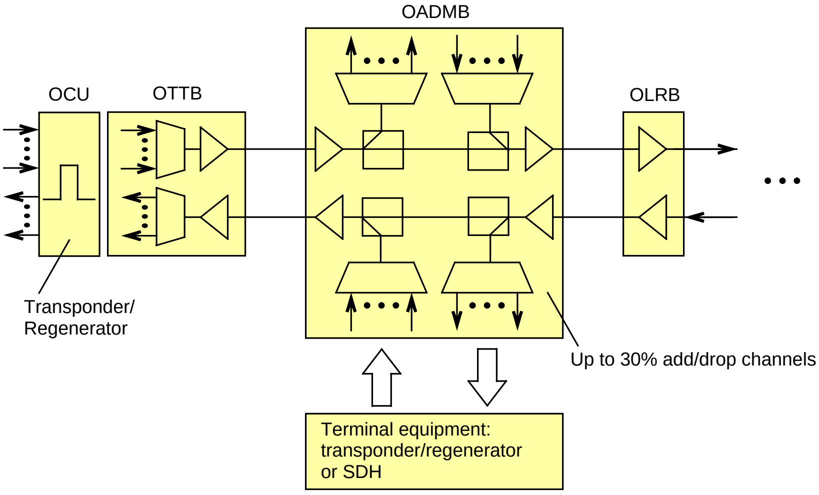


Fig. 2.3 Basic structure (example)
of the SURPASS hiT 7500-B optical network system

2.4 Wavelength bands / frequency spacing

The SURPASS hiT 7500-B system uses a maximum of 40 wavelengths within the C band, divided into groups:

– 20 “blue” (shorter) wavelengths, with 100 GHz frequency spacing
– 4 “grey” (band gap) wavelenghts, with 100 GHz frequency spacing
– 20 “red” (longer) wavelengths, with 100 GHz frequency spacing

i Note, that the use of the four grey wavelenghts depends on the individual configuration. Therefore, although a total of 44 channels are available, it is not possible to use more than 40 channels in one system.

i Note, that there are several possibilities to built up systems with different channel numbers at the begin of life (BOL) or at the end of life (EOL).
This allows cost-efficient sytem configurations during the whole life cycle of the system.

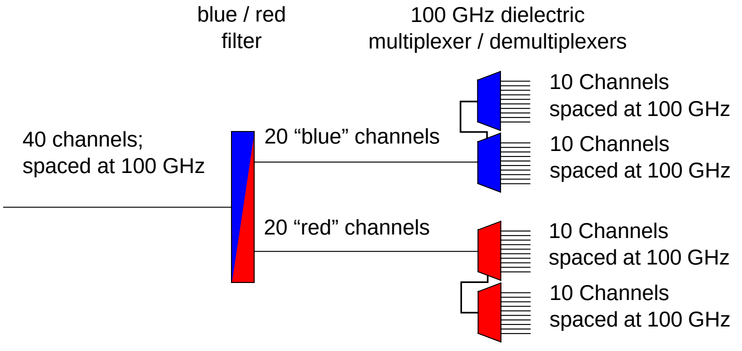


Fig. 2.4 Example for frequency / wavelength demultiplexing scheme
(40 channels)

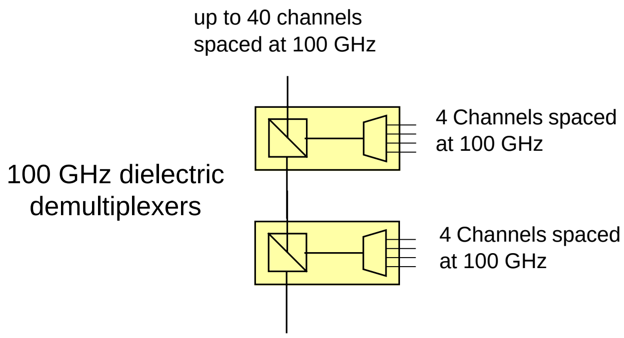


Fig. 2.5 Example for frequency / wavelength demultiplexing scheme (8 channels)

If new channels are to be added, the Siemens TransNet network planning tool (described in Chapter 9) supplies information about the channel upgrade order.

2.5 Compatibility with other systems

SURPASS hiT 7500-B presents wide channel passbands for compatibility with many kinds of 2.5 Gbit/s or 10 Gbit/s terminal equipment.

In particular, SURPASS hiT 7500-B is compatible with the following equipment:

- SDH line systems (SL64, SL16, SLR16, WTTR)
- SURPASS hiT 7070
- FSP1500
- FSP3000
- SN16k

3 System functions

This chapter describes important functions of the SURPASS hiT 7500-B system.

For a general introduction to the SURPASS hiT 7500-B functionality including some typical applications, see Chapter 2.

The SURPASS hiT 7500-B network elements are described in Chapter 4.

The SURPASS hiT 7500-B cards are described in Chapter 5.

An overview of the network management is given in Chapter 8.

3.1 Optical transmission functions

3.1.1 Laser safety

Optical safety mechanisms are indispensable to protect all users from harmful light emissions of optical amplifiers and pump light sources.

Detailed protective measures and handling instructions for the optical equipment are given in the Q3 Operating Manual (Q3 OMN).

It must be differentiated between the laser safety mechanisms for DWDM equipment and for transponder equipment.

Laser safety according to IEC60825-2:2004 of DWDM transmission system does not rely on the automatic laser shutdown (ALS) procedures of transponder units, which are described in section 3.1.1.2.

The description of automatic power shutdown (APSD) in the following sections is valid for all types of OLIs used in SURPASS hiT 7500-B (basic, slim and compact).

The terminal equipment is designed to provide IEC60825-2 hazard level 1M on the transmission fibers for basic link control.

3.1.1.1 Laser safety of DWDM equipment

The laser safety of WDM transport system is achieved by:

- automatic power shut down (APSD) of amplifiers feeding the transmission line fiber pair
- automatic power reduction mode (APRM) of preamplifier feeding the demultiplexer filter tree

The basic function of APSD is to shutdown the pump lasers of the respective stage if the input power of an optical amplifier stage (measured by the input power monitor diode) falls below a threshold value and remains below that threshold value (in order to avoid optical power surges when input power returns).

Each optical amplifier, booster, inline section one, inline section two and preamplifier, is equipped with the APSD and automatic restart capability. If the input power drops under a predefined threshold, the pump lasers in one amplifier section are switched off. The pump lasers are restarted, if the input power reaches a certain minimum threshold for a certain time.

In case of equipment failures of the OLI card, the PUMP card or the RPUMP card, the pump lasers on the respective card will be shut down. No automatic restart for OLI and RPUMP is allowed, but only a new link startup via LCT.

APSD is signaled on the OLI card via OB/OPLOS (loss of incoming signal). Each amplifier stage, sensing LOS at its input, will automatically change into APSD state and shutdown its pump lasers independently. This results in a shutdown of the optical output signal in signal direction.

Laser safety for network elements with basic link control

Several new transmission system configurations are introduced in conjunction with the basic link control. The whole transmission fiber system is considered as controlled area in the sense of IEC60825-2:2004. This overall requirement forms the basis of the laser safety mechanisms of the basic, compact and slim OLI cards for SURPASS hiT 7500-B version 3.13.

The transmission system is designed for IEC60825-2:2004 hazard level 1 M (21.3 dBm @1550 nm) at open connector. Central Office and transmission fiber duct has to fulfil the requirements for IEC60825-2:2004 controlled location.

The main mechanisms to guarantee the hazard levels are automatic power shutdown and automatic power reduction mode (APRM).

Means for achieving hazard level 1M

Hardware schemes:
- Slim OLIs and basic OLIs are limited to class 1M power by design.
- Compact OLI cards have a hardware control circuit for operation with class 1M power, which is active if there is no external pump card or in APRMode.

Note, that there is no hardware controlled APSD or APRM with hazard level 1. Nevertheless power reduction of shut down may be adjusted by a software scheme.

Software schemes:
- **Automatic power shutdown** may be triggered via CAN telegrams.
- **Automatic power reduction mode** is undertaken by smooth software controlled transitions. Reliability is guaranteed by hardware.

Signaling paths:
- for the APRM in case of open connections in RX path: between Demux APRM diodes and the preamplifier
- for the APSD in case of transmission line fiber break: between preamplifier and booster amplifier and between a pair of inline amplifiers
- for the APSD in case of transmission line with Raman fiber break: between RPUMP and preamplifier, and between Rpump and inline-amplifier

The patch cords used in basic NEs generally do not have laser safety labels.

Laser safety labeling for hazard level 1M is used on most cards.

The planning tool **TransNet** will prepare bill of material, commissioning documentation and an XML configuration file and give equipping and cabling instructions for each network element site.

3.1.1.2 Laser safety of transponder equipment

Automatic laser shutdown (ALS)

SURPASS hiT 7500-B implements an Automatic Laser Shutdown (ALS) safety feature.

ALS can be enabled/disabled for each OCR10T, OCR10R and TEX card by software. The ALS trigger condition can be configured so that only LOS will trigger ALS, or LOS or LOF will trigger ALS. The LOS or LOF condition must persist for a defined time to trigger ALS.

If an ALS-causing condition is detected at the "Line In" port of an OCR10R card, the laser of the OCR10R card in the opposite transmission direction is automatically shut off. These two OCR10R cards communicate ALS information to each other via the subrack backplane. So, OCR10R cards operate as bidirectional pairs.

If an ALS-causing condition is detected at the "Line In" port of an OCR10T or TEX card, the "Line Out" laser on the same card (i.e., in the opposite transmission direction) is automatically shut down.

➡ For details about installation of cards, see the Installation and Test Manual (ITMN) of SURPASS hiT 7500-B.

i It is recommended that ALS should remain in state 'disabled', since SURPASS hiT 7500-B has its own laser safety implementations and transponders emit only hazard level 1.

Automatic laser restart

SURPASS hiT 7500-B also features automatic laser restart that can be enabled/disabled for each OCR10T, OCR10R and TEX card by the user.

- Automatic restart enabled:
  Automatic attempts to restart will be made at preset time intervals.
- Automatic restart disabled:
  If the laser on this card has been automatically shut down, no automatic attempt to restart the laser will be made.

Help For more details about the automatic laser restart, see the online help of the SURPASS hiT 7500-B Element Manager software.

Manual laser restart

It is possible to restart a card laser manually via two Element Manager commands:

- Manual restart:
  This command can be issued after the laser was automatically shut down.
- Manual restart for test:
  Same behavior as for "manual restart", except that the laser is switched on for 90 s, then always switched off.

Help For more details about the manual laser restart, see the online help of the SURPASS hiT 7500-B Element Manager software.

Forced laser shutdown

A Forced Laser Shutdown command can be entered independently if the Automatic Laser Shutdown function is enabled or disabled. No restart will be possible until the laser is manually enabled again.

3.1.2 Super Forward Error Correction (S-FEC)

To achieve an optimum level of signal performance, a certain Optical Signal to Noise Ratio (OSNR), which depends on the use of Forward / Super Forward Error Correction (FEC/S-FEC) techniques must be met.

S-FEC is a coding algorithm that enables bit errors to be detected and corrected. It is applied on the line side only, whereas on the client the standard FEC technique can be used.

With increasing transmission rates, distance-limiting phenomena such as fiber non-linearities, chromatic dispersion, and PMD have a more pronounced effect. The ability to correct bit errors translates directly into the ability to have a higher reach. Distances that, without S-FEC, would suffer an unacceptable receive-end OSNR can be successfully spanned when S-FEC is used. S-FEC provides networks with additional OSNR margin.

S-FEC is a "forward" scheme, i.e., the receiver needs only the information it receives to detect and correct bit errors - it never requests a re-transmission.

Note that BIP-8 in the path (ODU) and section (OTU) layers provides error monitoring only on the payload. S-FEC provides error correction in the client's payload and all the overheads (OPU-OH, ODU-OH, OTU-OH). OPU, ODU and OTU are the sub-layers of the optical channel (client signal), as defined in ITU-T G.709.

SURPASS hiT 7500-B uses a proprietary method to implement "Out-of-Band" S-FEC (OOB S-FEC). With this method, the transmission rate is increased to accommodate the basic SONET/SDH/LAN PHY payload plus the added S-FEC and management overhead.

3.1.3 Optical control and management

Optical link control is intended to ensure optimized optical link operation in any link state. The goals are to maintain sufficient link performance and consequently an equally distributed OSNR level at each channel's tail end (OSNR at electrical receiver or regenerator locations).

Within each individual NE, the OSCT card serves as central instance to manage and control all optical link relevant information. OSCT cards within an optical link must exchange management information as well as measurement data among each other. A link master functionality is performed by the first OSCT card within the optical link. Each transmission direction has its own link master OSCT. The link master controls the complete optical link.

Link management information and measurement data needed for controlling the optical link is exchanged between network elements via the optical supervisory channel (OSC).

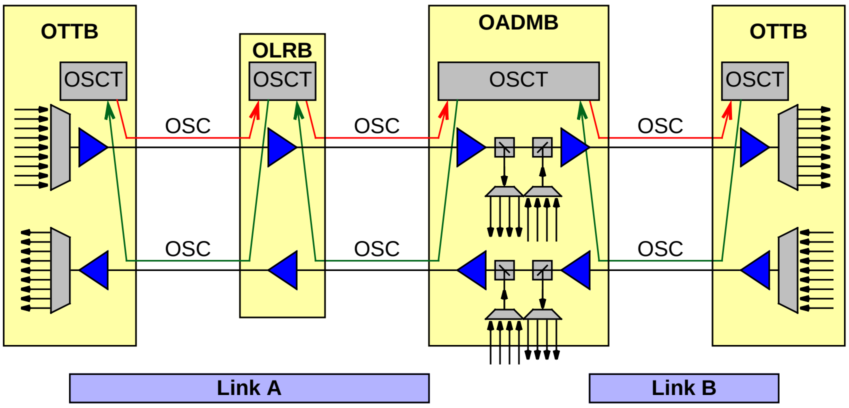


Fig. 3.1 Example (basic link type) for optical link communication between network

NE external communication links (Fig. 3.1) and NE internal communication links (Fig. 3.2) are established to properly operate all optical link control mechanisms for the whole link and within the NE. As OSCT cards must derive data and set actors within the NE reliably, CAN bus communication is implemented within the NE.

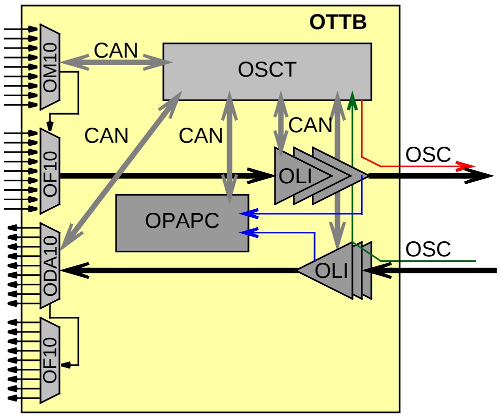


Fig. 3.2 Example for optical link communication within a network element

In detail, OSCT card is to establish permanent communication with:

- OLI cards
- OM10 cards
- ODA10 cards
- OPAPC
- RPUMPC
- SMU2

3.1.3.1 Basic Behavior of Basic Link Control

An optical link consists of several network elements (types OTTB, OLRB and OADMB) and the appropriate optical connections (Fig. 3.3).

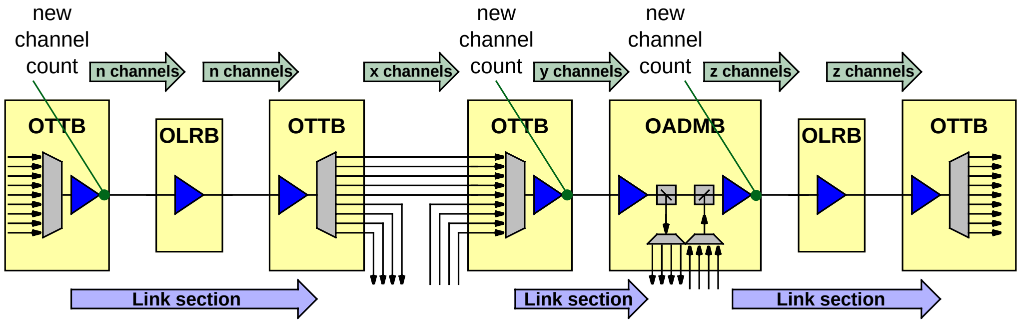


Fig. 3.3 Schematic of basic basic link control

Link section definition: Any link section comprises of a set of adjacent optical line spans without channel count change i. e., without any mux/demux device. A link section starts at any OTTB or OADMB (head end). A link section is terminated by any OTTB or OADMB (tail end).

Within the link, link control is responsible for distribution of all relevant information to properly operate all NEs. That is, OLI parameters (gain, channel power) within the link are to be set. For controlling the per-channel power, it is necessary to distribute proper control parameters within the link. These parameters can be the exact channel count (if and when available) or the current power levels at the link source side.

The NEs can be operated with two different channel status evaluation modes:

a) an OPAPC card is equipped within first NE of the optical link (head-end).
The OPAPC card will provide all relevant channel count and channel status information to properly operate the optical link on the basis of distributed channel status map. The channel status map will be updated by the OPAPC card. In case of explicit configuration by operator (via management interface), the OPAPC card may overwrite this information with the measured data of the actual spectrum scan.

b) no OPAPC card is available.
An explicit channel count and channel status must be entered manually. Optical link control must be performed with optical power level data from head-end location of the link (head-end of OMS). Hence, the input power of the first OLI within the optical link is supervised. If the first NE within the link is a booster-less type, the OMS section input power is evaluated at the card replacing the active booster (i.e., the OLIF card with OSC splitter and optical monitor for OMS input power detection). In case of power change (which is also an indication of channel upgrade/downgrade), this changed power level is distributed downstream within the optical link.
OSCT card master functionality is responsible for distribution of all relevant information in parallel:
   - channel status map:
     This type of data has to be consistent with actual link configuration (operator's responsibility). The channel status map is not tailored individually for basic link control type. The channel status bit map contains 89 channels. It is in the operator's responsibility to select the proper channels for basic link control type. The channel status map must be configured by the operator before link startup. The channel status map must be upgraded in case of every channel upgrade/downgrade.
   - first OLI's power level:
     This data follows strictly any channel power changes.

– power control type (channel status selector):
  This data indicate the validity of channel status map respectively the optical power level. In case of a newly configured channel status map, this selector points on the channel status map. All OSCT card functionalities within the link are able to readjust their calibration to an explicit channel count.

  Channel status map, OLI power level and power control type are distributed downstream to all OSCTs within the link in parallel.

In case of OLI shut-down within one NE, a channel status map with all channels inactive is sent to downstream NEs.

The optical link control covers the following link oriented tasks:

1. Network element startup
   Cards can be inserted and supply voltage is applied. For reasons of safety, all pump and RPump lasers in the system are switched off. The network element startup includes among others: upload and download of card status information, start of the optical supervisory channel (OSC), start of some internal control circuits (e. g. temperature control).

2. Prestart
   Setting direction ID and automatic spanloss correction. These configurations are signalled to the downstream NEs within the optical link.

3. Transmit channel power equalization / power adjustment
   Input power values of all channels are adjusted to TransNet pre-calculated values (TransNet power vector). Channel power adjustment must be performed in advance to link startup as well as for any channel to be upgraded at an existing and running link.

4. Link startup
   Is performed as sequential setup of the DWDM network elements (separately from both sides). The purpose of link startup is to determine, set and stabilize line and card parameters (e.g., EDFA gain and output power, speed of OLI output power control) prior to running traffic. Tilt is set to the required value according to calculation. The output power of each amplifier has to reach the desired value before the next amplifier in line is allowed to switch on.

5. Link running
   Includes normal running state as well as reaction on exceptional events such as loss of optical carriers, APSD etc. Tilt and VOA closed loop control on OLI cards is continuously working in running state (if enabled). Demux cards with VOAs (ODA10) autonomously perform output power control (drop control). The output power value is kept in a defined window.
   The channel status, delta power level of OMS section input and the channel usage will be periodically distributed downstream the link.
   Link power values from the first OLI within the optical link will be continuously distributed downstream the link for OLI control.

6. Tilt control
   Tilt control mechanisms are only supported if OPAPC cards are equipped at OLRB sites.
   Basic, compact and slim OLI cards include a VOA for tilt control. The tilt of the channel powers measured at the OLI output fiber is used to control the VOA locally on the same OLI.

7. Channel up-/downgrade while traffic is running
   In linkstate running, the automatic upgrade of additional channels or the downgrade of channels is possible. The remaining channels are not affected by the upgrade or downgrade. Link control mechanisms require a step-by-step upgrade of channels with per-step upgrade channel power limitation even if overall upgrade is requested for more channels.
   In mode SINGLESTEP, a preemphasis must be performed by the operator after upgrade or downgrade, if OM cards are equipped.

8. Preemphasis control
   Preemphasis is performed to achieve optimum OSNR distribution at each link end. It will be done by correction of Tx power values at the beginning of the link (OTTB) by means of attenuator plugs or VOAs (Fig. 3.4).
   Single step preemphasis is only possible at OTTB and must be triggered by the operator.
   At OTTB, only express channels (OTTB head-end to OTTB tail-end, i.e., spanning the whole link) located on active cards (OM10 - detectable by NE) can be included into the automatic preemphasis by OSCT. All relevant channel power measurement values have to be:
   - provided by the operator if no OPAPC is equipped at OTTB terminals
   - derived autonomously within the link if OPAPCs are equipped at OTTB terminals

   For OF10 and OMD4 cards, the following manual setting must be done for enhancement of the overall link performance: An end-of-life optimized channel specific attenuation is to be calculated by TransNet. The mux-side attenuator is realized, e.g., by attenuator plugs. The channels require a power adjustment via OSA or OPAPC measurement.

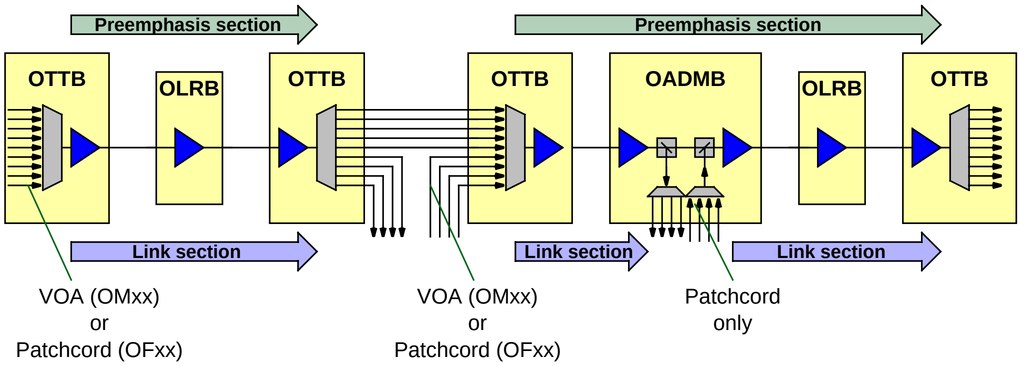


Fig. 3.4 Link and preemphasis sections

3.1.3.2 Optical link commissioning procedures

For basic link types channel detection, channel power adjustment and preemphasis settings must be performed explicitely and locally by the operator:

- If a channel is active, the link must be informed via operator configuration or via OPAPC detection.
- A new channel must be adjusted for proper OMS input power level. TransNet provides proper power values (mean value P1opt with channel individual deviations according tilt and preemphasis settings), which must be adjusted for each individual channel.
  For OF10 and OMD4 cards, power adjustment must be performed by changing external attenuators until OMS power level fits.
  For OM10 cards channels can be adjusted by means of the card's VOA.
- Express channels within OADMBs must be properly adjusted to TransNet power level (adapt to overall channel mean value P1opt) by means of an express channel attenuator (to be changed manually by service personnel during startup procedure).

3.1.3.3 Drop Channel Control

There are no means implemented to monitor or to directly control the demux output power at OF10 or at OMD4 card types. Therefore, during channel installation, the channel output power is to be evaluated and an appropriate output power level is to be established by means of external attenuators. The drop side attenuators must be set to fix the output power at the mean value of the allowed channel output power window.

Channel-specific VOAs on ODA10 cards will be controlled to fix each channel's output power dynamically at the mean value of the allowed output power window. Adapting the ODA10 based VOAs will be performed automatically after link startup and after each single-step preemphasis trigger (after preemphasis setting has properly stabilized). This ODA10 action will be performed for each active channel transported via this card, i.e., whether this channel is an express channel or an add/drop channel and whether this channel contributes to automatic preemphasis setting or not. It is in the responsibility of TransNet equipment selection to determine which channel is to be dropped by means of an ODA10 card.

3.1.3.4 ASE correction

Amplified Spontaneous Emissions (ASE) are undesired effects generated in optical amplifiers. ASE correction increases the required linear total output power.

The cyclical ASE correction is autonomously done by any OLI card in the optical path. However, a reduction of the ASE correction is required if the ASE accumulation in the optical path is interrupted (e.g., due to an automatic power shutdown in the optical line preamplifier of the OADMB). The reduction of the ASE correction is processed separately for each EDFA band (band specific updates).

