1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS(Formerly Metropolis® AM/AMS)

Release 1.0 through 7.2

Applications and Planning Guide
365-312-801R7.2
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Issue 10 | November 2016

Alcatel·Lucent

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Notice

Every effort has been made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

Release notification

This document describes AM/ AMS Release 1.0 through 7.2 and covers previous releases.

Compared to provided descriptions some of the legacy releases may vary due to the feature upgrades.

Declaration of Conformity

The Declaration of Conformity (DoC) for this product can be found in this document at "Conformity statements" (p. 9-5), or at: *http://www.alcatel-lucent.de/ecl*.

WEEE directive

The *Waste from Electrical and Electronic Equipment (WEEE) directive* for this product can be found in this document at "Eco-environmental statements" (p. 9-9).

Ordering information

The order number of this document is 365-312-801R7.2.

Technical support

Please contact your Alcatel-Lucent Local Customer Support Team (LCS) for technical questions about the information in this document.

Information product support

To comment on this information product, go to the Online Comment Form (*http://www.alcatel-lucent-info.com/comments/enus/*) or email your comments to the Comments Hotline (*comments@alcatel-lucent.com*).

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About this document

Purpose

This Application and Planning Guide (APG) provides the following information about the 1643 Access Multiplexer AM /1643 Access Multiplexer Small AMS, Release 1.0 through 7.2:

- System overview
- Features and benefits
- Applications
- Product description
- OAM&P
- System planning and engineering
- Ordering
- Product support
- Quality and reliability
- Technical specifications.

Note

1643 AMS is considered to be a special application of 1643 AM. It has a different hardware based on main components of 1643 AM. If not indicated specifically, given information is valid for 1643 AM and 1643 AMS.

What's new

This is the Issue 10 of this guide for 1643 AM and 1643 AMS Release 1.0 through 7.2.

A new version of this document was needed to address all features supported by 1643 AM and 1643 AMS, Release 1.0 through 7.2.

Note

The 1643 AM and 1643 AMS Applications and Planning Guide contains images with old logos and will be updated in forthcoming releases.

Previous versions and features are listed below:

Release	GA	Features added

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Ruby 1.0	December 2000	The following features are implemented in this release:
		• One or Two STM-1 or two STM-4 optical line interface pairs (transmit/receive)
		• Up to sixteen 2 Mbit/s interface ports - G.703 interface - G.704/G.706 interface
		• Remote and local software downloading
		• General VC-11/VC-12 SNC/N protection or VC-3 SNC/N protection
		• 1+1 MSP protection (STM-1 aggregate only) in terminal applications
		• Performance Monitoring
		• E1 or DS1 or E3 or DS3 or X.21 loopbacks
		• Cross-connect loopbacks
		• Four Miscellaneous Discrete Inputs (MDI)
		• Four Miscellaneous Discrete Outputs (MDO)
		• Dual fiber pair working
		• IP Tunneling in the DCC channels for the management of elements (TCP/IP protocol)
		• Space-efficient for simple and rapid installation within street cabinets or in customer premises
		• Supported by the user-friendly Integrated Transmission Management (ITM) network management and element management systems
		• AC/DC or DC/DC converter
		• Working in large temperature range
		• Optional additional sixteen 1.5 Mbit/s ports
		• Optional additional sixteen 2 Mbit/s ports
		• Optional additional two 34 Mbit/s ports
		• Optional additional two 45 Mbit/s ports
		• Optional additional four 2 Mbit/s X.21 ports
		• Optional additional four 10/100Base-T LAN interfaces
Topaz 2.0	July 2001	The following features are implemented in this release:
		• Optional additional two optical STM-1 tributary signals
Pearl 2.2	July 2002	The following features are implemented in this release:
		• Optional additional two electrical STM-1 tributary signals
		• Spanning tree protocol
Garnet 3.1	May 2003	The following features are implemented in this release:
		• Rapid spanning tree protocol
		• GFP mapping