For preemphasis type "power", the total local ASE power is calculated by each OLI card in the link. The own correction value or the default value is transmitted downstream via the OSC. In case of a loss of the OSC, the OLI card calculates using the last received ASE correction value.

The accumulated ASE power must be configured for each OLI card in the link. For calculating the accumulated ASE, the TransNet planning tool described in Chapter 9 is used.

3.1.3.5 Span loss supervision and correction

In the link state "running", the automatic span loss supervision and correction are done by any OLI card of the inline or preamplifier terminal type in the WDM link.

The span loss correction keeps both the OLI pretilt and the OLI total output power in a constant state for “slow” span loss changes.

A periodic supervision is performed against a predefined reference span loss. Usually, this reference span loss for supervision is identical to the EOL span loss as used during link calculation. The current total OLI preamplifier output power is periodically (30 ms) captured and - if enabled - smoothed by a moving average filter considering the last 100 values.

3.2 Synchronization

In all NEs (except of OCU), the OSCTUI/OSCTUT card provides the master system clock (T0), which is used to synchronize the real-time clock on the MCU card.

All clocks in the SURPASS hiT 7500-B system are synchronized via the Optical Supervisory Channel (OSC, see Chapter 5.3.16). The OSC timing generators can either be locked to the incoming OSC signal or they can be operated in free running mode

In addition, an external clock input (T3) can be used to achieve maximum accuracy. If the T3 signal fails, the internal clock (T2) will be used instead. A priority list is used to control the switchover.

The MCU clock is battery backed-up in case of power failure or temporary removal of the MCU card.

3.3 System management

➔ An overview of the network management (including user access control) is given in Chapter 8.

3.3.1 NE supervision and control

SURPASS hiT 7500-B provides the following access options:
– Flexible TMN (Telecommunications Managed Network) interface types for network element management: Q3 over TCP/IP (RFC1006) / 7-layer OSI stack / Q-F stack
– Advanced GUI-based Element Manager software that runs on MS-Windows platforms
– Remote download capability via FTP and Element Manager

The control capabilities include:
– Control of NEs during initial system startup; pump lasers off-state for safety, upload and download of card information, initial equalization of transmit channel signal power, stabilization of line and card parameters (e.g., EDFA gain and output power).
– After the network becomes fully operational, the system monitors the required adjustments of the EDFAs (pump lasers, output power, VOA and power tilt control, automatic power shutdown).
– Preemphasis and tilt control correct transmit input powers to guarantee an optimum output power distribution over all channels, also resulting in optimum OSNR values.

Information to control the optical path is communicated between the NEs via the Optical Supervisory Channel (OSC), see Chapter 3.3.3.

3.3.2 Data Communication Network (DCN)

The Data Communication Network (DCN) provides Element Manager (EM) access to all network elements within one sub-network. The SURPASS hiT 7500-B network elements are operable in pure OSI as well as in pure IP and mixed DCN networks.

In addition to the Ethernet interfaces (Q interface) of the network elements, the underlying DCN provides interconnected data channels (DCCs and GCCs) to operate all connected network elements. The available F interfaces do not provide access to the DCN, but allow only local operation of network elements.

The logical DCN network topology is principally independent of the actual traffic network topology, but uses the traffic network as service layer. DCN redundancy (e.g., alternative routing via IS-IS) is used instead of MCF redundancy inside the NE.

Following the OSI layer model of communication, the DCN is restricted to layers 1 to 4 and is independent of the application layer used (e.g., QST, QD2 or Q3).

3.3.3 Optical Supervisory Channel (OSC)

SURPASS hiT 7500-B offers a 2-Mbit/s optical supervisory channel to provide communications between all SURPASS hiT 7500-B NEs. This optical supervisory channel supports all network management communication for configuration, fault management, performance monitoring, and software maintenance required to set up and maintain a DWDM system. The OSC provides both a Data Communication Channel Optical (DCCOo) and a Data Communication Channel Multiplex (DCCMo), both with 576 kbit/s.

The OSC is a bidirectional channel with the same wavelength of 1625 nm being used for both transmission directions, each on a separate fiber as shown in Fig. 3.5.

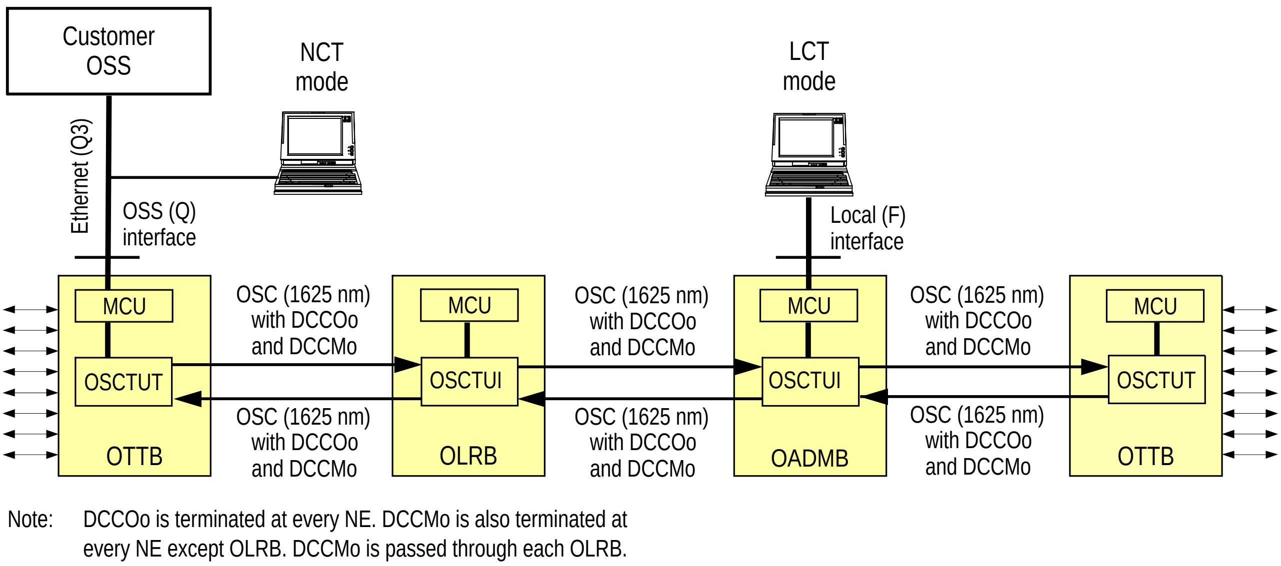


Fig. 3.5 Optical Supervisory Channel

➔ The OSCTUI and OSCTUT cards are described in Chapter 5.3.16.

3.3.4 Generic Communication Channels (GCCs)

The SURPASS hiT 7500-B transponder equipment supports the use of Generic Communication Channels (GCCs) that can be used to transmit network management information. The ITU-T G.709 standard defines three different GCCs:

- GCC0
  part of the section (OTU) overhead: row 1, columns 11 and 12
- GCC1
  part of the path (ODU) overhead: row 4, columns 1 and 2
- GCC2
  part of the path (ODU) overhead: row 4, columns 3 and 4

Since GCC0 is part of the OTU overhead, it supports communication between OTU termination points. Since GCC1 and GCC2 are part of the ODU overhead, they are used for communication between ODU termination points.

The stand-alone OCU network element support a number of GCC channels (depending on MCU and transponder types).

For each network element, the user can configure how these buses are used to implement the desired GCC(s). In each network element, any OCR10T, OCR10R or TEX card can be assigned to access GCC0, GCC1 or GCC2.

3.3.5 EOW interface

The engineering order wire (EOW) interface can be used for a telephone connection or conference from one NE to other NEs using a handset.

The interfaces on the OSCTUI/OSCTUT card are:

- Two external 4-wire interfaces
- One external 4-wire interface and one 4-wire interface for the handset with selective call.

The first external 4-wire interface or the 4-wire interface for the handset can only be used alternatively and not at the same time (4-wire interface #1 is permanently used for the handset).

To enable the communication between two optical links, the OTTB at the end of the link can be connected via the EOW2 connectors at the COPA. So it is possible to have telephone connections between these NEs by installing an external cable and to use only one handset in a location. Interconnection is possible via a distance of up to 10 m.

The EOW channel is mapped to the frame of the optical supervisory channel via the Eo byte or Fo byte (selected via software). Coding/decoding the EOW channel is configurable for A-law (ETSI) or µ-law (ANSI).

The complete EOW interface can be enabled or disabled by configuration. Disabled means all Eo and Fo bytes are passed through, no access is possible.

When the handset is "off hook" or the speech control detects an incoming speech signal on the 4-wire interface, the Eo and Fo bytes are connected to the EOW interface inside the OSCTUI/OSCTUT card.

A 400 Hz ring tone generator and a dual tone multi-frequency (DTMF) dialling receiver are permanently connected to the EOW conference.

The DTMF receiver is constantly monitoring both direction lines and the handset interface for a DTMF signal. The DTMF generator is part of the handset.

A signal tone is applied to indicate the conference status.

Support is provided for:
- Collective call
- Group call
- Selective call

The telephone number is a configurable decimal 3-digit number. Only selective calls activate an audible tone generator.

The electrical EOW interfaces are on the connector panel (COPA), on the network element alarm panel (NEAP), all accessible via the front of the NE.

The functions of the OSCTUI/OSCTUT cards (including the EOW related functions) are described in Chapter 5.3.16.

3.3.6 User data channels (sV.11)

The user data channels are used for bidirectional sV.11 connections between NEs (external electrical connection up to a distance of approximately 1000 meters).

There are two sV.11 interfaces with a data rate of 64 kbit/s on each OSCTUI/OSCTUT card. Each interface can be configured to access one of the OSC bytes Fo or NU1 or NU2. In the OTTB network element, these bytes are terminated, in the OLRB and OADMB network elements they are terminated or passed through (from OSC B to OSC A, i.e. from side 1 to side 2).

In the OTTB network element, a user data channel of OSC A can be connected to sV.11 #1 or sV.11 #2. In OLRB and OADMB network elements, a user data channel of OSC A and/or OSC B can be connected to sV.11 #1 or sV.11 #2, or can be passed through.

Codirectional Tx timing (data out, clock out) and contradirectional Rx timing (data in, clock out) is applied, both derived from Tx of the OSC clock A.

3.3.7 Telemetry interface (TIF)

TIF inputs and outputs are intended to be used for traditional user-defined “housekeeping” purposes.

The TIF inputs (monitors) usually supervise particular events at the site (such as fire alarm, over-temperature alarm, door-open alarm, etc.). The TIF outputs (actors) usually control particular devices at the site.

TIF monitors and actors are available on each subrack, provided by different card types: OSCTUI/OSCTUT, SMU2 and MCU. The OSCTUI/OSCTUT and SMU2 cards have the same interface characteristic (16 monitors and 4 actors). The MCU card (carrying out the TIF functionality on the OCU network element) has 2 monitors and 2 actors.

The TIF actors are relay contacts (switching between TIF output and TIF common). The TIF monitors on the OSCTUI/OSCTUT and SMU2 cards are optocouplers. These monitors can be triggered by an external voltage with independent potential. The TIF monitors on the MCU are transistor stages. These monitors can be triggered by a negative voltage related to the potential of the network element (positive return).

The TIF monitors generate an environmental alarm on the network element, when the current state differs from the configurable normal state. The TIF actors do not generate alarms.

TIF circuits must be powered by circuits that meet SELV (Safety Extra Low Voltage) limits according to Standards UL 1950, VDE 0100-410, and DIN EN 60950.

3.4 Performance measurements

SURPASS hiT 7500-B monitors various performance parameters (e.g. CV, BBE, ES, SES, SEFS, UAS, Avg-BER, Max-BER) on many layers in order to calculate the transmission quality. Each OCR10T, OCR10R and TEX card accumulates its performance measurements every 00, 15, 30, and 45 minutes past each hour. At the end of each 15-minute reporting period, each card automatically reports its performance counts to the MCU. In addition, 24-hour performance counts are obtained by summing all 15-minute counts of the day.

The user can set a threshold for performance count via software. If this threshold is exceeded, a Threshold Crossing Alert (TCA) will be raised.

➡ The performance analyzing functions of the OPAPC card are described in Chapter 5.3.15

3.5 Fault management

The Fault Management reports all hardware and software malfunctions within a network element and monitors the integrity of all incoming and outgoing digital signals.

The tasks of the Fault Management are to:
- detect anomalies
- derive faults by eliminating spurious anomalies
- trigger automatic maintenance actions (AIS insertion, laser shutdown, etc.)
- reduce alarms by correlation of defects and by adjustable persistence checks
- time stamp events using the system real time clock
- issue spontaneous alarm event notifications to the Element Manager
- prevent the report of unwanted alarm event notifications according to configurable alarm forwarding
- report alarms to the local alarm system
- indicate fault states of replaceable units
- store alarm events and alarm states for later retrieval
- support fault location for diagnosis and guiding of maintenance

3.5.1 Alarms

3.5.1.1 Alarm types

Basically, alarms can be grouped as follows:
- Traffic related:
  - **Communication alarms**, originating from termination points

  - **Quality of Service alarms** (QoS), originating from termination points with performance activities
- Equipment related:
  - **Equipment alarms**, originating from specific cards and slots (distinguished between “card not inserted” or “card faulty”)
  - **Environmental alarms**, originating from outside the network element (TIF)
  - **Processing error alarms**, originating from software
  - **Security alarms**, originating from security management

3.5.1.2 Alarm filtering

The standard filters are shown in Fig. 3.6.

They comprise:

- f1 Anomaly detection and integration to defect
- f2 Consequent action control
- f3 Defect correlation to fault cause
- f4 Integration of fault cause into failure (soak time)
- f5 Translation of failure into unit alarms
- f6 Translation of failure into network element alarm
- f7 Translation of failure into station alarm and alarm disconnect control
- f8 Fault management selective reporting control;
  these selective reports are forwarded to Fault Management specific logs

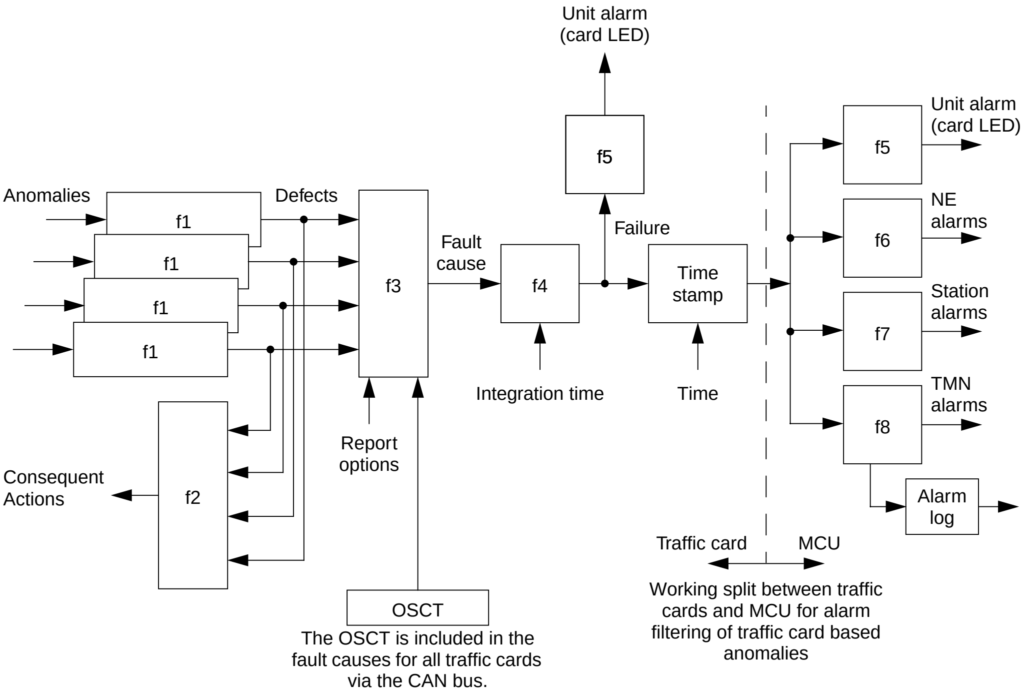


Fig. 3.6 Fault Management filters

3.5.1.3 Alarm signals and LED indications

Various LED indications on the SURPASS hiT 7500-B equipment allow physical localization and a quick overview of raised alarms, without the need for using any further equipment (such as a craft terminal).

Card alarms of active cards (i.e., cards that contain a local card controller) are created by the local card controller and displayed via the Fault LED on the card front (see Chapter 6.3.2.2). Otherwise the alarms are generated by neighboring cards (such as the fan units alarms that are generated by the OSCTUT/OSCTUI or SMU2 cards, which also switch on the fan alarm LED).

All shelf (subrack) alarms are created by the MCU card. The alarms are indicated by LEDs on the NEAP (see Chapter 6.2.2).

The rack alarms are derived from the subrack alarms. These alarm signals are available at the COPA (see Chapter 6.2.3) and at the alarm interface of the PDP on top of the rack (see Chapter 6.1.2.1).

3.5.1.4 Element Manager alarm display

The most detailed alarm informations are available using the SURPASS hiT 7500-B Element Manager software (described in Chapter 8.6).

It displays equipment and communication alarms on a configurable graphical view (e.g., module view, functional view, navigation tree), also offering:

- Current and history alarm lists with various filter and sorting options
- Alarm name, severity and state informations
- Alarm acknowledge functions

For detailed alarm information, see the Troubleshooting Manual of the SURPASS hiT 7500-B Element Manager.

3.5.2 AIS behavior

AIS is sent downstream as an indication that an upstream defect has been detected (ITU-T G.709). The tables below describe how the OCR10T, OCR10R and TEX cards implement AIS.

Condition at Client In	Resulting signal at Line Out
LOS	G-AIS / MS-AIS
LOF	G-AIS / MS-AIS
G-AIS mapped in payload	G-AIS
AIS	G-AIS / MS-AIS

Tab. 3.1 AIS implementation with OCR10T and TEX cards, Client In to Line Out direction

Condition at Line In	Resulting signal at Client Out
LOS	G-AIS / MS-AIS
LOF	G-AIS / MS-AIS
LOM	G-AIS / MS-AIS

Tab. 3.2 AIS implementation with OCR10T and TEX cards, Line In to Client Out direction

Condition at Line In	Resulting signal at Client Out
G-AIS mapped in payload	G-AIS / MS-AIS
ODU-AIS	G-AIS / MS-AIS Note that the OCR10T and TEX cards translate an ODU-AIS received at "Line In" to G-AIS output at "Client Out".
ODU-PLM	G-AIS / MS-AIS
ODU/OTU TIM	G-AIS / MS-AIS
OTU Trace Identifier Mismatch (TIM). When a TIM condition is detected, the designated AIS signal will be transmitted only if the "TIM Consequent Actions" feature is enabled by the user via a software command.	G-AIS / MS-AIS

Tab. 3.2 AIS implementation with OCR10T and TEX cards, Line In to Client Out direction (Cont.)

Condition at Line In	Resulting Signal at Line Out
ODU LOS	ODU-AIS
ODU LOF	ODU-AIS
OTU Trace Identifier Mismatch (TIM). When a TIM condition is detected, the designated AIS signal will be transmitted only if the "TIM Consequent Actions" feature is enabled by the user via a software command.	ODU-AIS

Tab. 3.3 AIS implementation with OCR10R cards, Line In to Line Out direction

The AIS signal on the ODU level suppresses all subsequent alarms on the OTU (section) layer. This avoids a fault in a regenerator chain leading to a large number of subsequent errors on other regenerators. However, reception of the ODU-AIS signal will lead to a fault on the ODU Layer in the OCR10T or TEX cards to indicate the fault on the ODU (path) layer.

If an LOS or LOF state is detected at the Client In port of an OCR10T or TEX card, a Generic AIS (G-AIS) will be mapped into the payload area of the OTU signal. This G-AIS will be transferred over the ODU path all the way to the end of the optical link (i.e., to the OCR10T or TEX card at the other end).

3.6 Protection switching

- Per-channel protection implemented as a 1+1 transmit bridge, non-revertive receive-end switch
- Automatic protection switching is based on detection of a signal failure condition (LOS, LOF, AIS, EOCI)
- Built-in algorithms prevent oscillatory switching

– Manual switching, forced switching, and switching lockout features can be executed remotely by the user via software commands

3.7 Loopback behavior

For test purposes, various loopback modes can be configured with the OCR10T and TEX cards. Tab. 3.4 gives a basic overview of the loopback options.

Loopback type	Card	Card variant			
		V5	LH / LH2	Regio2	V3
Client interface loopback	OCR10T	-	-	-	see Chapter 3.7.1.1
Line loopback, tributary path (ODU1)	TEX	see Chapter 3.7.2.3	see Chapter 3.7.2.3	see Chapter 3.7.2.3	see Chapter 3.7.2.3
Line loopback, path (ODU2)		see Chapter 3.7.2.2	see Chapter 3.7.2.2	see Chapter 3.7.2.2	see Chapter 3.7.2.1
Line loopback, path (ODU2)	OCR10T	see Chapters 3.7.1.2 [1)] and 3.7.1.3 [2)]	see Chapters 3.7.1.2 [1)] and 3.7.1.3 [2)]	see Chapters 3.7.1.2 [1)] and 3.7.1.3 [2)]	see Chapter 3.7.1.2

1) Client mode SDH/SONET or LAN (V5)
2) Client mode OTU2 or OTU2LAN (V5)

Tab. 3.4 Basic loopback overview

3.7.1 OCR10T loopbacks

3.7.1.1 OCR10T-V3 with client interface loopback

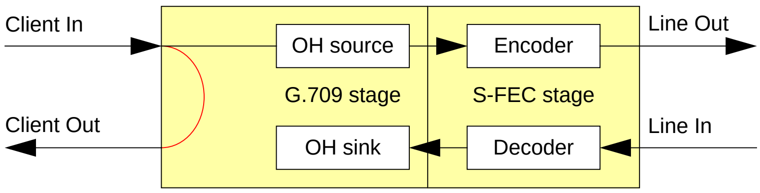


Fig. 3.7 OCR10T-V3 with client interface loopback

3.7.1.2 OCR10T with path (ODU2) loopback (client mode SDH/SONET or LAN [V5])

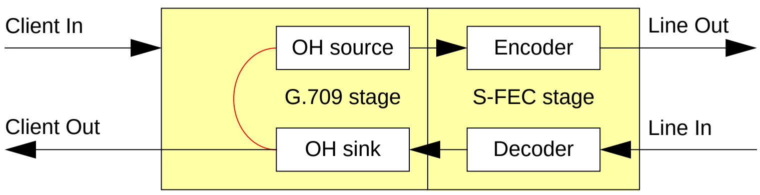


Fig. 3.8 OCR10T with path (ODU2) loopback (client mode SDH/SONET or LAN [V5])

3.7.1.3 OCR10T-V5/LH/LH2/Regio2 with path (ODU2) loopback (client mode OTU2 or OTU2LAN [V5])

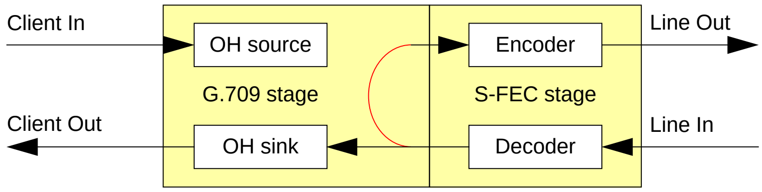


Fig. 3.9 OCR10T-V5/LH/LH2/Regio2 with path (ODU2) loopback (client mode OTU2 or OTU2LAN [V5])

3.7.1.4 OCR10T-V3 with both path and client loopbacks

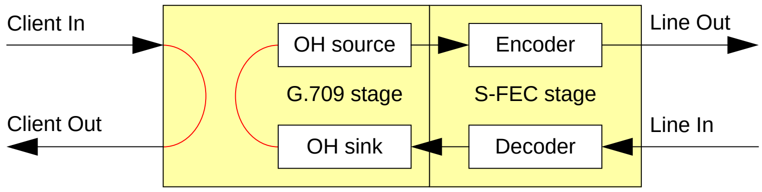


Fig. 3.10 OCR10T-V3 with both path and client loopbacks

3.7.2 TEX loopbacks

Up to 4 client loops can be configured independently.