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Garnet 3.2	July 2003	The following features are implemented in this release: • introduction of 1643 AMS • introduction of Network Termination Unit (NTU) (from R6.1 no longer supported) • Optional additional twelve SHDSL interfaces
Venus 4.0	September 2003	The following features are implemented in this release: • additional 8-port private line interfaces • LCAS functionality for VC-12 and VC-3 • AITS operation (DCC_m) • Transparent DCC_r
Earth 5.0	April 2004	The following features are implemented in this release: • Support of SNMP management (retrieve functionality) • Advanced SFP data retrieve capability • Enhanced VLAN tagging • Enhanced Ethernet port provisioning • Provisionable LSP size
Mars 6.1	June 2005	The following features are implemented in this release: • Enhanced flow classification (Port, VID, UP) on E/FE units • QoS in IEEE 802.1Q & IEEE 802.1ad mode on E/FE units, i.e. flow classification, rate control and traffic class handling • Oversubscription in IEEE mode • SHDSL Performance Monitoring • 3rd party NTU support for E1 and Ethernet applications • Port Loopback alarming • J0 support on STM-n lines • E1 non-intrusive monitoring • E1 PDH AIS • 1643 AMS with integrated AC power supply • Increased SFP support (STM-1e, single fiber) • New SHDSL option card with R6.1 Features, e.g. SW Download to NTUs.

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Uranus 7.1	November 2006	The following features are implemented in this release: • Optional TransLAN card - X5IP • Ethernet PM counter enhancements • PM counter for Congestion monitoring • Round trip time/delay measurement • Provisionable CBS • Flow classifcation based on DA-MAC and IP-TOS/DSCP • SHDSL enhancements • Remote Power Supply (RPS)
Miranda 7.2	May 2009	The following features are implemented in this release: • Alarm Severity Assignment Profile (ASAP) • X5IP option card enhancements • Outloops on Ethernet ports in repeater mode • Performance Monitoring • VC-4-4c cross connection • Supported by the Alcatel-Lucent OMS Release 5.0.2 and Wavestar® ITM-CIT - Release 18.0 • Digital Diagnostics Monitoring (DDM) on SFPs
Miranda 7.2.11	August 2012	The following features are implemented in this release: • X12SHDSL-V3 option card
Miranda 7.2.11	May 2014	Removed all vertical rack mounting content.

Safety information

For your safety, this document contains safety statements. Safety statements are given at points where risks of damage to personnel, equipment, and operation may exist. Failure to follow the directions in a safety statement may result in serious consequences.

Intended audience

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Applications and Planning Guide is primarily intended for network planners and engineers. In addition, others who need specific information about the features, applications, operation, and engineering of 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS may find the information in this manual useful.

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How to use this information product

Each chapter of this manual treats a specific aspect of the system and can be regarded as an independent description. This ensures that readers can inform themselves according to their special needs. This also means that the manual provides more information than needed by many of the readers. Before you start reading the manual, it is therefore necessary to assess which aspects or chapters will cover the individual area of interest.

The following table briefly describes the type of information found in each chapter.

Chapter	Title	Description
About this information product		This chapter • describes the guide's purpose, intended audience, and organization • lists related documentation • explains how to comment on this document
1	Introduction	This chapter • presents network application solutions • provides a high-level product overview • describes the product family • lists features
2	Features	Describes the features of 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS
3	Network topologies	Describes some of the main network topologies possible with 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS
4	Product description	This chapter • provides a functional overview of the system • describes the hardware and configurations available for the product
5	Operations, administration, maintenance, and provisioning	Describes OAM&P features (such as alarms, operation interfaces, security, and performance monitoring)
6	System planning and engineering	Provides planning information necessary to deploy the system
7	Ordering	Describes how to order 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS
8	Product support	This chapter • describes engineering and installation services • explains documentation and technical support • lists training courses

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Chapter	Title	Description
9	Quality and reliability	This chapter • provides the Alcatel-Lucent quality policy • lists the reliability specifications
10	Technical Specifications	Lists the technical specifications
11	Ethernet Overview	This chapter describes • Ethernet concepts • Ethernet engineering rules and guidelines
12	SHDSL Overview	This chapter describes • SHDSL configurations • SHDSL frame structure • Remote management and supervision • SHDSL features
Appendix A	SDH Overview	Describes the standards for optical signal rates and formats (SDH)
Glossary		Defines telecommunication terms and explains abbreviations and acronyms
Index		Lists specific subjects and their corresponding page numbers

Conventions used

These conventions are used in this document:

Numbering

The chapters of this document are numbered consecutively. The page numbering restarts at "1" in each chapter. To facilitate identifying pages in different chapters, the page numbers are prefixed with the chapter number. For example, page 2-3 is the third page in chapter 2.