3.7.2.1 TEX V3 with path (ODU2) loopback

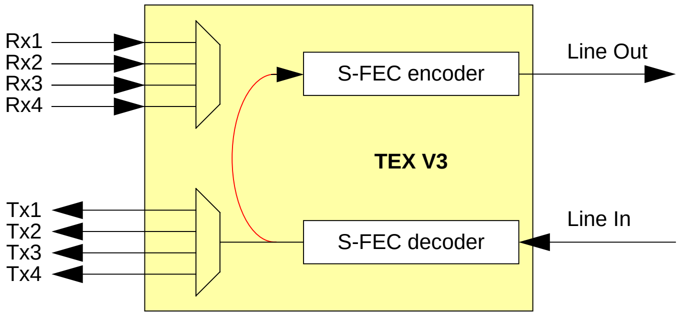


Fig. 3.11 TEX V3 with path (ODU2) loopback

3.7.2.2 TEX V5/LH/LH2/Regio2 with path (ODU2) loopback

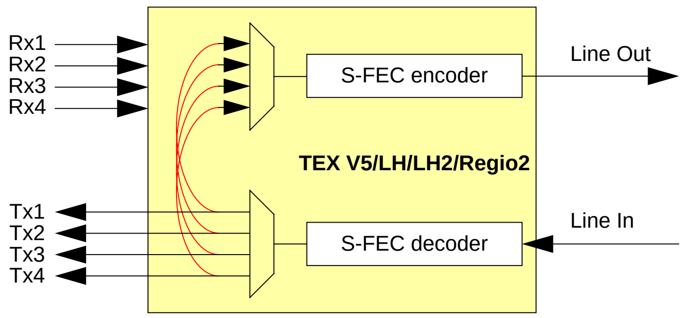


Fig. 3.12 TEX V5/LH/LH2/Regio2 with path (ODU2) loopback

3.7.2.3 TEX with path (ODU1) loopback

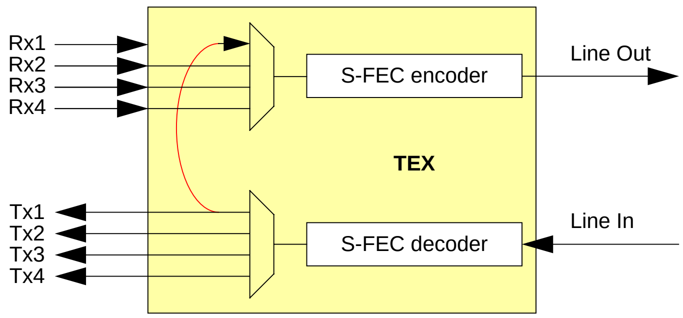


Fig. 3.13 TEX with path (ODU1) loopback (on tributary 1 in this example)

3.7.3 TEX LH2 and TEX Regio2 loopbacks

With TEX LH2 and TEX Regio2, a line loop (10 Gbit/s traffic) and a client loop (2.5 Gbit/s traffic) can be implemented (see Fig. 3.14).

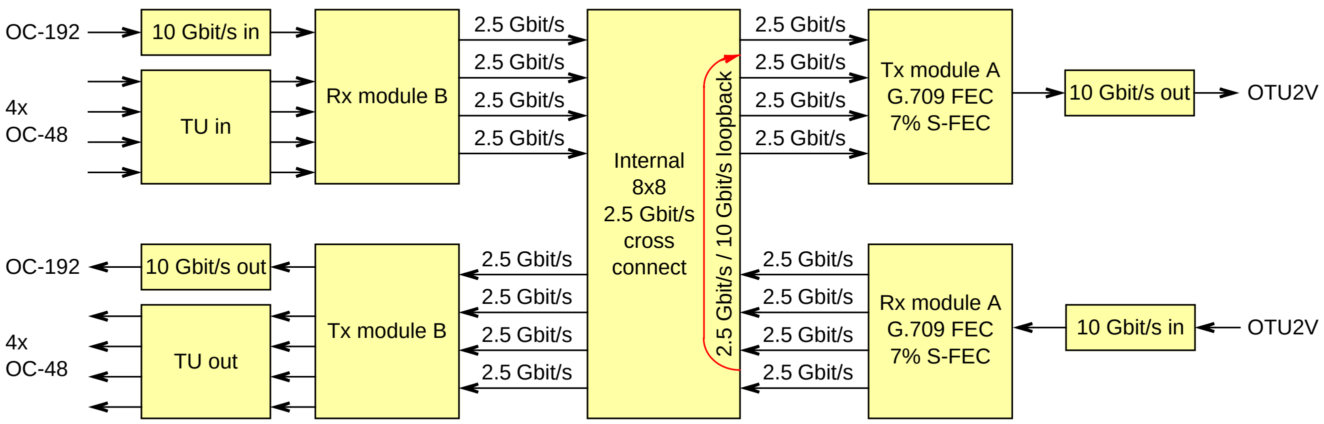


Fig. 3.14 TEX LH2/Regio2 with loopbacks

4 Network element and subsystem types

This chapter describes the available network element and subsystem types of SURPASS hiT 7500-B.

Important functions of the SURPASS hiT 7500-B system are described in Chapter 3.

The SURPASS hiT 7500-B cards are described in Chapter 5.

The hardware design of the SURPASS hiT 7500-B racks, subracks and cards is described in Chapter 6.

The names of the network element and subsystem types are explained in the Abbreviations chapter.

Tab. 4.1 lists all available network elements and subsystems.

NE or subsystem	Described in Chapter	Use
OTTB	4.1	Standalone NE or back-to-back OTTB
OLRB	4.2	Standalone NE
OADMB	4.3	Standalone NE
CCU	4.4	Standalone NE, used in: OTTB back-to-back
OCU	4.5	Standalone NE

Tab. 4.1 NE and subsystem types overview (sorted alphabetically)

4.1 Optical Transport Terminal Basic (OTTB)

The OTTB is a DWDM Network Element. It multiplexes or demultiplexes all channels of the DWDM transport network.

Back-to-back OTTBs (OTTB+CCU+OTTB) are realized as two back-to-back basic terminals with OCS cards in between, all channels can be added /dropped and channels which are connected via OCS cards are configurable. Back-to-back OTTBs (back-to-back terminals) will terminate preemphasis.

4.2 Optical Line Repeater Basic (OLRB)

The OLRB is a DWDM Network Element. It is used
- As a line amplifier
- To boost channel power
- To adjust power tilt
- To compensate dispersion

4.3 Optical Add/Drop Multiplexer Basic (OADMB)

The OADMB is an optical add/drop multiplexer with fixed 10 … 30% add/drop channels. The OADMB is OMS termination point. It is no termination point for preemphasis.

4.4 Optical Channel Connection Unit (CCU)

The CCU is a DWDM Network Element. It is used to Switch channels between add/drop or pass through without amplification (with OCS card).

The combination of two OTTBs as back-to-back terminals with a CCU in between is used as an Optical Add/Drop Multiplexer.

4.5 Optical Channel Unit (OCU)

The OCU is a transponder network element. It is used as the "link” between the client signals and the DWDM transport network, providing channel-specific services for the client signals.

Depending on the equipping with cards, the OCU can perform the following functions:
- Transponder
- Multiplexing transponder
- Regenerator
- Optical protection switch

5 Cards

This chapter lists the SURPASS hiT 7500-B plug-in cards and their application in the network elements, and describes the individual functions of the cards.

Important functions of the SURPASS hiT 7500-B system are described in Chapter 3.

The SURPASS hiT 7500-B network elements and subsystems are described in Chapter 4.

The hardware design of the SURPASS hiT 7500-B racks, subracks and cards is described in Chapter 6.

5.1 Card types overview

Tab. 5.1 lists the available cards and the network elements in which they can be used.

The names of the cards and network elements are explained in the Abbreviations chapter.

Card name	Card used in NE type(s)	Short explanation of the card	Details in chapter	Technical data in chapter
MCU	CCU OCU OADMB OLRB OTTB	Main control element of the SURPASS hiT7500-B system	5.3.1	10.4.1
MIBS32-2, MIBS256	CCU OCU OADMB OLRB OTTB	Management information base, storing all persistent management data handled by the MCU	5.3.2	10.4.2
OCP-V2	OCU	Optical channel protection	5.3.4	10.3.16
OCR10R-V3, OCR10R-V5, OCR10R-LH2, OCR10R-Regio2	OCU	Optical channel repeater 10 Gbit/s Regenerator	5.3.5	10.3.15
OCR10T-V3, OCR10T-V5, OCR10T-LH2, OCR10T-Regio2	OCU	Optical channel repeater 10 Gbit/s Transponder	5.3.6	10.3.14
OCS	CCU	Optical channel switch card for 4 channels	5.3.3	10.3.11
OD10	OTTB	Optical demultiplexer for 10 channels	5.3.7	10.3.8
ODA10	OTTB	Optical demultiplexer for 10 channels, including a VOA at each individual channel output	5.3.7	10.3.8

Tab. 5.1 Card types overview (sorted alphabetically)

Card name	Card used in NE type(s)	Short explanation of the card	Details in chapter	Technical data in chapter
OF10	OTTB	Optical filter with multiplexer or demultiplexer for 10 channels with or without upgrade port	5.3.8	10.3.9
OLIF	OTTB, OADMB, OLRB	Substitute of booster, used in stand-alone C band systems	5.3.9	10.3.3
OLIMINC	OLRB	Inline amplifier (compact version), used in stand-alone C band systems	5.3.10	10.3.2
OLIMTBNC	OTTB, OADMB	Booster (compact version), used in stand-alone C band systems	5.3.11	10.3.2
OLIMTPNC	OTTB, OADMB	Preamplifier (compact version), used in stand-alone C band systems	5.3.12	10.3.2
OLISINC	OLRB	Inline amplifier (basic version), used in stand-alone C band systems	5.3.10	10.3.2
OLISTBNC	OTTB, OADMB	Booster (basic version), used in stand-alone C band systems	5.3.11	10.3.2
OLISTPNC	OTTB, OADMB	Preamplifier (basic version), used in stand-alone C band systems	5.3.12	10.3.2
OLIVINC	OLRB	Inline amplifier (slim version), used in stand-alone C band systems	5.3.10	10.3.2
OLIVTBNC	OTTB, OADMB	Booster (slim version), used in stand-alone C band systems	5.3.11	10.3.2
OLIVTPNC	OTTB, OADMB	Preamplifier (slim version), used in stand-alone C band systems	5.3.12	10.3.2
OM10	OTTB	Optical multiplexer for 10 channels, including a VOA at each individual channel input	5.3.7	10.3.8
OMD4C	OTTB, OADMB	Filters for the separation of four channels within the C band (in OTTB OMD4C06 only)	5.3.13	10.3.6
OMDFC	OTTB, OLRB	Band filters for the separation of the blue and red subbands within the C band; in OLRB used for subband compensation	5.3.13	10.3.6
OPAPC	OTTB, OADMB OLRB	Optical performance analyzer “power” card	5.3.15	10.3.10
OSCTUI	OLRB OADMB	Optical supervisory channel card for the intermediate nodes	5.3.16	10.3.1
OSCTUT	OTTB, CCU	Optical supervisory channel card for the terminal sites	5.3.16	10.3.1

Tab. 5.1 Card types overview (sorted alphabetically) (Cont.)

Card name	Card used in NE type(s)	Short explanation of the card	Details in chapter	Technical data in chapter
PUMPA	OADMB OLRB OTTB	Pump cards with different wavelengths	5.3.17	10.3.5
PUMPB	OTTB			
RPUMP	OTTB OADMB OLRB	Raman pump card	5.3.18	10.3.5
SAB	CCU OADMB OLRB OTTB	Bus termination resistors	5.3.19	10.4.3
SMU2	CCU OCU OADMB OTTB	Subrack management unit	5.3.20	10.4.4
TEX V3, TEX V5, TEX LH2, TEX Regio2	OCU	Bidirectional multiplexing transponder	5.3.21	10.3.14
UDCMB	CCU OADMB OLRB OTTB	Unidirectional Dispersion Compensation Module Basic with slope compensation (to be placed into DWDM subrack)	5.3.23	10.3.12
UDCMC	OADMB OLRB OTTB	Unidirectional Dispersion Compensation Module with slope compensation (to be placed into DCM tray)	5.3.22	10.3.13

Tab. 5.1 Card types overview (sorted alphabetically) (Cont.)

5.2 Card power supply

Most cards have an on-board power supply (PSU). It is a DC/DC converter providing the necessary regulated operating voltages for the card.

The outputs are isolated from the input. All output circuits have a common reference point. When the card is inserted into the subrack, the card's reference point is connected to the grounding layers on the backplane.

The PSU is supplied by one (NUBAT1/2) or (optionally) two supply voltages (NUBAT1/2 and NUBAT3/4). These voltages are coupled by diodes, which give also a reverse-connect protection. Each PSU has one input line fuse on the card.

In the subrack, inserting or pulling of a card with on-board PSU does not affect the operating conditions of other cards. All card connectors to the backplane have premating contacts which first of all connect the cards to ground by inserting.

Some cards (e.g., UDCMC) are fed by the OSCTUT/OSCTUI or SMU2 cards via a power bus.

5.3 Card descriptions

The following subchapters are grouped by card functions.

i To quickly find a particular card description in the following subchapters, consult Tab. 5.1 (that is sorted alphabetically by card names).

The technical data of the cards are summarized in Chapters 10.3 and 10.4.

5.3.1 Main Control Unit (MCU)

i Note, that there are two different types of the MCU card: MCU-C and MCU-G.
If not otherwise stated in the text, “MCU” is used for both types MCU-C and MCU-G.
MCU-G is used with transponder equipment only and have additional functions, see below.

The MCU provides the central monitoring and control functions for the system (SEMF), as well as the Message Communication Function (MCF) to operate the F, Q and ECC communication interfaces.

For internal control, the MCU uses the Peripheral Control Bus (PCB) that consists of two asynchronous serial busses connecting the MCU to all cards which have their own card controllers (CCM/LCC). A second asynchronous serial bus system called CAN is used for very fast inter-card communications for time-critical operations.

Using these interfaces, the MCU performs the following main functions:

- Fault Management:
  Monitoring all system alarms and forwarding their states to the network management system and the rack alarm bus
- Performance Management:
  On request, sending all optical performance management information to the network management system and/or a craft terminal
- Configuration Management:
  Configuring the system to either default settings or to persistently stored settings initiated by the network management system and/or a craft terminal
- Security Management:
  Controlling the individual access via the network management system and/or a craft terminal to particular NE functions, using a hierarchical security management user ID and password concept
- Equipment Management:
  Monitoring the actual and required subrack equipping
- Communication Management:
  Implementing the Message Communication Function (MCF) for the communication between all NEs and the Network Management system
- Software Management:
  Performing all software downloads, uploads, and software integrity functions
- Real Time Management:
  Controlling the real time clock
- Providing NEAP or Bw7R alarm outputs from subracks and racks
- Controlling the NE alarm LEDs (e.g., major/minor, for communication and equipment alarms)

– Detecting the presence of the MIBS32-2/MIBS256 and SAB cards in the same sub-rack

In addition, the MCU supports general communication channel (GCC) access which is used in transponder equipment. Client GCC to external terminal equipment is supported by the MCU-G only.

5.3.2 Management Information Base module (MIBS32-2, MIBS256)

These MIBS cards mainly store all data that are visible and changeable via a Q3 interface. A subset of the MIBS, the NE-VCDB (Variable Configurable Database) contains the total variable configuration parameters of an NE. Only the NE-VCDB is persistently stored on the MIBS card, as a backup version of the master that is stored on the MCU in an external SRAM.

Hence, if an MCU fails, a replacement can be made without losing the entire contents of the MIBS module. The data also survive a power failure or cold start of the NE.

One MIBS module is required per NE. Replacement of the MIBS does not cause any interruption to the traffic being carried over this particular NE.

The following MIBS types are available:
– MIBS32-2 with 2 MAC addresses.
– MIBS256 with 2 MAC addresses, allowing the storage of a backup copy of the entire active MCU software. It can be configured with the LCT if the MIB256 is required or not. In case of MIBS mismatch correspondent alarms will be raised.

5.3.3 Optical channel amplifiers and channel switches (OCS)

This card allows either configuration of express channel connections or single add/drop channels in CCU network elements.

5.3.4 Optical Channel Protection (OCP-V2)

OCP-V2 cards can be used at each end of DWDM long-haul links. They provide 1+1 (transmit-bridge, receive-end switch) protection capabilities for the optical channels. OCP-V2 cards can be used in combination with transponder cards (Chapters 5.3.6 and 5.3.21) only. Automatic protection switching decisions are based on detection of LOS. Manual switching, forced switching, and switching lockout commands can also be remotely issued by the user via software.

Both the In 1 and In 2 interfaces have an optical tap with a photo-detector diode to monitor the power of the incoming signals (i.e., prior to the optical switch, see Fig. 5.1). If the power level of either incoming signal falls below the user-specified threshold, an LOS alarm on the affected port will be raised.

There is also an optical tap after the optical switch to monitor the power of the signal output at the Client Out port. If the power level of this signal falls below the user-specified threshold, a Transmit Fail (TF) alarm for the Client Out port will be raised.

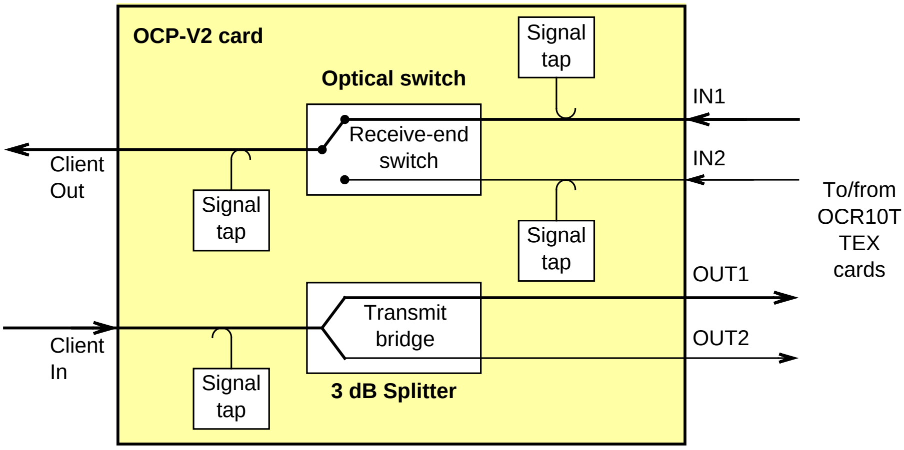


Fig. 5.1 OCP-V2 block diagram

In case of switching, the OCP-V2 software performs the following:
– Receives switch requests from various sources
– Sorts them according to defined priority
– Identifies the switch request with the highest priority
– Executes switching as necessary
– Conducts post-switching verification
– Sends a protection switch status report to MCU card

5.3.5 Optical Channel Repeater 10 Gbit/s Regenerator (OCR10R-V3, OCR10R-V5, OCR10R-LH2, OCR10R-Regio2)

The OCR10R cards are used at mid-span sites to further extend the total transmission distance. The exact wavelength is controlled via a tunable transmit laser (except for OCR10R-Regio2). The S-FEC feature (with OCR10R-V3, OCR10R-V5, OCR10R-LH2, OCR10R-Regio2) allows longer span distances.

The OCR10R-V3 card is a ULH version.

The OCR10R-V5 card is a ULH version with high dispersion tolerance. It can work in the 10 GE LAN or 10 GE OTU2 LAN mode with the higher line data rate.

i Note that OCR10R cards work in a unidirectional mode only, i.e. for bidirectional use 2 cards (in neighboring slots) are needed.

i Note that the transponder and regenerator cards described in Chapters 5.3.6 to 5.3.21 can only be used in the same bidirectional optical path if they are of the same type (i.e., all -V3 or all -V5 or all -LH2 or all -Regio2), due to differences in data format and data rate.

5.3.6 Optical Channel Repeater 10 Gbit/s Transponder (OCR10T-V3, OCR10T-V5, OCR10T-LH2, OCR10T-Regio2)

The OCR10T cards are used at each end of DWDM long-haul links, as a bidirectional interface between a client interface and a line interface. Each OCR10T card generates and terminates an optical channel of a wavelength appropriate for DWDM transmission. The exact wavelength is controlled via a tunable transmit laser (except for OCR10T-

Regio2). The S-FEC feature (with OCR10T-V3, OCR10T-V5, OCR10T-LH2, OCR10T-Regio2) allows longer span distances.

The OCR10T-V3 card is a ULH version.

The OCR10T-V5 card is a ULH version with high dispersion tolerance. It can be configured for the following client data formats:

– STM64 / OC192 mode: The overhead is monitored only, it can be monitored at the client input and at the client output
– OTU2 mode: The FEC overhead is used. On the client transmitter, the proper FEC overhead is inserted. On the client receiver, errors in the data stream can be corrected
– 10 GE LAN mode: The incoming data stream can be monitored. The 10 GE LAN data stream is wrapped in a OTU2 frame without stuffing byte
– OTU2 LAN mode

The OCR10T-V5 line data format is an OTU2 format with proprietary enhanced FEC overhead (OTU2v) with 10% S-FEC overhead.

i

Note that the transponder and regenerator cards described in Chapters 5.3.6 to 5.3.21 can only be used in the same bidirectional optical path if they are of the same type (i.e., all -V3 or all -V5 or all -LH2 or all -Regio2), due to differences in data format and data rate.

5.3.7 Optical multiplexers and demultiplexers for 10 channels (OM10, OD10, ODA10)

OM10 is an optical multiplexer for 10 channels with a Variable Optical Attenuator (VOA) at its input to control the power of the channel.

OD10 is an optical demultiplexer for 10 channels (without VOAs).

ODA10 is an optical demultiplexer for 10 channels with a VOA at its input to control the power of the channel.

5.3.8 Optical filter with multiplexer or demultiplexer for 10 channels (OF10)

The card OF10 provides multiplexer or demultiplexer functionality for 10 channels in the OTTB network element. Card types with or without upgrade port are available.

The common port contains a coupler tap and an APSD/APRM monitor diode.

The MUX / DEMUX function of the card depends on the slot in the subrack where the card is plugged in.

The OF10 card is a passive card without a local microprocessor module (LCC or CCM).

5.3.9 Optical line interface supervisory channel feeder (OLIF)

The OLIF card is a possible substitute for a OLI booster amplifier in OTTBs and OADMBs followed by a short span. In addition, it can be used in combination with OLIVINC / OLIVTPNC (preamplifier slim / inline slim) + UDCMB (+ OLIF) in OTTBs, OADMBs and OLRBs.

The OLIF contains mainly an OSC-filter, a power monitor and a local card controller (LCC).

The OLIF provides a monitor output (MonSo) for connecting e.g. the OPAPC card and an input for coupling the optical supervisory channel (OSC2) from OSCT into the multiplex signal.

5.3.10 Optical inline amplifiers (OLIMINC, OLISINC, OLIVINC)

Each OLIMINC, OLISINC and OLIVINC card contains an optical inline amplifier for C band in one direction. These amplifier cards are used at inline sites for optical amplification of the signal. The inline amplifier cards are designed for stand-alone systems.

The OLIMINC compact version are high-performance EDFA amplifiers. The output power of the cards can be increased by pump cards and Raman pump cards (described in Chapters 5.3.17 and 5.3.18 respectively).

The OLISINC basic version and the OLIVINC slim version are cost-effective amplifier type to be used in short and medium links (500 km to 1300 km) with only a low number of spans, or in longer links combined with the OLIMINC compact version.

The TransNet network planning tool (see Chapter 9) calculates which OLI card can be used depending on fiber type, fiber attenuation, link length, number and lengths of spans, etc.

5.3.11 Optical booster amplifiers (OLIMTBNC, OLISTBNC, OLIVTBNC)

Each OLIMTBNC and OLISTBNC card contains an optical booster amplifier for C band in one direction. These booster amplifier cards are used at terminal sites for amplifying the outgoing line signal. In a link, there is only one booster.

The OLIMTBNC compact version are high-performance EDFA amplifiers. The output power of these cards can be increased by pump cards (described in Chapter 5.3.17).

The OLISTBNC basic version and the OLIVTBNC slim version are cost-effective amplifier types for short and medium link lengths.

The planning tool (see Chapter 9) calculates which OLI card can be used depending on fiber type, fiber attenuation, link length, number and lengths of spans, etc.

5.3.12 Optical preamplifiers (OLIMTPNC, OLISTPNC, OLIVTPNC)

Each OLIMTPNC, OLISTPNC and OLIVTPNC card contains an optical preamplifier for C band in one direction. These preamplifier cards are used at terminal sites for amplifying the incoming line signal before it is fed into the demultiplexing stage. In a link, there is only one preamplifier.

The OLIMTPNC compact version are high-performance EDFA amplifiers. The output power of these cards can be increased by pump cards and Raman pump cards (described in Chapters 5.3.17 and 5.3.18 respectively).

The OLISTPNC basic version and the OLIVTPNC slim version are cost-effective amplifier types for short spans or with a low number of channels.

The TransNet network planning tool (see Chapter 9) calculates which OLI card can be used depending on fiber type, fiber attenuation, link length, number and lengths of spans, etc.

5.3.13 Optical band filters (OMDFC)

These cards contain the subband filter optical necessary for the 40 channel multiplexing/demultiplexing structure. The subband filters are used to separate the wavelengths using standard optical reflecting filter technology.

Fig. 5.2 indicate the basic functional of these cards.

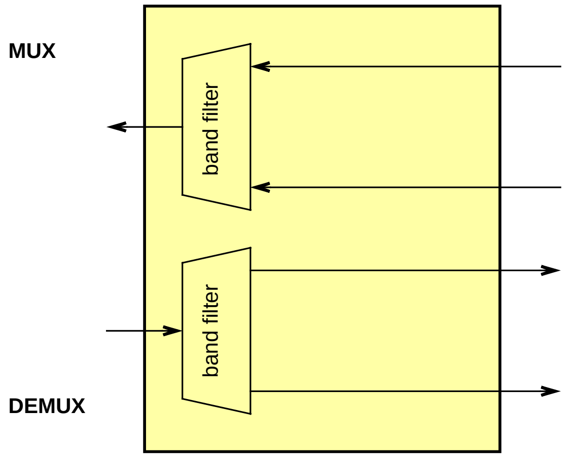


Fig. 5.2 OMDFC block diagram

5.3.14 Optical band filters (OMD4C)

These cards contain the subband filter optical necessary for the 32 channel multiplexing/demultiplexing structure. The subband filters are used to separate the wavelengths using standard optical reflecting filter technology.