Cross-references

Cross-reference conventions are identical with those used for numbering, i.e. the first number in a reference to a particular page refers to the corresponding chapter.

Keyword blocks

This document contains so-called keyword blocks to facilitate the location of specific text passages. The keyword blocks are placed to the left of the main text and indicate the contents of a paragraph or group of paragraphs.

Typographical conventions

Special typographical conventions apply to elements of the graphical user interface (GUI), file names and system path information, keyboard entries, alarm messages etc.

• Elements of the graphical user interface (GUI)

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These are examples of text that appears on a graphical user interface (GUI), such as menu options, window titles or push buttons:

– **Provision...**, **Delete**, **Apply**, **Close**, **OK** (push-button)

– **Provision Timing/Sync** (window title)

– **View Equipment Details...** (menu option)

– **Administration → Security → User Provisioning...** (path for invoking a window)

• File names and system path information

These are examples of file names and system path information:

– *setup.exe*

– *C:\Program Files\Alcatel-Lucent*

• Keyboard entries

These are examples of keyboard entries:

– **F1**, **Esc X**, **Alt-F**, **Ctrl-D**, **Ctrl-Alt-Del** (simple keyboard entries)

A hyphen between two keys means that both keys have to be pressed simultaneously. Otherwise, a single key has to be pressed, or several keys have to be pressed in sequence.

– `copy abc xyz` (command)

A complete command has to be entered.

• Alarms and error messages

These are examples of alarms and error messages:

– `Loss of Signal`

– `Circuit Pack Failure`

– `HP-UNEQ, MS-AIS, LOS, LOF`

– `Not enough disk space available`

Abbreviations

Abbreviations used in this document can be found in the "Glossary" unless it can be assumed that the reader is familiar with the abbreviation.

Related documentation

This section briefly describes the documents that are included in the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS documentation set.

• Installation Guide

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Installation Guide (IG) is a step-by-step guide to system installation and setup. It also includes information needed for pre-installation site planning and post-installation acceptance testing.

• Applications and Planning Guide

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The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Applications and Planning Guide (APG) is for use by network planners, analysts and managers. It is also for use by the Alcatel-Lucent Account Team. It presents a detailed overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.

- User Operations Guide

  The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS User Operations Guide (UOG) provides step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks by use of ITM Craft Interface Terminal (ITM-CIT).

- Alarm Messages and Trouble Clearing Guide

  The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Alarm Messages and Trouble Clearing Guide (AMTCG) gives detailed information on each possible alarm message. Furthermore, it provides procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.

- The Alcatel-Lucent OMS Provisioning Guide, Release 7.0 (Application 1643 AM and 1643 AMS)

  The Alcatel-Lucent OMS Provisioning Guide (Application 1643 AM and 1643 AMS) gives instructions on how to perform system provisioning, operations, and administrative tasks by using the Alcatel-Lucent OMS.

The following table lists the documents included in the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS documentation set.

Document title	Document code
1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Applications and Planning Guide Release 1.0 through 7.2	109635771 (365-312-801R7.2)
1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS User Operations Guide Release 1.0 through 7.2	109635813 (365-312-807R7.2)
1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Alarm Messages and Trouble Clearing Guide 1.0 through 7.2	109635763 (365-312-803R7.2)
1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Installation Guide 1.0 through 7.2	109635797 (365-312-802R7.2)
OMS Provisioning Guide, Release 7.2 (Application 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS)	109635805 (365-312-877R7.2)
CD-ROM Documentation 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS (all manuals on a CD-ROM)	109635789 (365-312-811R7.2)

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These documents can be ordered at or downloaded from the Customer Information Center (CIC) at http://www.cic.alcatel-lucent.com/documents.html, or via your Local Customer Support.

Related training

For detailed information about the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS training courses and how to register please refer to "Training support" (p. 8-13) in this document.

Intended use

This equipment shall be used only in accordance with intended use, corresponding installation and maintenance statements as specified in this documentation. Any other use or modification is prohibited.

Optical safety

IEC Customer Laser Safety Guidelines

Alcatel-Lucent declares that this product is compliant with all essential safety requirements as stated in IEC 60825-Part 1 and 2 "Safety of laser products" and "Safety of optical fibre telecommunication systems". Futhermore Alcatel-Lucent declares that the warning statements on labels on this equipment are in accordance with the specified laser radiation class.

Optical Safety Declaration (if laser modules used)

Alcatel-Lucent declares that this product is compliant with all essential safety requirements as stated in IEC 60825-Part 1 and 2 "Safety of Laser Products" and "Safety of Optical Fiber Telecommunication Systems". Furthermore Alcatel-Lucent declares that the warning statements on labels on this equipment are in accordance with the specified laser radiation class.

Optical Fiber Communications

This equipment contains an Optical Fiber Communications semiconductor laser/LED transmitter. The following Laser Safety Guidelines are provided for this product.

General Laser Information

Optical fiber telecommunication systems, their associated test sets, and similar operating systems use semiconductor laser transmitters that emit infrared (IR) light at wavelengths between approximately 800 nanometers (nm) and 1600 nm. The emitted light is above the red end of the visible spectrum, which is normally not visible to the human eye. Although radiant en at near-IR wavelengths is officially designated invisible, some people can see the shorter wavelength energy even at power levels several orders of magnitude below any that have been shown to cause injury to the eye.

Conventional lasers can produce an intense beam of monochromatic light. The term "monochromaticity" means a single wavelength output of pure color that may be visible or invisible to the eye. A conventional laser produces a small-size beam of light, and

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because the beam size is small the power density (also called irradiance) is very high. Consequently, lasers and laser products are subject to federal and applicable state regulations, as well as international standards, for their safe operation.

A conventional laser beam expands very little over distance, or is said to be very well collimated. Thus, conventional laser irradiance remains relatively constant over distance. However, lasers used in lightwave systems have a large beam divergence, typically 10 to 20 degrees. Here, irradiance obeys the inverse square law (doubling the distance reduces the irradiance by a factor of 4) and rapidly decreases over distance.

Lasers and Eye Damage

The optical energy emitted by laser and high-radiance LEDs in the 400-1400 nm range may cause eye damage if absorbed by the retina. When a beam of light enters the eye, the eye magnifies and focuses the energy on the retina magnifying the irradiance. The irradiance of the energy that reaches the retina is approximately 105, or 100,000 times more than at the cornea and, if sufficiently intense, may cause a retinal burn.

The damage mechanism at the wavelengths used in an optical fiber telecommunications is thermal in origin, i.e., damage caused by heating. Therefore, a specific amount of energy is required for a definite time to heat an area of retinal tissue. Damage to the retina occurs only when one looks at the light long enough that the product of the retinal irradiance and the viewing time exceeds the damage threshold. Optical energies above 1400 nm cause corneal and skin burns, but do not affect the retina. The thresholds for injury at wavelengths greater than 1400 nm are significantly higher than for wavelengths in the retinal hazard region.

Classification of Lasers

Manufacturers of lasers and laser products in the U.S. are regulated by the Food and Drug Administration's Center for Devices and Radiological Health (FDA/CDRH) under 21 CFR 1040. These regulations require manufacturers to certify each laser or laser product as belonging to one of four major Classes: I, II, lla, IIIa, lllb, or IV. The International Electro-technical Commission is an international standards body that writes laser safety standards under IEC-60825. Classification schemes are similar with Classes divided into Classes 1, 1M, 2, 2M, 3R, 3B, and 4. Lasers are classified according to the accessible emission limits and their potential for causing injury. Optical fiber telecommunication systems are generally classified as Class I/1 because, under normal operating conditions, all energized laser transmitting circuit packs are terminated on optical fibers which enclose the laser energy with the fiber sheath forming a protective housing. Also, a protective housing/access panel is typically installed in front of the laser circuit pack shelves The circuit packs themselves, however, may be FDA/CDRH Class I, IIIb, or IV or IEC Class 1, 1M, 3R, 3B, or 4.