Fig. 5.3 indicate the basic functional of these cards.

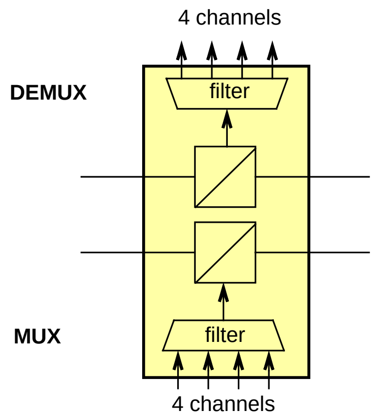


Fig. 5.3 OMD4C block diagram

5.3.15 Optical Performance Analyzer (OPAPC)

The OPAPC card monitors the channel power and frequency of all channels. It can detect valid channels. The OPAPC card is used in combination with standard, basic, compact or slim OLI cards and with OLIF. OPAPC is also used to record channel power for a rudimentary form of performance management.

The optical input of the OPAPC is connected to the MonSo port of an OLI card. The measured values are communicated to the OSCT card and OLI card via CAN bus.

The OPAPC card is part of link control for preemphasis / add channel adjust, power equalisation, master of channel count and for tilt control.

The OPAPC card consist of the following main functional blocks:
- LCC (Low-level Card Controller)
- Channel Power Monitor (CPM) module
- Interface to the LCC
- Optical Switch 2:1
- Power Supply Unit (PSU)

The main OPAPC functions are:
- measurement of optical signal power of carriers
- manage the measurement of the correct optical input signal for the respective optical link state and network element type
- participate in preemphasis mode and power optimization
- monitor power and CPM failures. Report failure and card fail
- perform automatic performance measurement of supervised optical carriers
- generate channel and carrier alarms for all supervised optical carriers
- generate No Light Detected (nldc) alarms
- calibrate optical power loss through optical switches and couplers. Store calibrated data on the cards SPI EEPROM
- provide debug support via the SDI port

5.3.16 Optical Supervisory Channel cards (OSCTUI, OSCTUT)

The main function of the OSCTUI and OSCTUT cards is the optical and electrical termination of the 2-Mbit/s Optical Supervisory Channel (OSC) that is transmitted on a separate wavelength to the main payload traffic, see Chapter 3.3.3.

OSCTUI cards are used in OLRB and OADMB network elements; OSCTUT cards are used in OTTB and CCU network elements.

In detail, the OSCTUI and OSCTUT cards perform the following functions:
- T3 clock input interface for incoming 2048-kHz for OSC synchronization and real-time clock synchronization. No 1.5-Mbit/s or 2-Mbit/s clocks are implemented because no complete SSM is required for OSC synchronization.
- All cross connections from terminated OSC bytes to the electrical interfaces, or cross connections for bytes which are to be passed through the NE unterminated
- User-configurable clock priorities via software for the T3 input and the T2 internal clock
- Implementation of a timing marker byte to prevent OSC timing loops
- User configurable EOW 4-wire electrical interface properties via software for ETSI or ANSI customer requirements
- User-configurable EOW channel encoding/decoding law (A-law [ETSI] or μ-law [ANSI]) of the 4-wire interfaces via software
- EOW selective calling, group or collective calling with decimal 3-digit telephone number
- EOW Ring Manager function for enabling the selection of one OTTB network element as a ring manager to allow ring EOW configurations for protections
- User-configurable Telemetry Interfaces (TIF) providing 4 outputs (actors) and 16 inputs (monitors) per OSCTUI/OSCTUT card

- Supervision of fan units, i.e., activation of fan alarms
- Controlling the LED display on the Network Element Alarm Panel (NEAP) for the fan and EOW functions
- Controlling the red and green LEDs on the OSCTUI/OSCTUT card itself
- Detection and reporting of all OSC alarms (such as LOS, LOF, SD, RDI, EXC, etc.)
- Card-present monitoring of the fans, UDCMs and SAB units (the card-present monitoring of all other cards is performed by the SMU2 or the MCU, whichever is present in the subrack)
- Providing a Synchronous Peripheral Interface (SPI) for communication to passive cards in the same subrack (i.e. the optical band filter/interleaver cards, see Chapter 5.3.13) and UDCMs
- Storage and retrieval of card inventory data management on EEPROMs in OSCTUI/USCTUT and in other passive cards in the same subrack, and in UDCMCs
- Power feeding to other passive cards in the same subrack and to UDCMCs

5.3.17 Pump cards (PUMPA, PUMPB)

These pump cards are used to increase the output power of the preamplifier, booster, and inline amplifier cards described in Chapters 5.3.12 to 5.3.10. The PUMPA and PUMPB cards differ in the pump signal wavelengths, see the technical data in Chapter 10.3.4.

With these pump cards, two application cases are possible, depending on the network requirements:
- PUMPA alone
- A combination of PUMPA and PUMPB

Each amplifier pump current and output power is precisely regulated by hardware and software control loops implemented on the amplifier card.

On each pump card, the signals from the two laser diodes are combined to one pump laser signal via a polarization beam combiner. This signal is sent to the OLI via an optical/electrical cable. The electrical connection is important, as it is used to determine whether the high optical power connection from the pump card to the OLI is closed. If not, the power of the pump card is automatically shut down.

The pump cards contain Peltier controlling elements and temperature sensors, which trigger an alarm if the temperature exceeds the programmed thresholds.

5.3.18 Raman pump card (RPUMP)

The Raman pump card (RPUMP) can be inserted at the input of an optical preamplifier card (OLIMTPNC, see Chapter 5.3.12). This increases the possible spacing between the optical amplifiers. Alternatively, the same amplifier spacing can be achieved with lower per channel EDFA output powers, allowing a higher total number of optical spans. Raman amplifiers are preferably applied to bridge single extra long spans.

Raman pumps must be inserted at the receiving line interface. An additional Raman pump card can be inserted at the input of each inline amplifier or preamplifier.

The RPUMP card contains 5 lasers for a total of 4 wavelengths. These laser diode signals are combined to one signal that is sent to the transmission fiber. The electrical connection is important, as it is used to determine whether the high optical power connection from the RPUMP card to the OLI is closed. If not, the power of the RPUMP card is automatically shut down.

Raman amplification

Raman amplification is named after the Indian physicist Sir Chandrasekhara Venkata Raman.

The basis of Raman amplification is the energy scattering effect called Stimulated Raman Scattering (SRS), a non-linear effect inherent to the fiber itself. SRS involves a transfer of power from a signal at a higher frequency (lower wavelength) to one at a lower frequency (higher wavelength), due to inelastic collisions in the fiber medium. It can be used for optical amplification, in which the higher frequency light serves as a pump source, amplifying the lower frequency wave carrying the actual traffic signal to be amplified.

Contra-directional Raman pumping, i.e., Raman pump traveling in the opposite direction to the traffic signal, is used. The Raman amplification process occurs at the end of an optical span. When the signal is at its weakest, it is given renewed energy via the pump light being inserted at the end of the hop in the reverse direction. Hence only in the last few kilometers of a span Raman amplification effectively takes place.

5.3.19 Bus termination resistors and CAN bus repeater/amplifier (SAB)

The SAB is called “Subrack Address Board” because it was originally designed to hold the subrack address information. In the current release of SURPASS hiT 7500-B, this function is carried out by the Network Element Alarm Panel (NEAP). However, one SAB is still required per subrack, as the SAB contains several bus termination resistors required for inter-subrack data communications.

5.3.20 Subrack Management Unit (SMU2)

The SMU2 card collects card presence and status data from the cards in the subrack and forwards this information to the concerned MCU card.

In addition, the SMU2 card provides telemetry interfaces (TIF), as described in Chapter 3.3.7.

5.3.21 Bidirectional multiplexing transponders (TEX V3, TEX V5, TEX LH2, TEX Regio2)

Each TEX card transparently multiplexes four 2.5-Gbit/s data streams (STM16/OC48) into one 10-Gbit/s data stream. Additionally, TEX V5 and TEX LH2 support OTU1 client also. Multiplexing transponders increase the efficiency of the DWDM network, by transmitting the four client signals on one wavelength, thus reducing the network costs.

The TEX V3 card has a 12.5-Gbit/s S-FEC DWDM optical interface at the line side, compatible to the OCR10R-V3 interface.

Each TEX LH2 and TEX Regio2 card has a 10.7-Gbit/s S-FEC DWDM optical interface at the line side.

The TEX V5 card is a ULH version with high dispersion tolerance. The line interface bit rate is approximately 11.00 or 11.35 Gbit/s. The TEX V5 card supports LAN PHY interface.

The TEX V5, TEX Regio2 and TEX LH2 cards are equipped with pluggable SFP modules for the optical 2.5 Gbit/s client interfaces (see Chapter 6.3.3).

The TEX LH2 card supports the full feature set, but does not have the feature OTU1 clients FEC enable/disable (FEC is always disabled, i.e., the FEC overhead is filled with zeros).

i Note that the transponder and regenerator cards described in Chapters 5.3.6 to 5.3.21 can only be used in the same bidirectional optical path if they are of the same type (i.e., all V3 or all V5 or all LH2 or all Regio2), due to differences in data format and data rate.

5.3.22 Unidirectional dispersion compensation modules (UDCMCs)

UDCMCs are primarily used to counteract the chromatic dispersion which a signal undergoes as it travels through a section of optical fiber. This chromatic dispersion has the effect of spreading the signal spectrum so much that the inter-symbol interference no longer allows an accurate recognition of a single 'one' bit or a single 'zero' bit.

The UDCMCs contain spools of Dispersion Compensating Fiber (DCF) that have the opposite dispersion characteristics compared to the fiber used for signal transmission, hence “compressing” the signal for better optical performance.

The type of DCF depends on the wavelength band and type of fiber used for transmission. So, many different variants of UDCMCs are available for accurate DCM management.

The strategy for selecting UDCMCs is highly system-dependent and is influenced by the optical performance limiting effects, such as Self Phase Modulation (SPM), Cross Phase Modulation (XPM), Raman crosstalk, etc.

UDCMCs are normally located in the optical path between the 2nd and 3rd stages of each optical amplifier, since the insertion loss of the UDCMC can be compensated here by the amplifier design. However, it is also possible to perform subband dispersion compensation, for example, using different UDCMCs for the C-red and C-blue bands in each NE type.

5.3.23 Unidirectional dispersion compensation module Bragg (UDCMB)

The UDCMB provides dispersion compensation of certain length of transmission fibers. It is used for C-band with a channel spacing of 100 GHz.

In UDCMB cards Fiber Bragg Gratings (FBG) are used for dispersion compensation . In contrast to UDCMC the UDCMB cards are placed in the DWDM subrack (rather than in the DCM tray).

6 Mechanical design

This chapter gives an overview of the mechanical features of the SURPASS hiT 7500-B racks, subracks and cards.

The functions of the SURPASS hiT 7500-B network elements are described in Chapter 4. The functions of the SURPASS hiT 7500-B cards are described in Chapter 5.

The dimensions and weights of the SURPASS hiT 7500-B racks, subracks and cards are listed in Chapter 10.

6.1 Racks

The SURPASS hiT 7500-B subracks are mounted in ANSI or ETSI racks, as exemplified in Fig. 6.1.

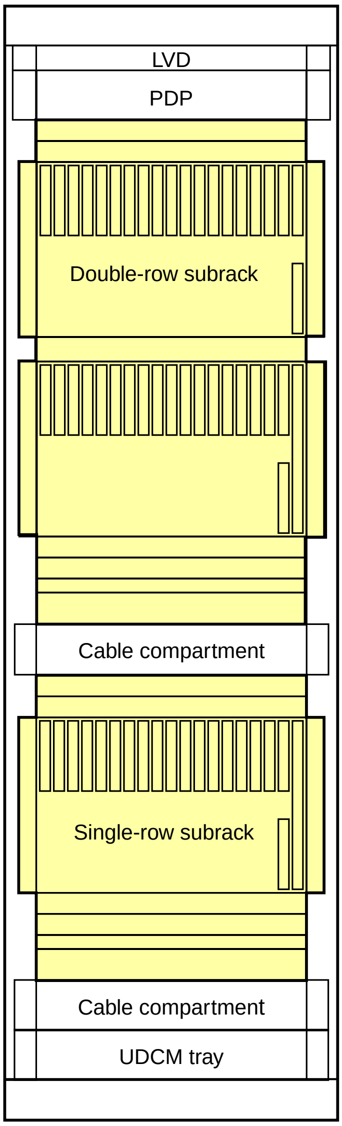


Fig. 6.1 ANSI rack equipping example with double-row and single-row subrack

6.1.1 General rack design

One rack can accommodate:

– One double-row and one single-row subrack with or without LVD (see Fig. 6.1)
– Two single-row subracks with or without LVD
– Two double-height subracks with or without LVD

6.1.2 Power distribution in the rack

6.1.2.1 Power Distribution Panel (PDP)

The Power Distribution Panel (PDP) is mounted at the top of the rack, as shown in Fig. 6.1. The PDP contains the circuit breakers (fuses) for the power supply inputs of the subracks and an alarm interface for rack and shelf alarms.

6.1.2.2 Low Voltage Disconnect device (LVD)

In ANSI racks, an Low Voltage Disconnect device LVD device is added above the PDP (see Fig. 6.1). The LVD checks the input voltage at the power inputs of the rack and disrupts the power connection if the input voltage drops below a given limit. The power input is automatically reestablished if the input voltage returns to the normal operating range.

6.1.3 UDCMC tray

The unidirectional dispersion compensation modules (UDCMCs, see Chapter 5.3.22) are physically stored in their own UDCMC trays at the bottom of the rack, as outlined in Fig. 6.1. One UDCMC tray can accommodate up to 4 UDCMCs, each in its own slot. There are two different UDCMC tray variants for ETSI and for ANSI racks.

6.2 Subracks

The SURPASS hiT 7500-B cards are accommodated in different types of subracks. All subrack types are with front access only.

6.2.1 General subrack design

Subracks are available with or without a door. If the subrack has a door, it is fitted with special hinges that enable the door to be removed from the subrack.

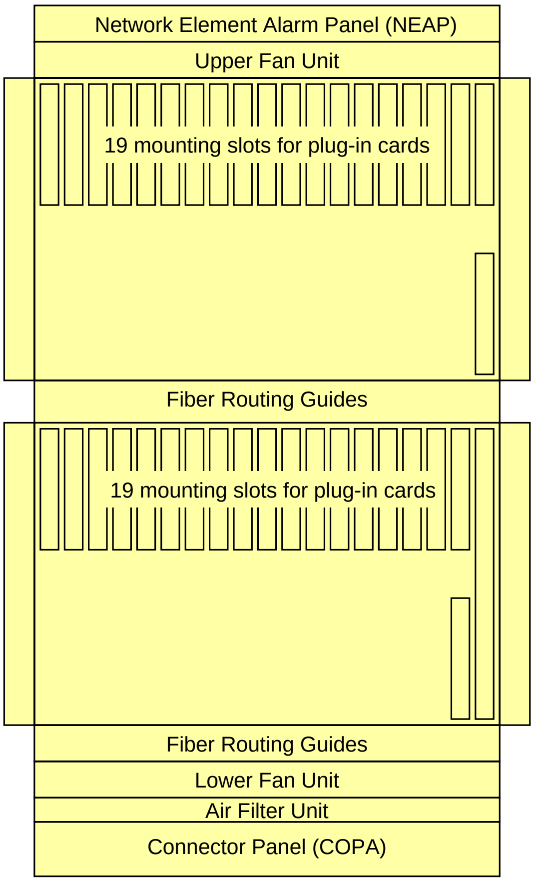


Fig. 6.2 Double-row subrack

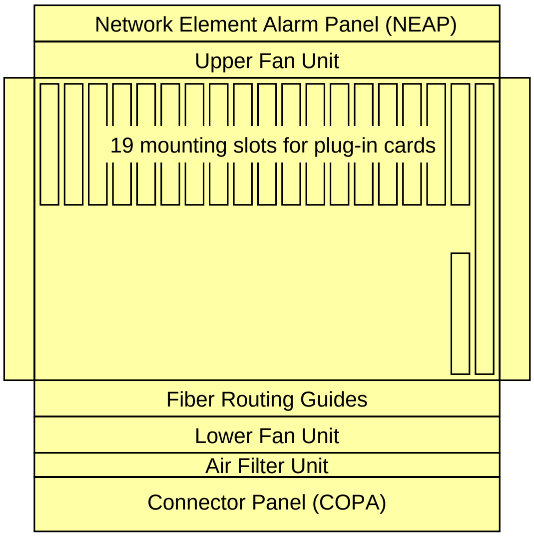


Fig. 6.3 Single-row subrack

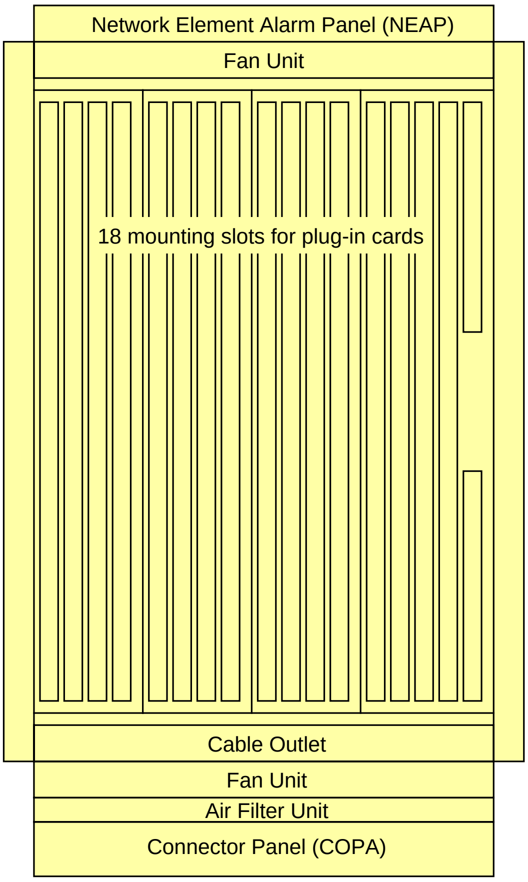


Fig. 6.4 Subrack for double-height cards

6.2.2 Network Element Alarm Panel (NEAP)

The NEAP (Fig. 6.5) contains the most important power-on and alarm LEDs as well as interfaces and the subrack address switch. The LEDs are visible and connectors are accessible even if the subrack front cover is mounted.

The NEAP is located at the top of each subrack, as shown in Fig. 6.2 to Fig. 6.4.

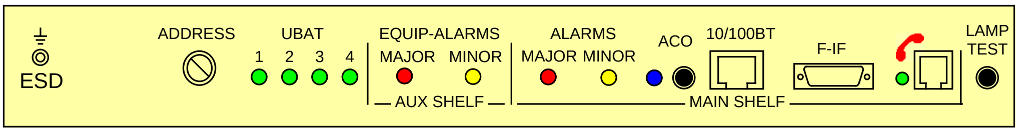
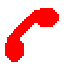


Fig. 6.5 Network element alarm panel

The NEAP elements are listed in Tab. 6.1.

Element marking	LED color	Explanation
ESD	–	ESD grounding socket
UBAT 1 to 4	green	Separate power-on LEDs for the supply voltages
EQUIP-ALARMS / MAJOR	red	Summarized Mayor equipment alarm indication
EQUIP-ALARMS / MINOR	yellow	Summarized Minor equipment alarm indication
ALARMS / MA-JOR	red	Summarized Mayor communication alarm indica-tion
ALARMS / MINOR	yellow	Summarized Minor communication alarm indication
ACO	blue	Alarm cut-off button with LED (cuts off indicated audible alarms)
10/100BT	–	Ethernet LAN connector (8-pin RJ45 connector); can be used for connecting the NE to the LAN, instead of the LAN M1 or 10BT_M1 connectors on the COPA (see Tab. 6.2). **Note:** On the COPA in the OCU network element (see Chapter 6.2.3), the 10/100BTN connector must be connected to the LAN M1 connector in this case.
ADDRESS	–	Subrack address switch
F-IF	–	F interface for serial connection to a craft terminal (9-pin D-Sub connector)
LAMP TEST	–	Lamp test button, switching on all LEDs on NEAP, cards and both fan units of the subrack. Notes: On the NEAP, only **either** the LEDs marked AUX SHELF **or** the LEDs marked MAIN SHELF (see Fig. 6.5) are lit by the lamp test – depending on the used shelf type. The UBAT LEDs are not included in the lamp test.
	green	EOW connector with LED (4-pin RJ45 connector)

Tab. 6.1 NEAP elements

6.2.3 Connector Panel (COPA)

The external management and power supply connectors of each subrack are centralized on its COPA, located at the bottom of the subrack (see Fig. 6.2 to Fig. 6.4). The COPA also contains the EMI filter elements.

There are two different COPA variants, depending on the NE type, as shown in Fig. 6.6 and Fig. 6.7.

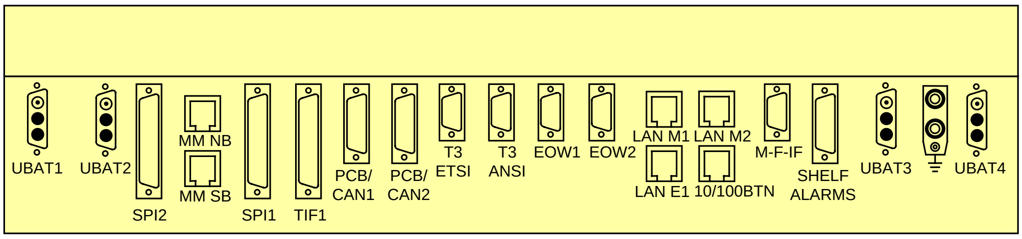


Fig. 6.6 Connector panel in OCU network element

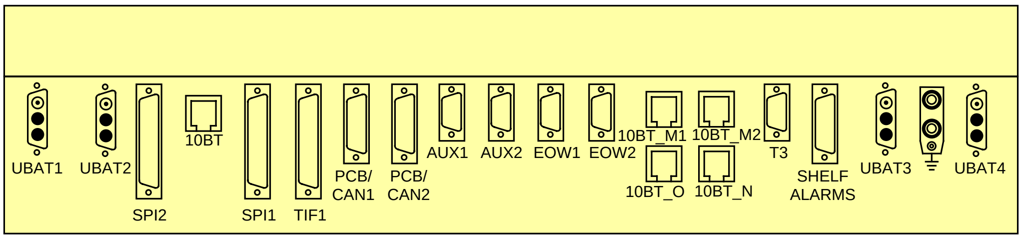


Fig. 6.7 Connector panel in DWDM network element

The COPA connectors are listed in Tab. 6.2.

Connector markings		Connector type	Explanation
COPA (OCU)	**COPA (DWDM)**		
UBAT1 to UBAT 4	UBAT1 to UBAT 4	4 x 3W3 D-Sub power connector	Power supply
SPI1	SPI1	D-Sub 15 pin (male)	SPI bus connection (from/to lower row and external DCM in double-row subrack)
SPI2	SPI2	D-Sub 15 pin (male)	SPI bus connection (used only in double-row subrack: from/to upper row and second external DCM)
MM NB	–	RJ45 8 pin	GNE Ethernet connection (north-bound) to customer DCN
MM SB	–	RJ45 8 pin	GNE Ethernet connection (south-bound) to Ethernet switch
–	10BT	RJ45 8 pin	Ethernet connection
TIF1	TIF1	D-Sub 25 pin (male)	TIF connections from/to OSCTUI/OSCTUT card and MCU card
PCB/CAN1, PCB/CAN2	PCB/CAN1, PCB/CAN2	D-Sub 15 pin (male)	Connections to the PCB and CAN busses

Tab. 6.2 COPA connectors

Connector markings		Connector type	Explanation
COPA (OCU)	COPA (DWDM)		
AUX1, AUX2	AUX1, AUX2	D-Sub 9 pin (male)	AUX connections (each with two V.11 interfaces) from/to OSCTUI/OSCTUT card
EOW1, EOW2	EOW1, EOW2	D-Sub 9 pin (male)	EOW connections from/to OSCTUI/OSCTUT card
LAN M1, LAN M2	–	RJ45 8 pin	Q3 Ethernet connection from/to MCU card
LAN E1	–	RJ45 8 pin	Unused
10/100BTN	–	RJ45 8 pin	Connected to the 10/100BT connector on the NEAP (see Tab. 6.1)
–	10BT_M1	RJ45 8 pin	Q3 Ethernet connection from/to MCU card
–	10BT_M2	RJ45 8 pin	EXT Ethernet connection from/to MCU card
–	10BT_O	RJ45 8 pin	Unused
–	10BT_N	RJ45 8 pin	Connected to the 10/100BT connector on the NEAP (see Tab. 6.1)
M-F-IF	–	D-Sub 9 pin (male)	F interface for serial connection to a craft terminal
–	T3	D-Sub 9 pin (male)	Supply voltages for the T3 termination network
SHELF ALARMS	SHELF ALARMS	D-Sub 15 pin (male)	Shelf alarm connections
⏚	⏚	Grounding socket	Ground

Tab. 6.2 COPA connectors (Cont.)