Laser Safety Precautions for Optical Fiber Telecommunication Systems

In its normal operating mode, an optical fiber telecommunication system is totally enclosed and presents no risk of eye injury. It is a Class I/1 system under the FDA and IEC classifications.

The fiber optic cables that interconnect various components of an optical fiber telecommunication system can disconnect or break, and may expose people to laser emissions. Also, certain measures and maintenance procedures may expose the technician to emission from the semiconductor laser during installation and servicing. Unlike more familiar laser devices such as solid-state and gas lasers, the emission pattern of a semiconductor laser results in a highly divergent beam. In a divergent beam, the irradiance (power density) decreases rapidly with distance. The greater the distance, the less energy will enter the eye, and the less potential risk for eye injury. Inadvertently viewing an un-terminated fiber or damaged fiber with the unaided eye at distances greater than 5 to 6 inches normally will not cause eye injury, provided the power in the fiber is less than a few milliwatts at the near IR wavelengths and a few tens of milliwatts at the far IR wavelengths. However, damage may occur if an optical instrument such as a microscope, magnifying glass, or eye loupe is used to stare at the energized fiber end.

⚠ ☢ CAUTION
Laser hazard

Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.

Laser Safety Precautions for Enclosed Systems

Under normal operating conditions, optical fiber telecommunication systems are completely enclosed; nonetheless, the following precautions shall be observed:

1. Because of the potential for eye damage, technicians should not stare into optical connectors or broken fibers

2. Under no circumstance shall laser/fiber optic operations be performed by a technician before satisfactorily completing an approved training course

3. Since viewing laser emissions directly in excess of Class I/1 limits with an optical instrument such as an eye loupe greatly increases the risk of eye damage, appropriate labels must appear in plain view, in close proximity to the optical port on the protective housing/access panel of the terminal equipment.

Laser Safety Precautions for Unenclosed Systems

During service, maintenance, or restoration, an optical fiber telecommunication system is considered unenclosed. Under these conditions, follow these practices:

1. Only authorized, trained personnel shall be permitted to do service, maintenance and restoration. Avoid exposing the eye to emissions from un-terminated, energized optical connectors at close distances. Laser modules associated with the optical ports of laser circuit packs are typically recessed, which limits the exposure distance. Optical port shutters, Automatic Power Reduction (APR), and

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Automatic Power Shut Down (APSD) are engineering controls that are also used to limit emissions. However, technicians removing or replacing laser circuit packs should not stare or look directly into the optical port with optical instruments or magnifying lenses. (Normal eye wear or indirect viewing instruments such as Find-R-Scopes are not considered magnifying lenses or optical instruments.)

2. Only authorized, trained personnel shall use optical test equipment during installation or servicing since this equipment contains semiconductor lasers (Some examples of optical test equipment are Optical Time Domain Reflectometers (OTDR's), Hand-Held Loss Test Sets.)

3. Under no circumstances shall any personnel scan a fiber with an optical test set without verifying that all laser sources on the fiber are turned off

4. All unauthorized personnel shall be excluded from the immediate area of the optical fiber telecommunication systems during installation and service.

Consult ANSI Z136.2, American National Standard for Safe Use of Lasers in the U.S.; or, outside the U.S., IEC-60825, Part 2 for guidance on the safe use of optical fiber optic communication in the workplace.

Technical Documentation

The technical documentation as required by the Conformity Assessment procedure is kept at Alcatel-Lucent location which is responsible for this product. For more information please contact your local Alcatel-Lucent representative.

How to order

This information product can be ordered with the order number 365-312-801R7.2 at the Customer Information Center (CIC), see *http://support.alcatel-lucent.com.*

An overview of the ordering process and the latest software & licences information is given in Chapter 7, "Ordering" of this manual.

How to comment

To comment on this document, go to the Online Comment Form (http://infodoc.alcatel-lucent.com/comments/) or e-mail your comments to the Comments Hotline (comments@alcatel-lucent.com).