6.2.4 Forced ventilation

6.2.4.1 Fan units

Each subrack has two independent, temperature controlled fan units for forced cooling. These slide-in units are mounted above and below the cards as shown in Fig. 6.2 to Fig. 6.4. Both fan units are identical, but the lower fan unit is fitted with an air filter.

Each fan unit is equipped with 3 fans.

A red LED on the fan unit indicates the operating status (alarm) of the fans: LED off means OK, no alarm.

6.2.4.2 Airflow guides

Airflow guides are used in the transponder NEs to maintain a uniform airflow impedance – needed only if a compartment (consisting of 4 slots) is partially equipped with OCR10 or TEX cards.

The airflow guide is an upright metal plate (with its own gasketed blank faceplate) that is inserted into the card guide rails of the subrack, similar to a plug-in card.

For details on using the airflow guides, see the Installation and Test Manual (ITMN) of SURPASS hiT 7500-B.

6.2.5 Blank panels and faceplates

Any card slot that remains empty (i.e., does not contain a card or an airflow guide) generally must be equipped with a blank panel for electromagnetic shielding.

In in a subrack of an OCU network element with at least 1 card per compartment, this compartment must be completely filled with blank panels. In addition, after installing the MCU card, a particular faceplate must be mounted covering also the MIBS and the remaining slot area. Else, the use of blank panels is optional, but recommended for better protection against accidental damage to components inside the subrack.

6.3 Cards

6.3.1 Basic card design

Fig. 6.8 and Fig. 6.9 show the basic design of single-height and double-height cards.

Each card consists of a multi-layer PCB with a surrounding ESD grounding frame and a face plate. The components are fitted on both sides of the PCB.

The card front elements are described in Chapter 6.3.2.

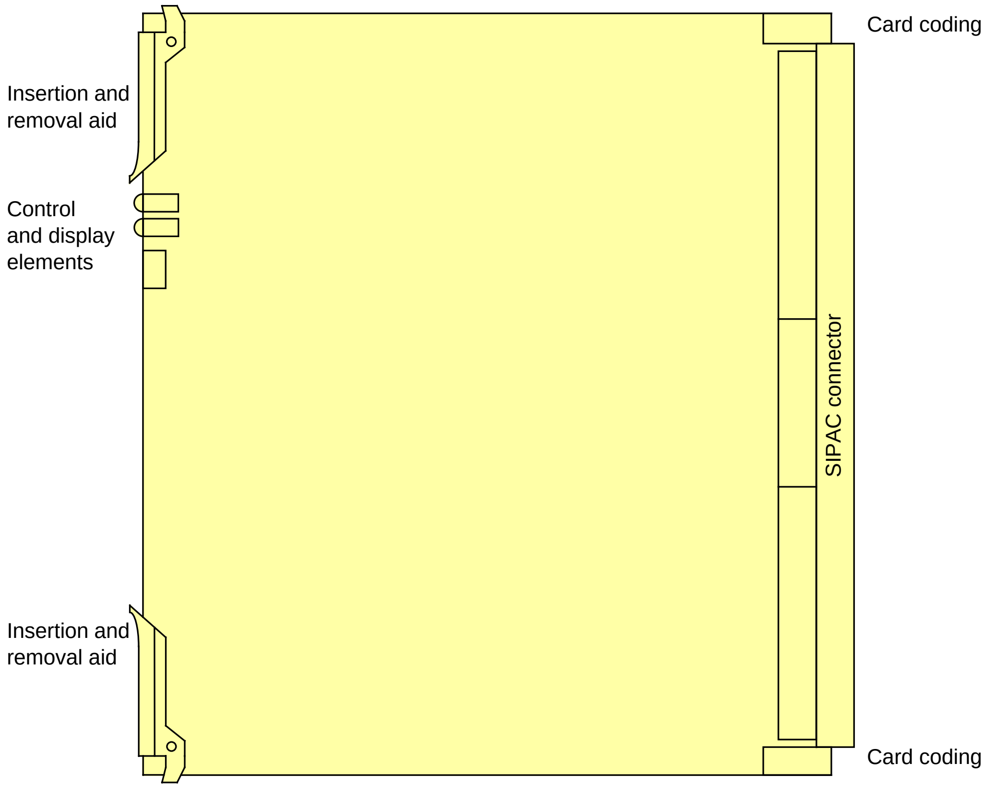


Fig. 6.8 Single-height card design

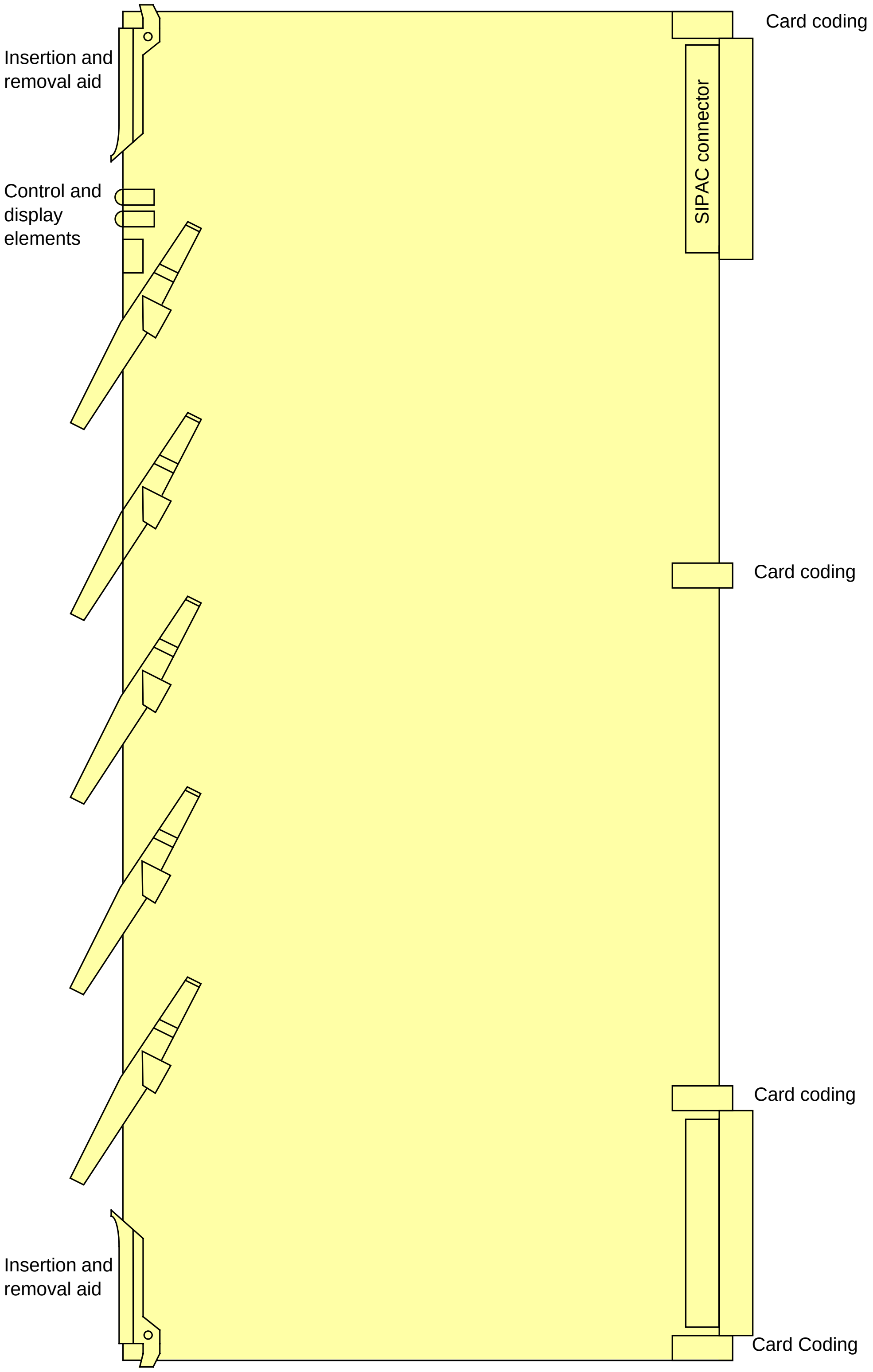


Fig. 6.9 Double-height card design with fiber connectors

6.3.1.1 SIPAC connectors

The SIPAC connectors at the rear of the card (see Fig. 6.8 and Fig. 6.9), as well as the corresponding SIPAC connectors on the subrack backplane, are fitted with mechanical card coding elements. Each card can only be fully inserted into a subrack slot that is suitable for this card, so that fundamental subrack equipping errors (which possibly might cause damages or extensive malfunctions) are impossible.

These mechanical coding elements also ensure the proper centering and grounding of the card in the subrack.

i Note that installing cards requires slow and careful handling.
Never apply excessive force!

➔ For detailed card handling instructions, see the Installation and Test Manual (ITMN) of SURPASS hiT 7500-B.

The grounding pins of the SIPAC connectors are pre-mating, so that they first of all establish the ground connection, when the card is being inserted into the subrack.

6.3.1.2 Insertion and removal aids

All cards have insertion and removal aids (as shown in Fig. 6.8 and Fig. 6.9) that fit into the holes of the card guides in the subrack. No special tools are necessary for inserting or extracting the cards.

i However, note that the insertion and removal aids must be handled carefully.
Never apply excessive force!

➔ The correct handling of the insertion and removal aids is described in the Installation and Test Manual (ITMN) of SURPASS hiT 7500-B.

The visible surfaces of the insertion and removal aids are used for card identifying labels.

6.3.2 Card front elements

6.3.2.1 Fiber connectors

The front panel of an optical card is either fitted with optical fiber connectors or with SFP modules (described in Chapter 6.3.3).

➔ The available fiber connector variants, depending on the card types, are listed in Chapter 10.3.

6.3.2.2 LEDs

All active cards (i.e., cards that contain a local card controller) are fitted with the two standard LEDs listed in Tab. 6.3. They are visible when the subrack front door is open.

Element	Color	Explanation
OK LED	green	– Activated if the card is ready for data transmission or actually transmitting data. – If deactivated, the card may be removed from the subrack. – Also activated if the lamp test button on the NEAP is pushed (see Tab. 6.1). For startup and fault indications, see Tab. 6.4.
Fault LED	red	– Activated if the card detected a hardware or software failure condition that requires attention by service staff as soon as possible. – Deactivated automatically as soon as all failures with this card have been cleared. – Also activated if the lamp test button on the NEAP is pushed (see Tab. 6.1). For startup and fault indications, see Tab. 6.4.

Tab. 6.3 Standard front LEDs

The Fault LED is fed from an off-card supply voltage (ULED) to ensure that the LED can be activated even if the power supply unit of the card fails.

Tab. 6.4 lists the possible OK and Fault LED indications during startup or fault conditions.

Operating or failure condition	OK LED	Fault LED
Software startup (peripheral card controller), boot process (SC)	off	on
Application software startup	on	on
Built in self test: software OK	flashing	off
Application software not OK	off	on
Operational state = enabled, application software OK	on	off
Operational state = disabled, application software OK	off (switched off by SC software)	off
Card/equipment fault	off or undefined (switched off by SC software if possible)	on or undefined (switched on by card software if possible)

Tab. 6.4 Startup and fault indications by the card front LEDs

Operating or failure condition	OK LED	Fault LED
Operational state = enabled, application software OK, and LOS detected by the card	on	flashing
MCU only: MIBS failure	undefined	flashing

Tab. 6.4 Startup and fault indications by the card front LEDs (Cont.)

The OF10 card is fitted with two green LEDs listed in Tab. 6.5. They are visible when the subrack front door is open.

LED Demux (green)	LED Mux (green)	Explanation
Off	Off	Power supply unit (PSU) is defect
On	Off	OF10 card is equipped in a slot for demux application (slot 1, 5, 9 or 13) and PSU is working.
Off	On	OF10 card is equipped in each other slot and PSU is working.
On	On	OF10 card is equipped in any slot and lamp test signal is active. It operates even without PSU by using the ULED voltage.

Tab. 6.5 Standard front LEDs

6.3.2.3 Debug port

All active cards (i.e., cards that contain a local card controller) are fitted with a debug port at the card front. This interface is intended for use by authorized personnel only. The debug port is not accessible when the subrack front door is closed.

6.3.3 SFP modules

The optical 2.5 Gbit/s client interfaces of the TEX V5, TEX LH2 and TEX Regio2 cards (i.e., the latest design in each case) are equipped with hot-pluggable SFP modules that are mounted on the front panel of the card. The SFP modules perform the optical / electrical conversion in both signal directions (SFP transceiver), with integrated clock and data recovery (CDR) and serializer / deserializer (SerDes) functionalities.

Fig. 6.10 shows an example of an SFP module.

The functions of the TEX cards are described in Chapter 5.3.21.

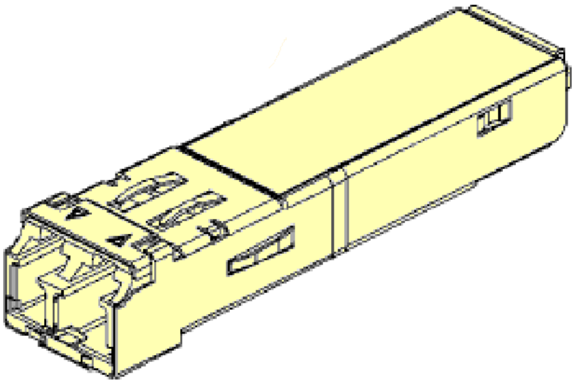


Fig. 6.10 SFP module (example)

Two SFP types are available:
– 2 km interface (I-16)
– 15 km interface (S-16.1)
– 40 km interface (L-16.1)
– 80 km interface (L-16.2)

Compared to direct optical interfaces at the card front, SFP modules provide the following benefits:
– SFP modules can be exchanged quickly to react to varying customer demands
– Spare costs can be reduced (e.g., only one TEX V5 card with different SFP modules instead of different TEX cards)

A maximum of four SFP modules of the same type can used per card; underequipping and mixed equipping is allowed. The card software can derive presence and type information from each SFP module.

If a SFP is mounted on the card and another type is configured, it will raise a SFP Mismatch and a LOS alarm. If one SFP is not mounted, it will raise a SFP Missing and a LOS alarm.

7 Commissioning, startup and maintenance

This chapter gives some basic information about commissioning, startup and maintenance of SURPASS hiT 7500-B.

7.1 Commissioning

SURPASS hiT 7500-B has to be configured on initial commissioning, prior to the regular operation. There are different commissioning manuals depending on the used network elements and management system.

➔ The order numbers of the commissioning manuals are listed in the SURPASS hiT 7500-B Documentation Guide.

7.2 Startup

7.2.1 Cold start

A cold start can be initiated by applying power to the rack or subrack, by inserting a card into a subrack, by a hardware reset or by software.

The cold start includes the following automatic actions:

- Basic checks and initializations
- Card configurations
- Software startup to normal operation

7.2.2 Warm start

A warm start (reboot) can be initiated by a Software Reset or a Swap command.

The warm start includes the following automatic actions:

- Basic checks and initializations
- All software attributes which correspond to hardware configurations are recovered from the transmission hardware or from a protected RAM area (depending on the particular card type)
- Hardware configurations remain unchanged
- All software attributes which do not affect hardware configurations are set to default (e.g., fault management and performance management settings)
- Software startup to normal operation

7.3 Maintenance

The alarm and maintenance concept of SURPASS hiT 7500-B provides sufficient alarm information to localize and clear a fault at card (module) level.

➔ For an overview of the alarm features, see Chapter 3.5.1.

Maintenance measures (e.g., fault localizing) can be carried out locally or by remote control – starting from LED indications (see Chapters 6.2.2 and 6.3.2) or from an error message at the GUI (see Chapter 8).

➡ For details see the Troubleshooting Manual (TSMN). The order number of the TSMN is listed in the SURPASS hiT 7500-B Documentation Guide.

8 Network management

This chapter provides an overview of the telecommunication network management systems that can be used in combination with the SURPASS hiT 7500-B software, including the access and security management functions.

The Siemens network management systems for optical networks (as described in Chapters 8.3 to 8.5) are designed for the needs of regional transport networks as well as for long distances within national and international networks.

The network management systems provide all the major network management functions defined in the ITU-T standard M.3010 “Principles for a Telecommunication Management Network”.

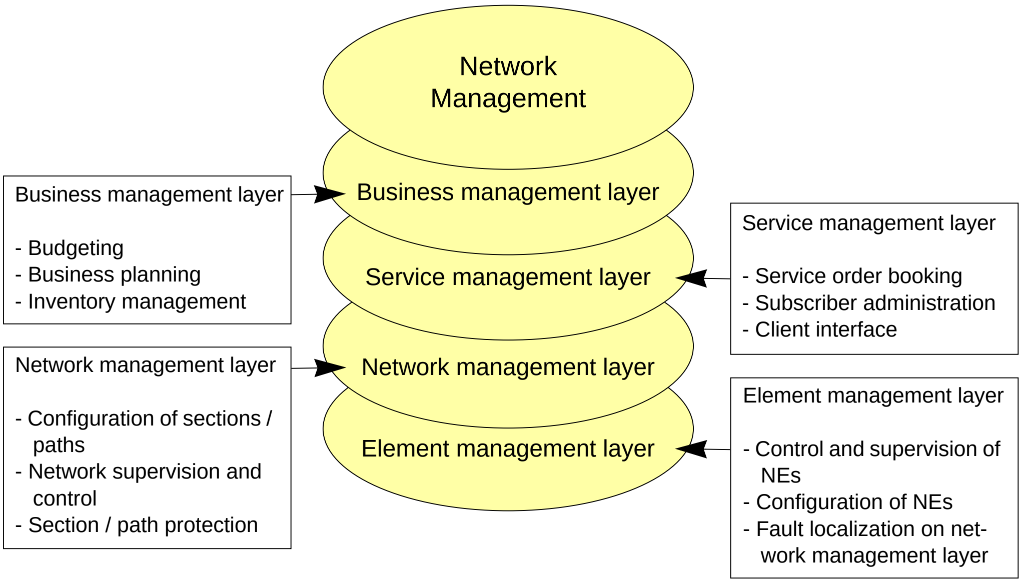


Fig. 8.1 Network management functions according to ITU-T

Based on that standard, the five functional areas fault, configuration, accounting, performance and security management can be distributed to the four layers as shown in Fig. 8.1.

The lowest layer of the network management functions is the **element management layer**. Its functionality and its user interface allow all system components and function units of a network element to be monitored and handled, e.g., line cards with user ports, cross connect units, multiplex modules, etc.

The **network management layer** includes all the functions required to manage the optical network in an effective and user-friendly way, such as the visualization of the network topology, creation of services, correlation of alarms to network resources.

Fault, configuration and performance management are supported on the element management layer, with configuration and fault management also being provided on the network management layer. Additional configuration, fault and performance management features are available on the service management layer. Security management functions can be used to restrict access either to the user interfaces of the network management system or to individual network elements.

8.1 Access and security management

8.1.1 NE access management

Several management systems (see Chapters 8.3 to 8.5) are allowed to establish connections to the NE at the same time. Operations (non-modifying as well as modifying) can be requested by management systems in parallel without the need to explicitly request write access before, i.e., all requests are serialized in the NE on a first-come-first-serve basis.

To ensure data consistency between all NEs and all connected managing systems, the NE sends notifications to all connected management systems as a result of any modifying operation, which has been performed in the NE successfully.

8.1.2 User security management and access control

Several physical interfaces (see Fig. 8.2) can be used to access the monitoring and configuring functions of SURPASS hiT 7500-B. For access control via Q3 interface, a password based client authentication with different user classes is implemented.

The Q3 interface apply enhanced security rules, such as:

- Force the user to change password at first login
- Strictly check every new user password for syntax complexity (e.g., minimum length, different character types, no trivial sequences)
- Inactivity timeout (logout the user automatically after a configurable period of inactivity)
- Disable user account on configurable period of non-use
- Disable user account after a defined number of consecutive unsuccessful login attempts
- Provide password aging per user account with configurable aging interval
- Avoid password toggling (do not allow to re-use recently used passwords)

Security and configuration data are stored in persistent logs.

8.2 Network management interfaces and architecture

8.2.1 Network management interfaces

Fig. 8.2 provides an overview of the network management systems and interfaces that can be used to manage the SURPASS hiT 7500-B software via the Q and F communication interfaces.

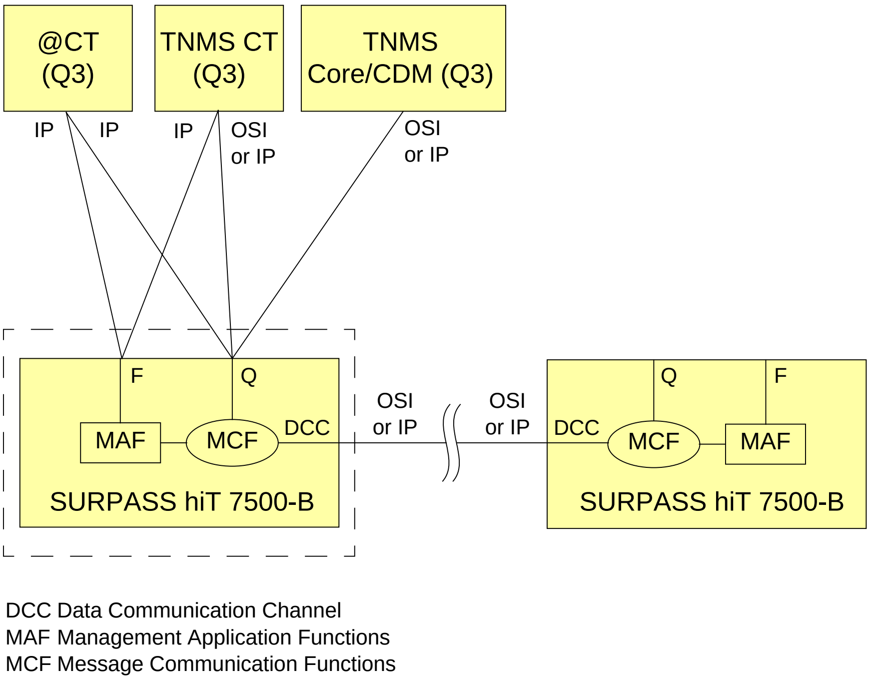


Fig. 8.2 Network management interfaces

8.2.1.1 Q3 interface

The Q3 interface allows the SURPASS hiT 7500-B system to be connected to an OSI Q3-CMISE compliant TMN. SURPASS hiT 7500-B supports the Message Control Function. This allows remote access for the network management systems to network elements via Q3. The Q3 interface is a half-duplex 10 Mbit/s Ethernet protocol.

Communication is carried out via the implemented communication stacks.

8.2.1.2 F interface

The F interface allows direct connection of a craft terminal (in LCT mode) for the control of only the local network element. The F interface supports the same CMISE protocol as that for the Q3 interface.

The data communication channels (DCC) are HDLC type serial channels embedded in the fiber optical signal(s) used for TMN purposes.

8.2.2 Network management architecture

The following three examples of network management architecture were chosen to visualize the possibilities of managing SURPASS hiT 7500-B networks.

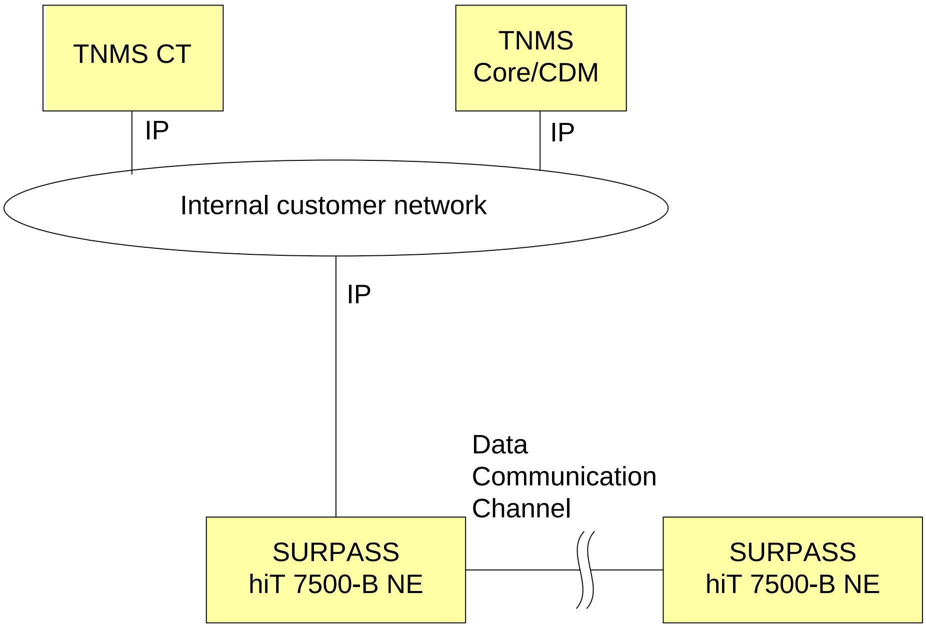


Fig. 8.3 Network management architecture with Q3 Gateway NE

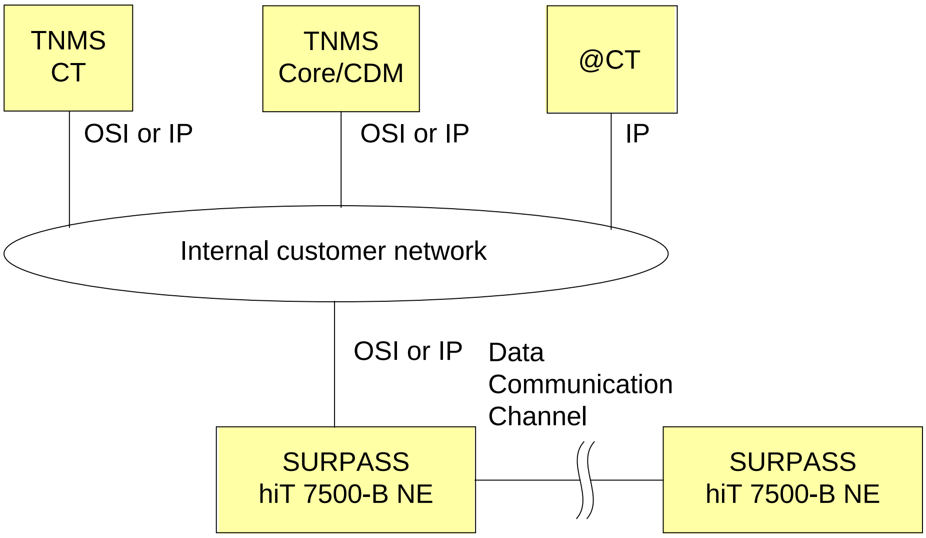


Fig. 8.4 Network management architecture without Gateway NE

8.3 TNMS CT

➔ Please refer to the User Manual TNMS CT for detailed information on TNMS CT.

For the order number of the User Manual TNMS CT, see the SURPASS hiT 7500-B Documentation Guide.

TNMS CT is a transparent software platform for SDH and WDM network elements using QD2, QST, QST V2, Q3 or SNMP telegram protocols. It provides access to network elements via a network interface (Ethernet) or via a line interface (RS232).

There are two operation modes for TNMS CT:

– Local Craft Terminal (LCT) mode, which is used for local management and for the commissioning of network elements, and the
– Network Craft Terminal (NCT) mode, which is used for either local or remote network management.

TNMS CT supports line, star, ring and mesh networks comprising WDM, SDH and network elements.

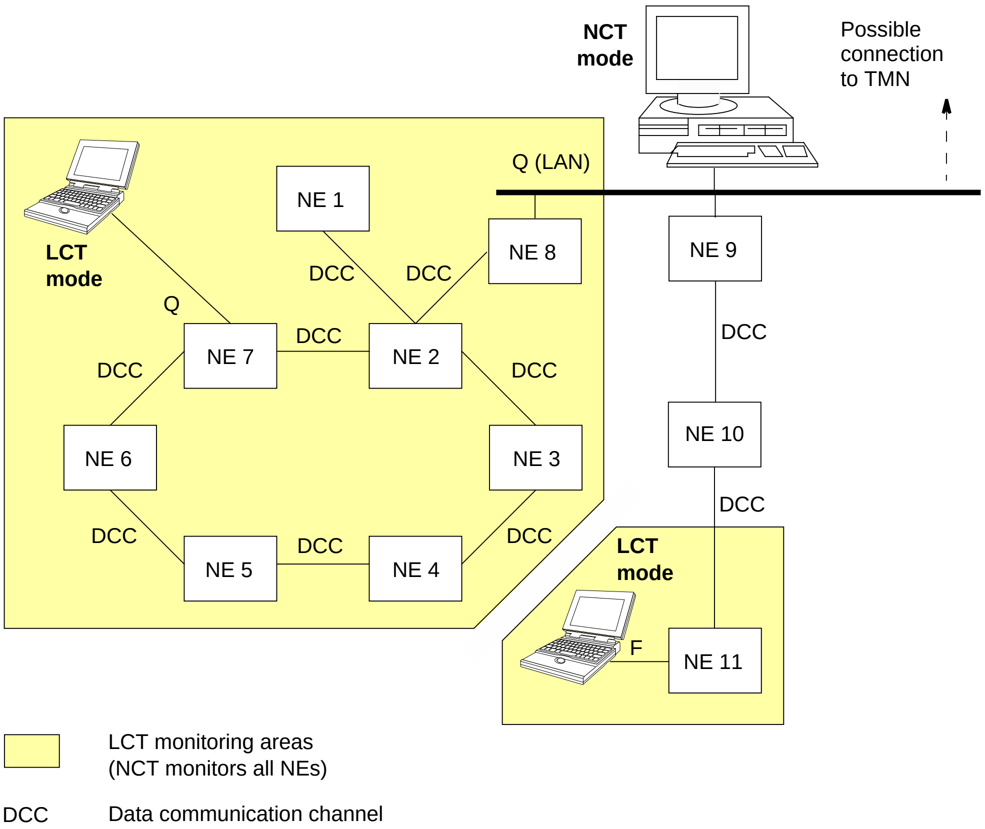


Fig. 8.5 Application example for craft terminals (in LCT and NCT modes) in a transmission network

Element management functions are executed via the Element Managers (LCTs, MSN managers) provided by the TMNS CT system. TNMS CT allows 50 Element Managers to be opened at the same time. The TNMS CT terminal in NCT mode can communicate with a maximum of 150 network elements.

TNMS CT is a scalable single-user system with a client/server architecture comprising several industry standard PCs with the Windows 2000 operating system and various software applications. The client and server software can be installed either on different PCs or on one single PC.

The TMNS CT menu items and dialogs allow the supported communication channels to be set up. The network element to be operated is selected by a simple procedure adapted to the requirements of the connected communication channel.

TNMS CT enables addresses to be assigned to the network elements. The program icons for these applications are used to present the assigned network elements in the network view for the communication channel. Double-clicking such an icon starts the assigned device application, i.e., an Element Manager, and thus permits network element operation.

Please see Chapter 8.6 for the SURPASS hiT 7500-B Element Manager.

8.4 @CT

Please refer to the User Manual @CT for detailed information on @CT.

@CT provides web access to SURPASS hiT 7500-B network elements in the customer network without the use of a management system. @CT is a Java applet pre-installed on the Main Control Unit (MCU) of a network element. MCUs are responsible for supporting the gathering and reporting of traditional local telemetry. @CT contains the Element Manager of the network element. When a TCP/IP connection is set up to the NE, the applet is downloaded by a web browser, and the Element Manager is opened.

@CT may be accessed locally via the southbound interface of the NE.

Please see Chapter 8.6 for the SURPASS hiT 7500-B Element Manager.

8.5 TNMS Core/CDM

Please refer to the User Manual TNMS Core/CDM for detailed information on TNMS Core/CDM.

The telecommunication network management system TNMS Core/CDM is an integrated solution designed for large, medium and small networks. It supports networks elements with WDM, OTH SDH, PDH, Ethernet and data interfaces and can be used to manage networks at the access, edge, metro, core and backbone levels.

TNMS Core/CDM supports line, star, ring and mesh networks.

The network elements of a transmission network provide various management interfaces so that they can be connected to the management system via the DCN in several ways.

Element management functions are executed via the Element Managers (craft terminals in LCT mode, TNMS SX, MSN Manager, EM OS, NetViewer NME) provided by the TNMS Core/CDM system. For network elements managed via EM OS, network management is restricted to fault management (alarm mapping). These network elements are displayed as universal objects in the TNMS Core/CDM network plan.

TNMS Core/CDM is a scalable, multi-user system with a client/server architecture comprising several industry standard PCs with the Windows 2000 operating system and various software applications. The TNMS Core/CDM software comprises the Client, SysAdmin, Server and NetServer applications. Client and SysAdmin are installed on a client PC. Up to 40 Client and 10 SysAdmin installations can be managed simultaneously, facilitating distributed network operation.

Fig. 8.6 shows the system architecture of TNMS Core/CDM:

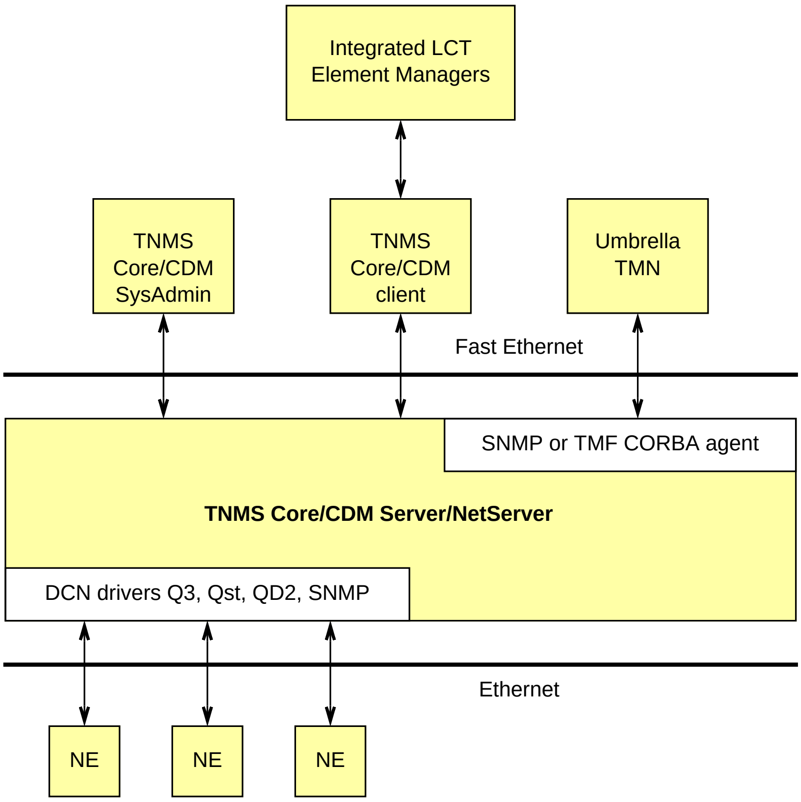


Fig. 8.6 System architecture of TNMS Core/CDM

The administrator of the management system can access the system via the SysAdmin client, while the operator can use the TNMS Core/CDM client interface. The integrated Element Managers (LCTs) are also available from here. Different communication drivers (Q3, QST, SNMP or QD2) are provided for the communication to the gateway NEs.

Please see Chapter 8.6 for the SURPASS hiT 7500-B Element Manager.

TNMS Core/CDM consists of the following software components:

- **TNMS Core/CDM client components**
  These components provide a graphical user interface that is used to monitor and manage suscribers, services, the network, and the DCN components.
  Depending on the user class, access to certain functions may be restricted.
  In addition, the TNMS Core/CDM Client components provide access to the local Element Managers of all network elements managed by TNMS Core/CDM. The local Element Manager of an NE is started by simply double-clicking an NE icon in the TNMS Core/CDM network map.
- **TNMS Core/CDM SysAdmin components**
  These components provide a graphical user interface for administrators to manage the TNMS Core/CDM NetServers, the TNMS Core/CDM server, the user accounts and a few settings that need to be uniform on a system-wide basis.
  New network elements can be added to TNMS Core/CDM only by SysAdmin users.
  In addition, the external interfaces are managed via TNMS Core/CDM SysAdmin.

- **TNMS Core/CDM Server components**
  In each TNMS Core/CDM system there is always one single active TNMS server. The TNMS server is the central component of TNMS Core/CDM. Its main functions are
  – Providing and performing the TMN functions (FCAPs: fault, configuration, accounting, performance, security)
  – Maintaining the databases needed for network management, log management, and configuration management
  – Supporting the existing interfaces
- **TNMS Core/CDM NetServer components**
  The TNMS Core/CDM NetServer components work as a mediation device between TNMS Core/CDM and the data communication network. Their main task is to process the huge amount of DCN data in order to reduce the data flow passed on to the TNMS Core/CDM server.
  The TNMS NetServer components consist of the
  – NE controllers
  – TNMS Core/CDM NetServer data cache

8.6 SURPASS hiT 7500-B Element Manager

➔ The PC requirements for running the Element Manager are listed in Chapter 10.9.

The SURPASS hiT 7500-B Element Manager enables the user to perform a wide variety of operation, administration, maintenance, and provisioning tasks for the SURPASS hiT 7500-B system.

These include:

- Fault management
- Configuration management
- Performance management
- Security management
- Optical link commissioning procedures
- Equipment management
- Software management

These SURPASS hiT 7500-B Element Manager functions are provided by TNMS CT and TNMS Core/CDM systems (see Chapters 8.3 and 8.5) and can be accessed from @CT (see Chapter 8.4).

SURPASS hiT 7500-B menu overview

The Element Manager **main window** acts as the root screen from which all other windows are accessible.

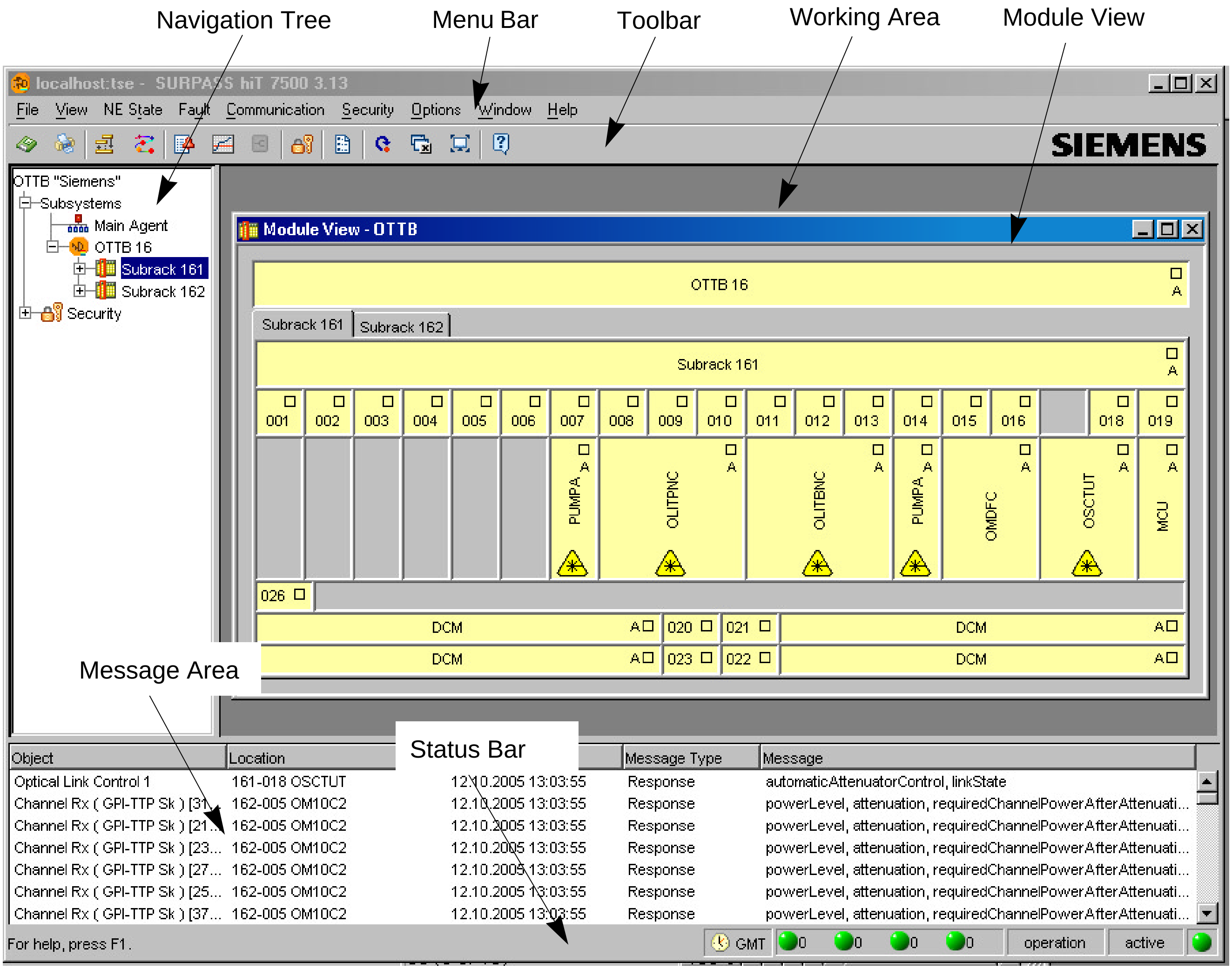


Fig. 8.7 SURPASS hiT 7500-B Element Manager main window (example)

The **main window's Menu Bar** provides pull-down menus for access to listings (e.g., alarms) and windows for administrative tasks that reflect the network element as a whole. The **Toolbar** allows quick access to frequently used functions. The **Status Bar** provides information on alarm status and parameters. The **Message Area** shows all incoming messages from the network element which are related to configuration and parameter changes. Moreover, the main window provides access to the Navigation Tree and the Module View.

The structure of the network element's equipment is reflected in the **Navigation Tree**.

The **Module View** shows graphical subrack symbol(s), complete with cards in their slots. By navigating in the Module View, it is possible to access detailed information about individual entities in the network element (cards, slots, databases, etc.).

The **Functional View of a network element** offers an easy-to-understand overview of the network element's general optical path structure and of the cards involved. Additionally, the Functional View displays information about these cards.
The Functional Views for each type of network element are similar to one another, except, of course, for the number and type of cards depicted.

The top portion of the Functional View always shows the Network Element Bar symbol. By right-clicking the Network Element Bar, a number of fault, configuration, and log screens can be accessed. Some of the sub-windows accessible from the Functional View's Network Element Bar are common to all types of network elements, others appear only for particular types of network elements.

Right-clicking a pane will pop up all the menu items obtainable for this pane (fault, configuration, etc.).

➡ For details, see the Q3 Operating Manual (Q3 OMN) of the SURPASS hiT 7500-B.

9 TransNet network planning tool

This chapter describes the application and the GUI of the TransNet software tool.

The order number of the network planning tool manual is listed in the SURPASS hiT 7500-B Documentation Guide.

For detailed information on TransNet, please refer to the TransNet User Manual.

TransNet is a sophisticated software simulation tool developed specifically for designing optical DWDM networks with SURPASS hiT 7500-B. It runs on PCs using the Windows 2000 or Windows XP operating systems.

The TransNet GUI makes it possible to “draw” network structures on a geographical map. It provides easy-to-understand user guidance features that take users through the steps of designing a network and assigning equipment to the DWDM routes. It also provides guidance on how to plan connections, protection groups and aggregations. TransNet performs all the calculations necessary in the process. It offers price-optimized routes for selection. It allows existing (Siemens and non-Siemens) optical networks to be extended and changed. In addition, TransNet supports the generation of network related reports and of DWDM route-specific reports.

The TransNet main window is divided into five panes (see Fig. 9.1):

- **Tree view**
  In the tree view, the user can see a list of all the sites, links, DWDM links, and protection groups organized in a tree structure. The actions that can be performed on the tree elements are offered for selection in a menu.
- **Network view**
  The network view can be used as a drawing pane for creating the network structure. It displays a background map, sites and links. For each layer (part of network planning, see Chapter 9.1) a special diagram is used. Each layer diagram features a layer-specific tool bar.
- **Data view**
  For each link or site selected in the network view the data view window displays information about the demand and about the routes contained in the selected link or which originate/terminate/pass through the selected site.
- **Detailed data view**
  The detailed data view shows the details of a site or a link selected in the network view or of a route selected in the data pane, e.g., details about ducts, fibers, etc.
- **Physical DWDM route planning view**
  This view shows the physical DWDM route planning. It is visible only during the physical DWDM route planning process.

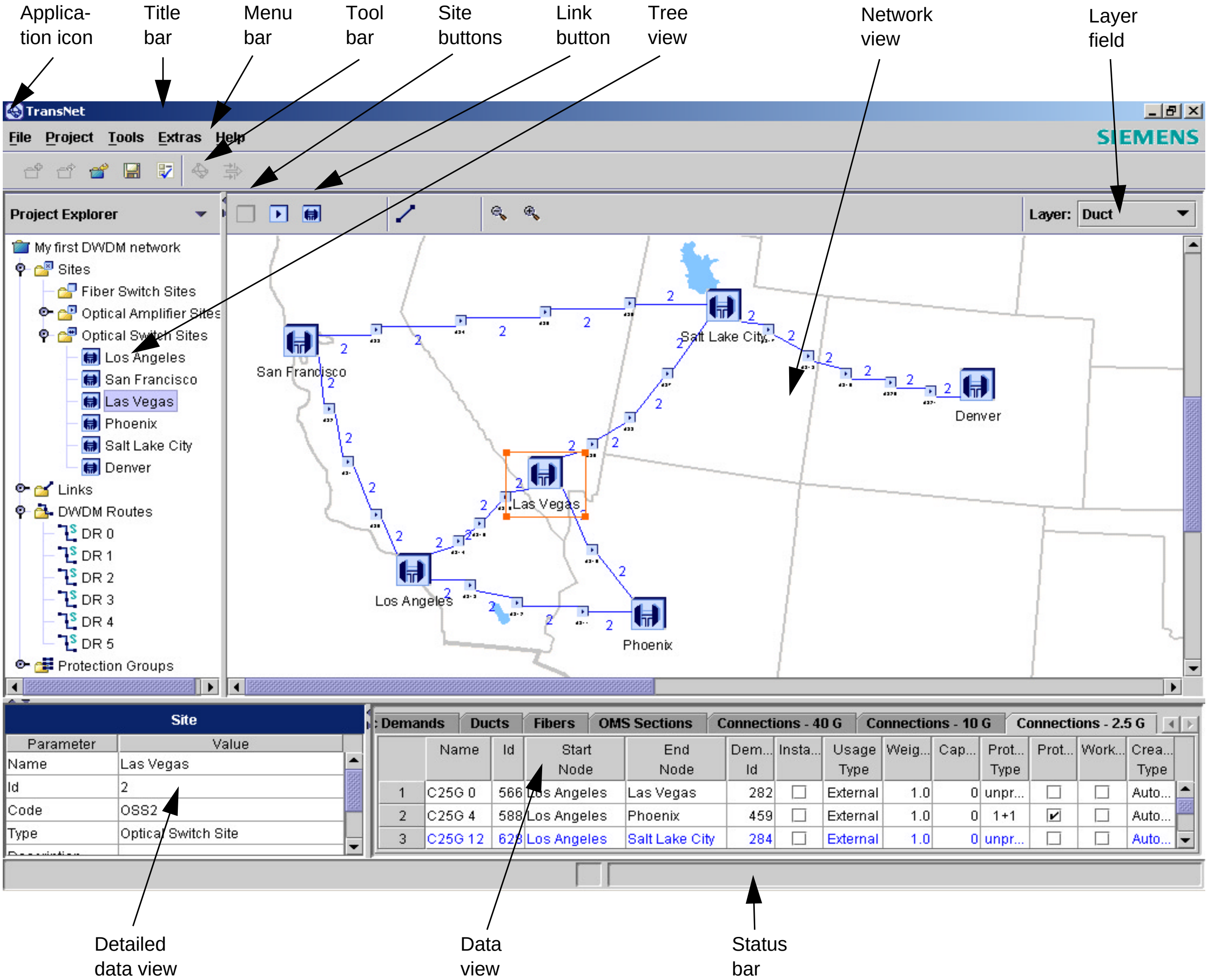


Fig. 9.1 TransNet GUI main panes and icons

9.1 Designing and creating a SURPASS hiT 7500-B network structure

The physical topology of the network created in TransNet consists of the following elements (as shown in Fig. 9.1):

- Sites (fiber switch sites [FSS], optical amplifier sites [OAS], optical switch sites [OSS])
- Ducts
- Fibers
- Optical multiplex sections (OMS)
- DWDM routes
- Connections (2.5 Gbit/s, 10 Gbit/s, 40 Gbit/s)
- Protection groups

Network planning takes place on different layers:
- Duct layer - creating sites and ducts between sites
- Fiber layer - placing fibers into ducts
- OMS layer - creating OMS sections from fibers
- Connection layer - creating connections

Designing a network includes creating protected connections, protection groups, routing and traffic aggregation.

There are two operation modes:
- Automatic mode (fast, some restrictions)
- Manual mode (slower, no restrictions)

Having finished network planning, the user can
- Change the network structure (re-plan the network)
- Change physical parameters and perform the DWDM route planning again
- Extend the current network, add more sites, DWDM routes and traffic demands
- Create protected connections
- Create protection groups
- Create aggregations

9.2 Assigning equipment and planning DWDM routes for SURPASS hiT 7500-B networks

In the course of the physical DWDM route planning process, equipment is assigned to the selected DWDM route. The process consists of the following steps:

- Entering DWDM **project information data** (e.g., project title and user name, descriptions)
- Entering default **analysis parameters** and global parameters:
  - Default parameters, such as:
    splice loss, reel length, connector loss, connectors per span, use maintenance, use margin per Kilometer, maintenance margin, margin per Kilometer, construction margin
  - Global parameters, such as:
    preemphasis type, cost optimization via statistical design, version, enable compact OLI
- **Entering data** for the main DWDM routes and for the back DWDM routes:
  The user has to provide information on the physical characteristics of the fibers, such as distance, fiber type, fiber loss, dispersion, PMD etc.
- Configuring the end-of-life channels via the **EOL channel manager**:
  The user can change the EOL channel count and view the channel assignment
- Specifying **site types and restrictions**:
  The user can assign specific equipment type and specify site restrictions and additional site-specific parameters. Fig. 9.2 shows the route graphic display depicting concrete sites of the DWDM route.

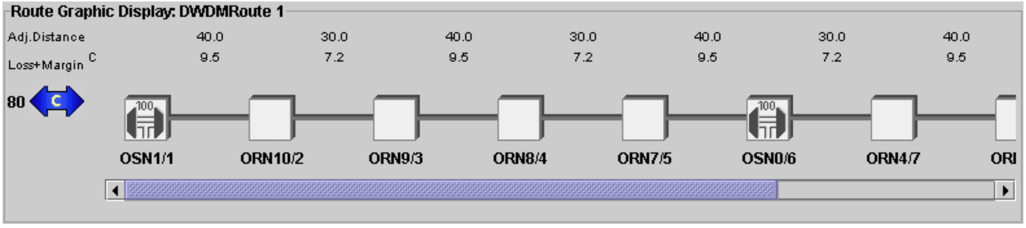


Fig. 9.2 Route graphic display

- Performing the **analysis** and selecting the solution:
  Several analysis parameters can be adjusted, e.g., bit error rate, maximum number of spans without 3R, span loss padding, concatenation limit, terminal equipment, minimize pump equipment, place basic OLI, Raman pump, price calculation. TransNet analyzes whether the just created DWDM route is physically viable and compatible with the chosen parameters. After the analysis, solutions are presented. If more than one solution is offered, the user can select the preferred one.

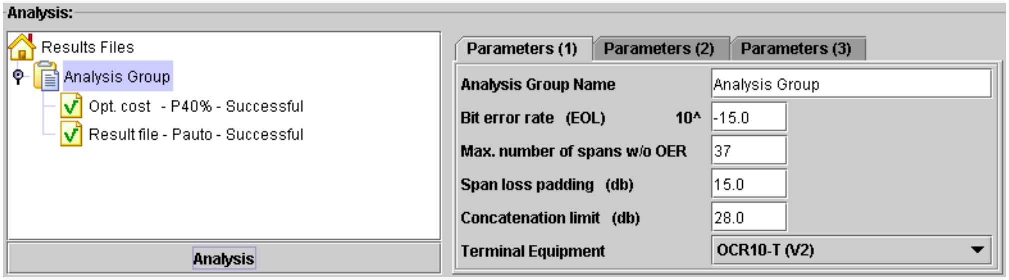


Fig. 9.3 Analysis solutions

10 Technical data

This chapter lists technical data of SURPASS hiT 7500-B equipment.

10.1 Physical layers

Maximum number of channels	40
Bit rate / line coding of optical tributary signals	10 Gbit/s (NRZ)
Maximum bit error ratio	user configurable 10^{-12} to 10^{-16} ; typ. 10^{-13}
Supported fiber types	SSMF, DSF, NZDSF± according to ITU-T G.652, G.653 and G.655 DMC (Dispersion Managed Cable) TrueWave Classic
Wavelength Grid	compliant to ITU-T G.692

Tab. 10.1 Physical layers, general information

Point MPI-SM	A multichannel reference point on the optical fiber just after the optical output connector of the NE transport interface.
Maximum mean channel output power	11.0 dBm (depending on channel count)
Minimum mean channel output power	–5.0 dBm (depending on channel count)
Maximum mean total output power of each wavelength C band	depends on the type of optical line amplifier used (see Chapter 10.3.2)
Central frequency	compliant to ITU-T G.692
Channel spacing	100 GHz
Maximum central frequency deviation	± 10 GHz for 100 GHz channel spacing
Minimum channel extinction ratio	10 dB

Tab. 10.2 Physical layers, interface at point MPI-SM

Point MPI-SM	A multichannel reference point on the optical fiber just after the optical output connector of the NE transport interface.
Point MPI-RM	A multichannel reference point on the optical fiber just after the optical input connector of the NE transport interface.
Maximum attenuation	40 dB using Raman pumps
Minimum attenuation	15 dB
Minimum optical return loss	for 1 span: –17 dB without Raman, –20 dB with Raman for 10 spans: –25 dB without Raman, –26 dB with Raman for 30 spans: –29.7 dB without Raman, –30.7 dB with Raman
Maximum discrete reflectance	for 1 span: –20 dB without Raman, –23 dB with Raman for 10 spans: –27 dB without Raman, –29 dB with Raman for 30 spans: –31.7 dB without Raman, –33.7 dB with Raman

Tab. 10.3 Physical Layers, optical path (single span) from point MPI-SM to point MPI-RM

Maximum differential group delay	40 ps for 1 dB OSAR penalty

Tab. 10.3 Physical Layers, optical path (single span) from point MPI-SM to point MPI-RM (Cont.)

Point MPI-RM	A multichannel reference point on the optical fiber just after the optical input connector of the NE transport interface.
Maximum mean channel input power	–15 ICBM (depending on channel count)
Minimum mean channel input power	–26 dBm (depending on channel count)
Maximum mean total input power	+2.0 dBm
Maximum channel power difference	12 dB
Maximum optical path penalty for n spans	1.8 dB + √n x 0.5 dB
Maximum receiver reflectance	–27 dB

Tab. 10.4 Physical Layers, interface at point MPI-RM

10.2 External interfaces

For card data, see Chapters 10.3 and 10.4.

Connector	LC/PC
Mean channel output power	–5 dBm to +11 dBm
Mean channel input power	–26 dBm to –15 dBm
OSC output power range	–2.0 dBm to –5.0 dBm
OSC input power range	–15 dBm to –50.0 dBm

Tab. 10.5 Optical line interface specifications

Connector	LC/PC
Input power	adjustable between: –8 dBm (± 4.5 dBm) to +2 dBm (± 4.5 dBm)
Wavelength stabilization for 10 Gbit/s	± 10 GHz for 100 GHz channel spacing
Required extinction ratio	10 dB
Required receiver dynamic range	–14 dBm to –2dBm

Tab. 10.6 Optical tributary interface specifications

Connector	D-SUB 9
Compliant to	G.703
Frequency	2048 kHz ± 4.6 ppm

Tab. 10.7 T3 clock interface specifications

Impedance	75 Ω coaxial pair 120 Ω symmetrical pair
Peak voltage	0.75 to 1.5 V at 75 Ω 1.0 to 1.9 V at 120 Ω

Tab. 10.7 T3 clock interface specifications (Cont.)

Data channel	similar to ITU-T V.11
Number of available bidirectional channels	2
Connector	2 D-SUB 9-pin connectors
Bit rate	64 kbit/s
Input impedance	150 Ω ± 10% balanced
Maximum load resístance	150 Ω balanced
Output voltage (line a to b)	2 to 5 V (at R_i = 150 Ω)
Input voltage (line a to b)	0.3 to 6 V
Used overhead bytes	Fo, NU1, NU2

Tab. 10.8 User data channel (sV.11) specifications

Realization	4-wire interface and handset
Transmission range	300 to 3400 Hz
Dialing: - method - transmit level - receive level	 DTMF –14 to–9 dBm0 –30 to 0 dBm0
Modulation method	PCM, A-law / µ-law
Bit rate	64 kbit/s
Input/output impedance - handset - 4-wire interface	 600 / 150 Ω balanced 600 / 600 Ω balanced
Input level (handset)	0 dBr
Output level (handset)	–14 dBr
Input level (4-wire interface)	–4/ –16 dBr (settable via SW)
Output level (4-wire interface)	–4/ +7 dBr (settable via SW)
Connector	Western plug (handset) and D-SUB 9 pin (4-wire interface)
Used overhead bytes	Eo, Fo

Tab. 10.9 Engineering order wire (EOW) specifications

Number of inputs (monitors) available per subrack	16

Tab. 10.10 Telemetry interface (TIF) specifications with OSCTUI/OSCTUT and SMU2 (DWDM Equipment)

Input voltage range (DC)	0 V to 75 V (TIF1_INxx →TIF1_COM_IN2/4) (SELV) / central office battery supply (TNV-2)
Input voltage range for inactive state	Open or 0V to 3 V
Input voltage range for active state	30 V to 75 V
Maximum input current	3 mA
Number of outputs	4
Output voltage range	0 V to ± 75 V (SELV) / central office battery supply (TNV-2)
Maximum output current	200 mA
Connector	D-SUB 25 pin

Tab. 10.10 Telemetry interface (TIF) specifications with OSCTUI/OSCTUT and SMU2 (DWDM Equipment) (Cont.)

Number of inputs (monitors) available per subrack	2
Input voltage range (DC)	0 V to –75 V
Input voltage range for inactive state	Open or –10 V to –75 V
Input voltage range for active state	Closed to GND or 0 V to –3 V
Maximum input current	5 mA
Number of outputs	2
Output voltage range	0 V to ± 75 V
Maximum output current	200 mA
Connector	D-SUB 25 pin

Tab. 10.11 Telemetry interface (TIF) specifications with MCU (transponder equipment)

10.3 Traffic cards

The following subchapters are grouped by the card functions.

For an alphabetical card list (including selective references to the below subchapters), see Tab. 5.1.

10.3.1 Optical supervisory channel cards (OSCTUI, OSCTUT)

Card dimensions	50 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	1.6 kg (both)
Power consumption	see Tab. 10.63
Front panel fiber connectors	2 LC/PC for OSCTUT cards 4 LC/PC for OSCTUI cards
Front panel LEDs	OK (green) and Fault (red)
External interfaces	2 V.11 for 64 kbit/s customer channels 2 4-wire voice (EOW) 16 housekeeping inputs and 4 outputs
EOW implementation	2 x 4-wire interfaces (#1 and #2, 64 kbit/s PCM with A law or µ law) with access via connector panel; 4-wire interface #1 can also be used for the DTMF handset; 4-wire interface #2 is used for an EOW connection to another NE at the same site.
Laser class	class 1M
OSC capacity	2 Mbit/s
OSC wavelength	1625 ± 8 nm
Tx output power range	0.0 dBm to –3.0 dBm (typical: –1.0 dBm)
Rx input power range	–15 dBm to –50 dBm
EOL span loss range	15.0 dB to 40.0 dB at 1550 nm (47 dB at 1625 nm)
Line coding	CMI

Tab. 10.12 OSCTUI and OSCTUT specifications

10.3.2 Optical line amplifier cards (OLIMTPNC, OLISTPNC, OLIVTPNC, OLIMTBNC, OLISTBNC, OLIVT-BNC, OLIMINC, OLISINC, OLIVINC)

Overall dimensions	75 mm wide x 265 mm high x 235 mm deep (2.95 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	4.0 kg (3.8 kg for basic card versions, see Tab. 5.1)
Electrical power consumption	see Tab. 10.63

Tab. 10.13 Common specifications for all optical line amplifier cards

Type of front panel fibre connectors	- pigtails with E2000/HRL for connection of pump cards; - LC/PC for optical signal monitoring, for line-in and line-out fiber connections and for the OSC
Front panel LEDs	OK (green) and Fault (red)
Maximum output power	17 to 24 dBm per C band (depends on OLI type)
Laser class	Class 1M with APSD
Automatic power shut-down (APSD) level	–21.7 to -28.0 dB (depends on OLI type)
Maximum return loss at LC connectors	30 dB for booster input 35 dB for line input and output
Pump leakage	<0 dBm (< 1.0 mW)
Multichannel gain variation/difference	1.0 dB; (1.6 dB for basic card versions, see Tab. 5.1)
Multichannel gain tilt	0.7 dB/dB (compensated with internal tilt filters); (0.7 dB/dB for basic card versions, see Tab. 5.1) (compensated by EDFA pretilt)

Tab. 10.13 Common specifications for all optical line amplifier cards (Cont.)

Maximum total mean output power	18.5 dBm
Per channel mean output power range	–5.0 dBm ≤ Pout ≤ +5.5 dBm (at OLI line output, depending on channel count)
Required per channel mean output power range (40 channels)	–2.0 dBm ≤ Pout ≤ +2.5 dBm
Per channel mean input power range	–26.0 dBm ≤ Popt ≤ –15.0 dBm (depending on channel count)

Tab. 10.14 Particular specifications for the OLISTPNC card

Maximum total mean output power	18.0 dBm
Per channel mean output power range	–5.0 dBm ≤ Pout ≤ +5.0 dBm (at OLI line output, depending on channel count)
Required per channel mean output power range (40 channels)	–2.0 dBm ≤ Pout ≤ +2.0 dBm
Per channel mean input power range	OLISTBNC: –26.0 dBm ≤ Popt ≤ –14.0 dBm (depending on channel count) OLISINC: –26.0 dBm ≤ Popt ≤ –15.0 dBm (depending on channel count)

Tab. 10.15 Particular specifications for the OLISTBNC and OLISINC cards

10.3.3 Optical line interface supervisory channel feeder (OLIF)

Overall dimensions	75 mm wide x 265 mm high x 235 mm deep (2.95 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	1.5 kg
Electrical power consumption	see Tab. 10.63

Tab. 10.16 Particular specifications for the OLIFcard

10.3.4 Optical pump cards (PUMPA, PUMPB)

Card dimensions	25 mm wide x 265 mm high x 235 mm deep (0.98 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	1.15 kg
Power consumption	see Tab. 10.63
Optical connector type	E2000 angled. The connector is located inside the card (behind front panel)
Front panel LEDs	OK (green) and Fault (red)
On-board laser diodes	PUMPA: two 1480 nm laser diodes PUMPB: two 1495 nm laser diodes
Maximum optical output power	450 mW (26.5 dBm)
Laser class	class 1M with APSD

Tab. 10.17 PUMPA and PUMPB specifications

10.3.5 Optical Raman pump card (RPUMP)

Card dimensions	50 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	2 kg
Power consumption	see Tab. 10.63
Front panel fiber connector	RPumpC: 2 LC/PC and 1 Duplex LC/PC
Front panel LEDs	OK (green) and Fault (red)
Maximum optical output power	max. 650 mW)
Laser class	class 1M with APSD

Tab. 10.18 RPUMP specifications

10.3.6 Optical band filter card (OMD4)

Card dimensions	50 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Power consumption	see Tab. 10.63

Tab. 10.19 OMDFC, OMD4 specifications

Front panel fiber connectors	OMD4: 12 LC/PC
Front panel LEDs	none

Tab. 10.19 OMDFC, OMD4 specifications (Cont.)

10.3.7 Optical band filter card (OMDFC)

Card dimensions	50 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Weights	OMDFC: 1.5 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	OMDFC: 6 LC/PC
Front panel LEDs	none
Maximum return loss with LC connectors	35 dB
Bandwidth (1 dB)	16 GHz
Even-odd channel isolation	25 dB
Active temperature controlled over	–5˚C to +65˚C

Tab. 10.20 OMDFC specifications

10.3.8 Optical multiplexer and demultiplexer cards for 10 channels (OM10, OD10, ODA10)

Card dimensions	50 mm wide x 265 mm high x 235mm deep 1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Weight OD10xx/OM10xx/ODA10xx	1.66 kg (all)
Power consumption	see Tab. 10.63
Front panel fiber connectors type C3/C4	12/11 LC/PC
Front panel LEDs	OK (green) and Fault (red)
Input power range for OM10	adjustable between: –5 dBm (± 3.0 dBm) to +1 dBm (± 3.0 dBm)
Output power range for OD10/ODA10	–14 dBm to –0.0 dBm per channel
Maximum return loss at LC connector	35 dB
Bandwidth (1 dB)	27.5 GHz
Adjacent channel isolation	25 dB
Non-adjacent channel isolation	40 dB
Temperature stability range	–5˚C to +65˚C via passive compensation

Tab. 10.21 OM10, OD10 and ODA10 specifications

10.3.9 Optical Filter (OF10)

Card dimensions	50 mm wide x 265 mm high x 235mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Power consumption	see Tab. 10.63
Front panel fiber connectors type	12/11 LC/PC
Front panel LEDs	Demux indication / OK (green) Mux indication / OK (green)
Input power range for OF10	Com. port Cx: min. -27.5 dBm (when using as demultiplexer) Fx port: max. +10 dBm (when using as multiplexer) Upgr. port: max. +13 dBm (when using as multiplexer)

Tab. 10.22 OF10 specifications

10.3.10 Optical performance analyzer card (OPAPC)

Card dimensions	25 mm wide x 265 mm high x 235 mm deep (1 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	2 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	4 LC/PC
Temperature stability range	–5˚C to +70 ˚C
Total input power range	–30 dBm minimum + 9.4 dBm maximum
TapC1 and TapC2 total output power	+ 3.9 dBm maximum
Absolute frequency accuracy	± 15 GHz
Maximum measurement time	1 s

Tab. 10.23 OPAPC specifications

10.3.11 Optical channel switch card (OCS)

Card dimensions	50 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	OCS: 1.7 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/APC connectors
Front panel LEDs	OK (green) and Fault/LOS alarm (red)
Add-channel input power range	adjustable between: –8 dBm (± 4.5 dBm) to +2 dBm (± 4.5 dBm)
Drop-channel output power range	–12.0 dBm to –6.0 dBm
Switching time	< 15 ms

Tab. 10.24 OCS specifications

Maximum return loss at LC connector	35.0 dB
Laser class	class 1M with APSD
Optical switches	OCS: two 2:1 switches per channel (four channels) for add/drop or express traffic
Temperature stability	OCS: –5˚C to +70 ˚C

Tab. 10.24 OCS specifications (Cont.)

10.3.12 Dispersion compensation modules basic (UDCMBs)

Card dimensions	25 mm wide x 265 mm high x 235 mm deep (1.96 inch wide x 10.43 inch high x 9.25 inch deep)
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/PC connectors

Tab. 10.25 Technical data of the UDCMBs

10.3.13 Dispersion compensation modules (UDCMCs) and UDCM tray

Shelf size (UDCM tray)	For ANSI and ETSI racks: 583 mm wide x 88.2 mm high x 300.3 mm deep (23 inches wide x 3.5 inches high x 11.8 inches deep)
UDCM dimensions (up to 4 fit into a UDCM Tray)	268 mm wide x 40.8 mm or 83.2 mm high x 294 mm deep 10.5 inches wide x 1.6 inches or 3.3 inches high x 11.6 inches deep
Weight	UDCM, depending on type: 10 km to 80 km: 3.15 kg + n x 0.12 kg ("n" for each 10 km = 1 to 8); 90 km to 120 km: 3.7 kg + n x 0.12 kg ("n" for each 10 km = 9 to 12); UDCM tray: 5.0 kg
Power consumption	see Tab. 10.63
Maximum return loss without LC connector (Rayleigh backscatter)	27 dB
Relative dispersion slope (RDS)	0.0021 / nm

Tab. 10.26 Technical data of the UDCMCs and of the UDCM tray

10.3.14 Transponder cards

10.3.14.1 OCR10T-V3

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.8 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000

Tab. 10.27 OCR10T-V3, general specifications

Front panel LEDs	OK (green) and Fault (red)

Tab. 10.27 OCR10T-V3, general specifications (Cont.)

Interface 2 km short reach	I-64.1
Interface 40 km wideband	S-64.2b
Bit rate	Standard SONET OC-192 / SDH STM-64 (9.95328 Gbit/s)
Allowable input power at Client In (end of life)	–11 dBm to –1 dBm (I-64.1) –14 dBm to –1 dBm (S-64.2b)
Client out launch power	–6 dBm to –1 dBm (I-64.1) –1 dBm to 2 dBm (S-64.2b)
Client out signal	1310 nm wavelength
Jitter performance	according to ITU-T G.8251
Span attenuation	0 dB to 4 dB (I-64.1) 3 dB to 11 dB (S-64.2b)
Extinction ratio	minimum 6 dB (I-64.1) minimum 8.2 dB (S-64.2b)

Tab. 10.28 OCR10T-V3, client interface specifications

Interface type	Long-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.692)
Bit rate	12.494096 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB @ –1 dBm output power
Beginning-of-life receive OSNR, S-FEC enabled	10.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-Life receive OSNR, S-FEC enabled	11.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.29 OCR10T-V3, line interface specifications

10.3.14.2 OCR10T-V5

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.3 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front panel LEDs	OK (green) and Fault (red)

Tab. 10.30 OCR10T-V5, general specifications

Interface 2 km short reach	I-64.1
Interface 40 km wideband	S-64.2b
Interface 80 km	P1L1-2D2
Line bit rates	11.00320 Gbit/s; in 10 GE LAN mode or OTU_LAN mode: 11.35241 Gbit/s; 10G LAN PHY standard: 10.3125 Gbit/s
Allowable input power at Client In (end of life)	–11 dBm to –1 dBm (I-64.1) –14 dBm to –1 dBm (S-64.2b)
Client out launch power	–6 dBm to –1 dBm (I-64.1) –1 dBm to 2 dBm (S-64.2b)
Client out signal	1310 nm wavelength (I-64.1) 1550 nm (S-64.2b)
Jitter performance	according to ITU-T G.8251
Span attenuation	0 dB to 4 dB (I-64.1) 3 dB to 11 dB (S-64.2b)
Extinction ratio	> 12 dB at rated output power

Tab. 10.31 OCR10T-V5, client interface specifications

Interface type	Long haul DWDM interface with S-FEC
Bit rates	11.00320 Gbit/s, 11.3524 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB @ rated output power
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.

Tab. 10.32 OCR10T-V5 line interface specifications

back-to-back Dispersion tolerance	-1500 ps/nm ... +1500 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	50 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port or client port.
Laser class	class 1M

Tab. 10.32 OCR10T-V5 line interface specifications (Cont.)

10.3.14.3 OCR10T-LH2 and OCR10T-Regio2

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.3 kg (OCR10T-LH2) 2.18 kg (OCR10T-Regio2)
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front Panel LEDs	OK (green) and Fault (red)

Tab. 10.33 OCR10T-LH2 and OCR10T-Regio2, general specifications

Interface 2 km short reach	I-64.1
Interface 40 km wideband	S-64.2b
Bit rate	Standard SONET OC-192 / SDH STM-64 (9.95328 Gbit/s)
Allowable input power at Client In (end of life)	–11 dBm to –1 dBm (I-64.1) –14 dBm to –1 dBm (S-64.2b)
Client out launch power	–6 dBm to –1 dBm (I-64.1) –1 dBm to 2 dBm (S-64.2b)
Jitter performance	according to ITU-T G.8251
Span attenuation	0 dB to 4 dB (I-64.1) 3 dB to 11 dB (S-64.2b)
Extinction ratio	minimum 6 dB (I-64.1) minimum 8.2 dB (S-64.2b)

Tab. 10.34 OCR10T-LH2 and OCR10T-Regio2, client interface specifications

Interface type	Medium-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.692)
Bit rate	10.709225316 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ

Tab. 10.35 OCR10T-LH2, line interface specifications

Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB at rated output power (without filter)
Beginning-of-life receive OSNR, S-FEC enabled	12 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
back-to-back Dispersion tolerance	-800 ps/nm ... +800 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	35 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.35 OCR10T-LH2, line interface specifications (Cont.)

Interface type	Medium-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.709)
Bit rate	10.709 Gbit/s
Transmit wavelengths available	Fixed laser, 100 GHz ITU-T grid spacing in C band. 40 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 20 GHz (approximately ± 160 ppm)
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 8.2 at rated output power (without filter)
Beginning-of-life receive OSNR, S-FEC enabled	12.5 dB (0.1 nm) for BER = 10^{-13} without margin for temperature/ageing dispersion /PMD/PDL
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port
Laser class	class 1M

Tab. 10.36 OCR10T-Regio2, line interface specifications

10.3.14.4 TEX V3

Card dimensions	54.0 mm wide x 565 mm high x 235 mm deep (2.12 inch wide x 22.24 inch high x 9.25 inch deep
Weight	4.62 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front Panel LEDs	OK (green) and Fault (red)

Tab. 10.37 TEX V3, general specifications

Interface 2 km short reach	I-16
Interface 15 km short reach	S-16.1
Bit rate	ITU-T G.709 (2.488 Gbit/s)
Allowable input power at Client In (end of life)	–18,5 dBm to –3 dBm (I-16) –18,5 dBm to 0 dBm (S-16.1)
Client out launch power	–10 dBm to –3 dBm (I-16) –5 dBm to 0 dBm (S-16.1)
Jitter performance	according to ITU-T G.8251
Span attenuation	0 dB to 7 dB (I-16) 0 dB to 12 dB (S-16.1)
Extinction ratio	minimum 8.2 dB

Tab. 10.38 TEX V3, client interface specifications

Interface type	Long-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.692)
Bit rate	12.494096 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.70 THz to 196.10 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB @ –1 dBm output power
Beginning-of-life receive OSNR, S-FEC enabled	10.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life receive OSNR, S-FEC enabled	11.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to 0 dBm

Tab. 10.39 TEX V3, line interface specifications

Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port. (ALS can be enabled/disabled by the user)
Laser class	class 1M

Tab. 10.39 TEX V3, line interface specifications (Cont.)

10.3.14.5 TEX V5

Card dimensions	54.0 mm wide x 565 mm high x 235 mm deep (2.12 inch wide x 22.24 inch high x 9.25 inch deep
Weight	2.12 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front Panel LEDs	OK (green) and Fault (red)

Tab. 10.40 TEX V5, general specifications

Interface 2 km short reach	I-16
Interface 15 km short reach	S-16.1
Interface 40km	L-16.1
Interface 80 km	L-16.2
Bit rate	ITU-T G.709 (2.488 Gbit/s)
Allowable input power at Client In (end of life)	min. –18 dBm for STM and –17 dBm for OTU signals
Client out launch power	–10 to –3 dBm (I-16) –5 to 0 dBm (S-16.1)
Jitter performance	according to ITU-T G.8251
Span attenuation	0 to 7 dB (I-16) 0 to 12 dB (S-16.1)
Extinction ratio	> 12 dB at rated output power

Tab. 10.41 TEX V5, client interface specifications (with SFP modules)

Interface type	Long haul DWDM interface with S-FEC
Bit rates	11.00320 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB

Tab. 10.42 TEX V5 line interface specifications

Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB @ rated output power
Beginning-of-life receive OSNR, S-FEC enabled	for OTU/SDH client (11.0032 Gbit/s):10.6 dB (0.1 nm) @ BER 10^{-13}; for 10 GE LAN (11.3524 Gbit/s):10.8 dB (0.1 nm) @ BER 10^{-13}
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
back-to-back Dispersion tolerance	-1500 ps/nm ... +1500 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	50 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.42 TEX V5 line interface specifications (Cont.)

10.3.14.6 TEX LH2 and TEX Regio2

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.1 kg (TEX LH2) 1.92 kg (TEX Regio2)
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front Panel LEDs	OK (green) and Fault (red)

Tab. 10.43 TEX LH2 and TEX Regio2, general specifications

Interface 2 km short reach	I-16
Interface 15 km short reach	S-16.1
Bit rate	ITU-T G.709 (2.488 or 2.666 Gbit/s)
Allowable input power at Client In (end of life)	–18,5 dBm to –3 dBm (I-16) –18,5 dBm to 0 dBm (S-16.1)
Client out launch power	–10 dBm to –3 dBm (I-16) –5 dBm to 0 dBm (S-16.1)
Jitter performance	according to ITU-T standard G.8251
Span attenuation	0 dB to 7 dB (I-16) 0 dB to 12 dB (S-16.1)
Extinction ratio	minimum 8.2 dB

Tab. 10.44 TEX LH2 and TEX Regio2, client interface specifications (SFP modules used for LH2 and Regio2)

Interface type	Long-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.709)
Bit rate	10.709 Gbit/s
Transmit wavelengths available	Fixed laser, 50 GHz ITU-T grid spacing in C band. 40 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB at rated output power (without filter)
Beginning-of-life receive OSNR, S-FEC enabled	12 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
back-to-back Dispersion tolerance	-800 ps/nm ... +800 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	35 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.45 TEX LH2, line interface specifications

Interface type	Medium-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.709)
Bit rate	10.709 Gbit/s
Transmit wavelengths available	Fixed laser, 100 GHz ITU-T grid spacing in C band. 40 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 20 GHz (approximately ± 160 ppm)
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 8.2 at rated output power (without filter)
Beginning-of-life receive OSNR, S-FEC enabled	12.5 dB (0.1 nm) for BER = 10^{-13} without margin for temperature/ageing dispersion /PMD/PDL
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).

Tab. 10.46 TEX Regio2, line interface specifications

End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.46 TEX Regio2, line interface specifications (Cont.)

10.3.15 Regenerator cards

10.3.15.1 OCR10R-V3

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.7 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front panel LEDs	OK (green) and Fault (red)

Tab. 10.47 OCR10R-V3, general specifications

Interface type	Long-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.692)
Bit rate	12.494096 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Extinction ratio	> 12 dB @ -1 dBm output power
Beginning-of-life receive OSNR, S-FEC enabled	10.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life receive OSNR, S-FEC enabled	11.5 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
Automatic Laser Shutdown (ALS) triggered by	LOS or LOF condition at Line In port. Laser on the OCR10R-V3 card serving the opposite transmission direction will be shut off.
Laser class	class 1M

Tab. 10.48 OCR10R-V3, line interface specifications

10.3.15.2 OCR10R-V5

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.12 kg
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000
Front panel LEDs	OK (green) and Fault (red)

Tab. 10.49 OCR10R-V5, general specifications

Interface type	Long haul DWDM interface with S-FEC
Bit rates	11.00320 Gbit/s, 11.3524 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 80 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB @ rated output power
Beginning-of-life receive OSNR, S-FEC enabled	Client. 10.5 dB @ 10^{-13} BER 10 GE LAN: 11,2 dB to 10,7 dB @ 10^{-13} BER
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
back-to-back Dispersion tolerance	-1500 ps/nm ... +1500 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	50 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.50 OCR10R-V5 line interface specifications

10.3.15.3 OCR10R-LH2 and OCR10R-Regio2

Card dimensions	27.0 mm wide x 565 mm high x 235 mm deep (1.06 inch wide x 22.24 inch high x 9.25 inch deep)
Weight	2.2 kg (OCR10R-LH2) 1.96 kg (OCR10R-Regio2)
Power consumption	see Tab. 10.63
Front panel fiber connectors	LC/LC, F2000

Tab. 10.51 OCR10R-LH2 and OCR10R-Regio2, general specifications

Front Panel LEDs	OK (green) and Fault (red)

Tab. 10.51 OCR10R-LH2 and OCR10R-Regio2, general specifications (Cont.)

Interface type	Medium-reach DWDM interface with S-FEC (meets distance variant per ITU-T G.692)
Bit rate	10.709225316 Gbit/s
Transmit wavelengths available	Tunable laser, 50 GHz ITU-T grid spacing in C band. 40 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 20 ppm)
End-of-life transmit power	User-selectable –11 to –1 dBm
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels of the tunable laser)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 12 dB at rated output power (without filter)
Beginning-of-life receive OSNR, S-FEC enabled	12 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
back-to-back Dispersion tolerance	-800 ps/nm ... +800 ps/nm for 2 dB OSNR penalty
back-to-back DGD tolerance	35 ps total DGD for 2 dB OSNR penalty
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.52 OCR10R-LH2, line interface specifications

Interface type	Medium-reach DWDM interface with S-FEC. (meets distance variant per ITU-T G.709)
Bit rate	10.709 Gbit/s
Transmit wavelengths available	Fixed laser, 100 GHz ITU-T grid spacing in C band. 40 channels 191.7 THz to 196.1 THz (1563.86 nm to 1528.77 nm)
Data format	NRZ
Wavelength stability	± 2.5 GHz (approximately ± 160 ppm)
Transmit power stability	± 0.5 dB
Transmit power accuracy	± 1.0 dB (over all channels)
Jitter performance	according to ITU-T G.8251
Extinction ratio	> 8.2 at rated output power (without filter)

Tab. 10.53 OCR10R-Regio2, line interface specifications

Beginning-of-life receive OSNR, S-FEC enabled	12.5 dB (0.1 nm) for BER = 10^{-13} without margin for temperature/ageing dispersion /PMD/PDL
End-of-life receive OSNR, S-FEC enabled	13 dB (0.1 nm) @ 10^{-13} BER without optical path penalties (back to back measurement).
End-of-life input power	Allowable input power range is –14 dBm to –2 dBm.
Automatic laser shutdown (ALS) triggered by	LOS or LOF detected at Line In port.
Laser class	class 1M

Tab. 10.53 OCR10R-Regio2, line interface specifications (Cont.)

10.3.16 Optical Channel Protection card (OCP-V2)

OCP-V2 card dimensions	62.5 mm wide x 265 mm high x 235 mm deep (2.46 inch wide x 10.43 inch high x 9.25 inch deep)
Card weight	0.6 kg (1.32 lb)
Power consumption	see Tab. 10.63
Front panel fiber connectors	6 x SC/Super PC
Wavelength ranges	1290 nm to 1330 nm and 1520 nm to 1570 nm
Switching time	< 60 msec total (10 msec detection + 50 msec actual switching time).
Front panel LEDs	OK (green) and Fault (red)
Maximum allowable input powers	At "Client In" connector:10 dBm At "In 1" connector: 10 dBm At "In 2" connector: 10 dBm
Input reflection attenuation	40 dB at all ports
Insertion Loss	"Client In" to "Out 1": 4.5 dB maximum "Client In" to "Out 2": 4.5 dB maximum "In 1" to "Client Out": 3.0 dB maximum "In 2" to "Client Out": 3.0 dB maximum
Polarization Dependent Loss (PDL)	"Client In" to "Out 1": 0.1 dB maximum "Client In" to "Out 2": 0.1 dB maximum "In 1" to "Client Out": 0.1 dB maximum "In 2" to "Client Out": 0.1 dB maximum

Tab. 10.54 OCP-V2 specifications

10.4 Supervision and control

For an alphabetical card list (including selective references to the below subchapters), see Tab. 5.1.

10.4.1 Main Control Unit (MCU)

Card dimensions	25 mm wide x 265 mm high x 235 mm deep (0.98 inch wide x 10.43 inch high x 9.25 inch deep)
Weight	2.0 kg
Power consumption	see Tab. 10.63
Front panel LEDs	OK (green) and Fault (red)
OSS interfaces	Q3 over TCP/ IP (RFC1006) / 7-layer OSI stack / Q-F stack / @CT of TL1-GNE
Office alarm outputs	Major audible/visual and Minor audible/visual Form C relays. Power fail form B relay. All relays are 100 mA maximum.

Tab. 10.55 Technical data of the MCU card

10.4.2 Management information base (MIBS32-2, MIBS256)

Dimensions	7.5 mm wide x 50 mm high x 235 mm deep (0.30 inch wide x 1.97 inch high x 9.25 inch deep)
Weight	0.05 kg
FEPROM storage capacity	MIBS32-2: 32 MByte MIBS256: 32 + 192 MByte
Number of MAC addresses	MIBS32-2 and MIBS256: 2
Power consumption	see Tab. 10.63

Tab. 10.56 Technical data of the MIBS32-2 and MIBS256 modules

10.4.3 SAB module

Card dimensions	7.5 mm wide x 90 mm high x 235 mm deep (0.30 inch wide x 3.94 inch high x 9.25 inch deep)
Weight	SAB: 0.03 kg
Power consumption SAB	see Tab. 10.63

Tab. 10.57 Technical data of the SAB

10.4.4 Subrack management unit (SMU2)

Card dimensions	25 mm wide x 265 mm high x 235 mm deep (0.98 inch wide x 10.43 inch high x 9.25 inch deep)

Tab. 10.58 Technical data of the SMU2

Weight	0.8 kg
Power consumption	see Tab. 10.63
Front panel LEDs	OK (green) and Fault (red)

Tab. 10.58 Technical data of the SMU2

10.4.5 Data Communication Network (DCN)

Max. number of routers per autonomous system without filtering	160 (may vary according to the topology)
Max. number of routers per area	160 (may vary according to the topology)
Max. number of areas per routing domain	50
Max. number of members on a common LAN	30 to 40

Tab. 10.59 DCN specifications

10.5 Power supply

10.5.1 Rack and subrack power supply

Nominal DC supply voltage	–48/–60 V, positive grounded
DC supply voltage range	–40.5 V to –75 V
Number of circuit breakers per subrack	4 (mounted at PDP)
Circuit breaker values for – OADMB equipped with OLI cards – all other subracks	 20 A 15/16 A

Tab. 10.60 Rack and subrack power supply

10.5.2 Low Voltage Disrupt Device (LVD)

Switching criterion for disrupting the power connection	Input voltage within –39.5 to –37.5 V for more than 100 ms
Switching criterion for automatic return to normal operation	Input voltage within –47.0 ± 0.5 V

Tab. 10.61 LVD specifications

10.5.3 Electrical power consumption of the subracks

Subrack	Electrical power consumption
	maximum
Subrack, fully equipped	Single-row subrack: 800 W Double-row subrack: 1150 W

Tab. 10.62 Electrical power consumption of the subracks

Subrack	Electrical power consumption
	maximum
Subrack for OCU network elements, fully equipped	1160 W

Tab. 10.62 Electrical power consumption of the subracks (Cont.)

10.5.4 Electrical power consumption of the cards and units

Card	Electrical power consumption	
	typical	maximum
Fan Box	25 W	50 W
MCU	15 W	25 W
MIBS32-2	1 W	1 W
MIBS256	1 W	1.5 W
OCP-V2	5.8 W	7.5 W
OCR10R-LH2	35 W	45 W
OCR10R-Regio2	42 W	65 W
OCR10R-V3	35 W	50 W
OCR10R-V5	37 W	43 W
OCR10T-LH2	43 W	55 W
OCR10T-Regio2	42 W	65 W
OCR10T-V3	45 W	60 W
OCR10T-V5	42 W	53 W
OCS	16 W	18 W
OD10	3.6 W	5.3 W
ODA10	3.6 W	5.3 W
OF10	3.0 W	6.0 W
OLIF	3.0 W	5.0 W
OLIMINC	40 W	75 W
OLIMTBNC	40 W	75 W
OLIMTPNC	40 W	75 W
OLISINC	40 W	75 W
OLISTBNC	40 W	75 W
OLISTPNC	40 W	75 W
OLIVINC	30 W	40 W
OLIVSTBNC	30 W	40 W
OLIVTPNC	30 W	40 W
OM10	3.6 W	5.3 W
OMD4	0.13 W	0.3 W

Tab. 10.63 Electrical power consumption of the cards and units

Card	Electrical power consumption	
	typical	maximum
OMDFC	0.2 W	0.2 W
OPAPC	10 W	16 W
OSCTUI	10 W	18 W
OSCTUT	10 W	18 W
PUMPA	25 W	45 W
PUMPB	25 W	45 W
RPUMP	85 W	110 W
SAB	0.5 W	0.5 W
SMU2	7 W	12 W
TEX LH2	45 W	55 W
TEX Regio2	31 W	34 W
TEX V3	85 W	100 W
TEX V5	47 W	65 W
UDCMB	0.13 W	0.3 W
UDCMC	0.2 W	0.2 W

Tab. 10.63 Electrical power consumption of the cards and units (Cont.)

10.5.5 ULED bus

Nominal voltage	4.7 V ± 10 %
Maximum current	50 mA
Supply by every card	+5 V via a decoupling diode and a serial resistor (4 x 464 Ω in parallel)
Protection against	Overload, short-circuit

Tab. 10.64 ULED bus specifications

10.6 Environmental conditions

Operating range according to ETSI standard 300 019 class 3.1E	–5˚ to +45 ˚C (temperature of air flowing into the subracks)
Operating range according to Telcordia GR 63	+5 to +40 ˚C; short term: +5 to +50 ˚C
Storage range according to ETSI standard 300 019 class 1.2	–25˚ to +55 ˚C
Storage range according to Telcordia GR 63	–40˚ to +70˚ C during a maximum of 72 hours
Climate during transport according to ETSI standard 300 019 class 2.3	–40˚ to +70˚ C; 93% humidity at 40˚ C

Tab. 10.65 System environmental specifications

Humidity	5% to 90%
Altitude	–100 m to 4000 m
Earthquake shock / vibration	Zone 4 (ANSI rack only)

Tab. 10.65 System environmental specifications (Cont.)

10.7 Mechanical data of the subracks

Parameter	**ETSI**	**ANSI**
Overall height (including cable compartment)	576 mm	576 mm
Overall width with flanges	533 mm	583 mm
Overall width without flanges	500 mm	500 mm
Mounting center distance	515 mm	566.7 mm
Mounting depth (front)	125 mm	125 mm
Rack spacing	600 mm	578 mm
Weight of the unequipped single-row subrack	19 kg	

Tab. 10.66 Dimensions and weight of the single-row subrack

Parameter	**ETSI**	**ANSI**
Overall height (including cable compartment)	956 mm	956 mm
Overall width with flanges	533 mm	583 mm
Overall width without flanges	500 mm	500 mm
Mounting center distance	515 mm	566.7 mm
Mounting depth (front)	125 mm	125 mm
Rack spacing	1000 mm	978 mm
Weight of the unequipped double-row subrack	about 26 kg	

Tab. 10.67 Dimensions and weight of the double-row subrack

Parameter	**ETSI**	**ANSI**
Overall height (including cable compartment)	876 mm	876 mm
Overall width with flanges	533 mm	583 mm
Overall width without flanges	500 mm	500 mm
Mounting center distance	515 mm	566.7 mm
Mounting depth (front)	125 mm	125 mm
Mounting depth (rear)	155 mm	155 mm
Rack spacing including air outlet	925 mm	889 mm

Tab. 10.68 External dimensions of the double-height subrack

Parameter	ETSI	ANSI
Height (rack spacing)	100 mm	88.9 mm
Height	88 mm	88 mm
Width (overall)	533 mm	583 mm
Width between mounting holes	515 mm	567 mm
Depth (max.)	280 mm	280 mm
Weight of the empty DCM tray	about 5 kg	

Tab. 10.69 Mechanical specifications of the DCM tray

10.8 Mechanical data of the racks

Parameter	Dimension
Height	2200 mm
Height (usable)	2050 mm
Width	600 mm
Usable width between rack uprights	500 mm
Depth	300 mm
Depth (usable)	280 mm
Weight of the unequipped ETSI subrack	about 59 kg

Tab. 10.70 Dimensions of the ETSI rack according to ETS 300

Parameter	Dimension (mm)	Dimension (ft/HU)
Height	2134 2286 2438	7 ft 7 1/2 ft 1) 8 ft 1)
Height (usable)	1867 2045 2178	42 HU 2) (in a 7 ft rack) 46 HU (in a 7 1/2 ft rack) 49 HU (in a 8 ft rack)
Width	660	2 ft, 2 inch
Usable width between rack uprights	546	21.5 inch
Depth	305	12 inch
1) In some customer applications, 7 1/2 ft and 8 ft racks are used 2) 1 HU = 1 3/4 inch = 44.45 mm		

Tab. 10.71 Dimensions of the ANSI rack

10.9 PC requirements for running the Element Manager software

SURPASS hiT 7500-B is fitted with the following connectors for a craft terminal (see Chapters 6.2.2 and 6.2.3):

– 1 10 BaseT connector (Q interface);

– 1 RS-232 9 pin D-SUB connector (F interface).

The PC to be used as a craft terminal should at least fulfil the data specified in Tab. 10.72, for running the Element Manager software in LCT mode or NCT mode.

CPU	Pentium IV 1.8 GHz (or equivalent)
Memory	1 GByte
Hard disk drive	30 GByte
Monitor	Color monitor 17” recommended
LAN	Ethernet card, 2x 3COM (3C982-TXM)
Operating system	Windows® 2000, Windows® XP

Tab. 10.72 Minimum PC requirements

11 Abbreviations

ACO	Alarm Cut-Off
AIS	Alarm Indication Signal
ANSI	American National Standards Institute
ASE	Amplified Spontaneous Emissions
ATM	Asynchronous Transfer Mode
Avg-BER	Average Bit Error Rate
BBE	Background Block Error
BER	Bit Error Rate
BIP-8	Bit Interleaved Parity 8
Bw7R	Narrow-rack style 7R
CCM	Card Controller Module
CCU	Channel Connection Unit
CDM	Compressed Data Mode
CDR	Clock and data recovery
CMI	Code Mark Inversion
CMISE	Common Management Information Service Element
COPA	Connector Panel
CPU	Central Processing Unit
CV	Code violation
DC	Direct Current
DCCMo	Data Communication Channel Multiplex
DCCOo	Data Communication Channel Optical
DCF	Dispersion Compensating Fiber
DCN	Data Communication Network
DMC	Dispersion Managed Cable
D-SUB	Sub-Miniature Connector
DTMF	Dual Tone Multi Frequency
ECC	Embedded Communication Channel
EM OS	Element Managing Operating System
EM	Element Manager
EMI	Electromagnetic Interference
EOCI	External Optical Connection Indicator
EOL	End Of Life
EOW	Engineering Order Wire
ES	Errored Seconds
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
ETSI	European Telecommunication Standards Institute

FC	Fiber Channel
FEC	Forward Error Correction
FSS	Fiber Switch Site
G-AIS	Generic Alarm Indication Signal
GCC	Generic Communication Channel
GE	Gigabit Ethernet
GND	Ground
GUI	Graphical User Interface
HDLC	High Level Data Link Control
HRL	High Return Loss (connector type)
HU	Height Unit
IF	Interface
IP	Internet Protocol
IS-IS	Integrated system for fulfilling the infrastructure requirements of fiber optics systems
ITU	International Telecommunication Union
ITU-T	Telecommunication Standardization Sector of ITU
LAN	Local Area Network
LCC	Local Card Controller
LCT	Local Craft Terminal
LED	Light Emitting Diode
LH	Long Haul
LOM	Loss Of Multiframe
LVD	Low Voltage Disconnect (device)
MAF	Management Application Functions
Max-BER	Maximum Bit Error Rate
MCF	Message Communication Function
MCU	Main Control Unit
MM NB	Master MCU North Bound (COPA connector)
MM SB	Master MCU South Bound (COPA connector)
MS-AIS	Multiplex Section AIS
MSN	Multi Service Node
NCT	Network Craft Terminal
NEAP	Network Element Alarm Panel
NML	Network Management Layer
NRZ	Non Return to Zero
OAS	Optical Amplifier Site
OC	Optical Carrier
OCP	Optical Channel Protection

OCR10R	Optical Channel Repeater 10 Gbit/s Regenerator
OCR10T	Optical Channel Repeater 10 Gbit/s Transponder
OCS	Optical Channel Switch
OCU	Optical Channel Unit
OD10	Optical Demultiplexer card, 10 channels
ODA10	Optical Demultiplexer card with VOAs, 10 channels
ODU	Optical Data Unit
OH	Overhead
OLISINC	Optical LIne Interface Inline amplifier (basic version) for C band systems
OLISTBNC	Optical Line Interface Short-span Terminal Booster for C band
OLISTPNC	Optical Line Interface Short-span Terminal Preamplifier for C band
OLRB	Optical inLine Repeater Basic
OM10	Optical Multiplexer card with VOA, 10 channels
OMDFC	Optical Multiplexer/Demultiplexer Filters for C band
OOB EFEC	Out-of-Band Super Forward Error Correction
OPAPC	Optical Performance Analyzer "Power" card for C band
OPU	Optical Payload Unit
OS	Operating System
OSAR	Optical Signal-to-accumulated-ASE Ratio
OSCT	Optical Supervisory Channel Termination
OSCTUI	Optical Supervisory Channel Termination card Unidirectional for the Intermediate nodes
OSCTUT	Optical Supervisory Channel Termination card Unidirectional for the Terminal sites
OSI	Open Systems Interconnection
OSNR	Optical Signal to Noise Ratio
OSS	Optical Switch Site
OTH	Optical Transport Hierarchy
OTT	Optical Transport Terminal
OTTB	Optical Transport Terminal Basic ,
OTU	Optical Transport Unit
PC	Personal Computer
PCB	Peripheral Control Bus
PCB	Printed Circuit Board

PCM	Puls Code Modulation
PDH	Plesiochronous Digital Hierarchy
PDL	Polarization Dependent Loss
PDP	Power Distribution Panel
PLM	Payload Mismatch
PMD	Polarization Mode Dispersion
PSU	Power Supply Unit
PUMPA	Pump card, 1480 nm
PUMPB	Pump card, 1495 nm
Q	Interface to a Telecommunication Management Network
Q3	Interface between a network element and an operating system in the public network
QD2	System interface with SISA system
Q-F	Operating Terminal Interface
QoS	Quality of Service (alarms)
QST	Proprietary Q Interface
RAM	Random-Access Memory
RDS	Relative Dispersion Slope
RFC	Request for Comments
RPUMP	Raman Pump card
Rx	Receive signal
SAB	Subrack Address Board
SDH	Synchronous Digital Hierarchy
SEFS	Severely Errored Framing Seconds
SELV	Safety Extra Low Voltage
SEMF	Synchronous Equipment Management Function
SerDes	Serializer / deserializer
SES	Severely Errored Seconds
SFEC	Super forward error correction
SFP	Small Form factor, Pluggable (module)
SIPAC	Siemens Packaging system
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPI	Synchronous Peripheral Interface
SPM	Self Phase Modulation
SRAM	Static RAM
SRS	Stimulated Raman Scattering
SSM	Synchronization Status Message
SSMF	Standard Single Mode Fiber
sV.11	Similar to V.11 (interface)

TCA	Threshold Crossing Alert
TEX	Ten Gigabit Multiplexer
TF	Transmit Fail (alarm)
THz	Tera-Hertz (1 THz = 1 000 000 000 000 Hz)
TIF	Telemetry Interface
TIM	Trace Identifier Mismatch
TMN	Telecommunication Managment Network
TNMS	Telecommunications Network Management System
Tx	Transmit signal
UAS	Unavailable Seconds
UDCMC	Unidirectional Dispersion Compensation Module for C band
ULH	Ultra Long Haul
VCDB	Variable Configurable Data Block
VOA	Variable Optical Attenuator
WDM	Wavelength Division Multiplexing
XPM	Cross Phase Modulation

12 Index

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