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1 Introduction

Overview

Purpose

This chapter introduces the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

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Structure of safety statements

Overview

This topic describes the components of safety statements that appear in this document.

General structure

Safety statements include the following structural elements:
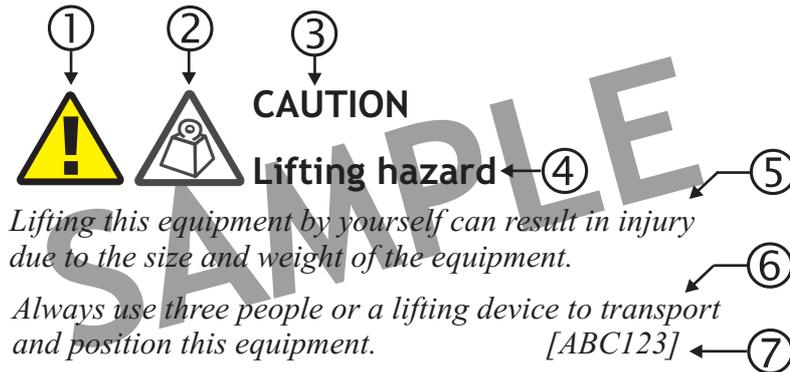
Item	Structure element	Purpose
1	Safety alert symbol	Indicates the potential for personal injury (optional)
2	Safety symbol	Indicates hazard type (optional)
3	Signal word	Indicates the severity of the hazard
4	Hazard type	Describes the source of the risk of damage or injury
5	Safety message	Consequences if protective measures fail
6	Avoidance message	Protective measures to take to avoid the hazard
7	Identifier	The reference ID of the safety statement (optional)

Signal words

The signal words identify the hazard severity levels as follows:

Signal word	Meaning
DANGER	Indicates an extremely hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Signal word	Meaning
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a hazardous situation not related to personal injury.

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1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS system overview

The 1643 AM/1643 AMS are high capacity, flexible and cost-effective wideband multiplexers which can multiplex standard PDH and SDH bit rates as well as Ethernet signals to line transport rates. These systems are useful elements in building efficient and flexible networks because of their wide-ranging in capacity in addition to a compact and flexible design.

The standard 1643 AM/1643 AMS without option card is capable of multiplexing up to sixteen 2 Mbit/s signals into an STM-1 or STM-4 signal. The equipment is available unprotected or with 1+1 MSP protection (with STM-1 aggregate only) in terminal applications and SNC/N protection for ring applications.

The main board can be upgraded with one of eleven option cards as described in Chapter 4, "Product description" and thus be adapted to special network requirements.

The standard 1643 AMS is capable of multiplexing up to sixteen DS1 or E1 (depending on the version) signals into an STM-1 signal. The equipment is available unprotected or with 1+1 MSP protection in terminal applications and SNC/N protection for ring applications. The main unit comprises 16 DS1 or 16 E1 interfaces and 2 STM-1 optical line interfaces. The optical line interfaces can be equipped with various SFPs (Small Form-factor Pluggable units). All SFPs are equipped with LC connectors. For the STM-1e interfaces 1.0/2.3 coax connectors are used. Additionally the main board can be upgraded with one of eight option cards as described in Chapter 4, "Product description".

1643 AM

The 1643 AM is an SDH STM-1 or STM-4 Terminal or Add-Drop-Multiplexer optimized to provide various tributary services, e.g. STM-1, 1.5 Mbit/s, 2 Mbit/s, 34 Mbit/s, 45 Mbit/s, X.21, SHDSL and 10/100BASE-T, to business and residential customers. The main card is able to multiplex tributary signals into a 155 Mbit/s (STM-1) or a 622 Mbit/s (STM-4) optical aggregate signal. The system provides the ability to add one option card. In the access network, the 1643 AM can be installed at the customer premises for fiber-to-the-business applications, or taking into account the large temperature range, in street cabinets for fiber-to-the curb applications enabling a variety of configurations. Other applications include LAN-to-LAN traffic on campus networks or WANs.

The space-efficient design of 1643 AM allows for wall, rack or desk mounting; please refer to the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Installation Guide.

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This figure gives an outline of the basic 1643 AM building blocks.
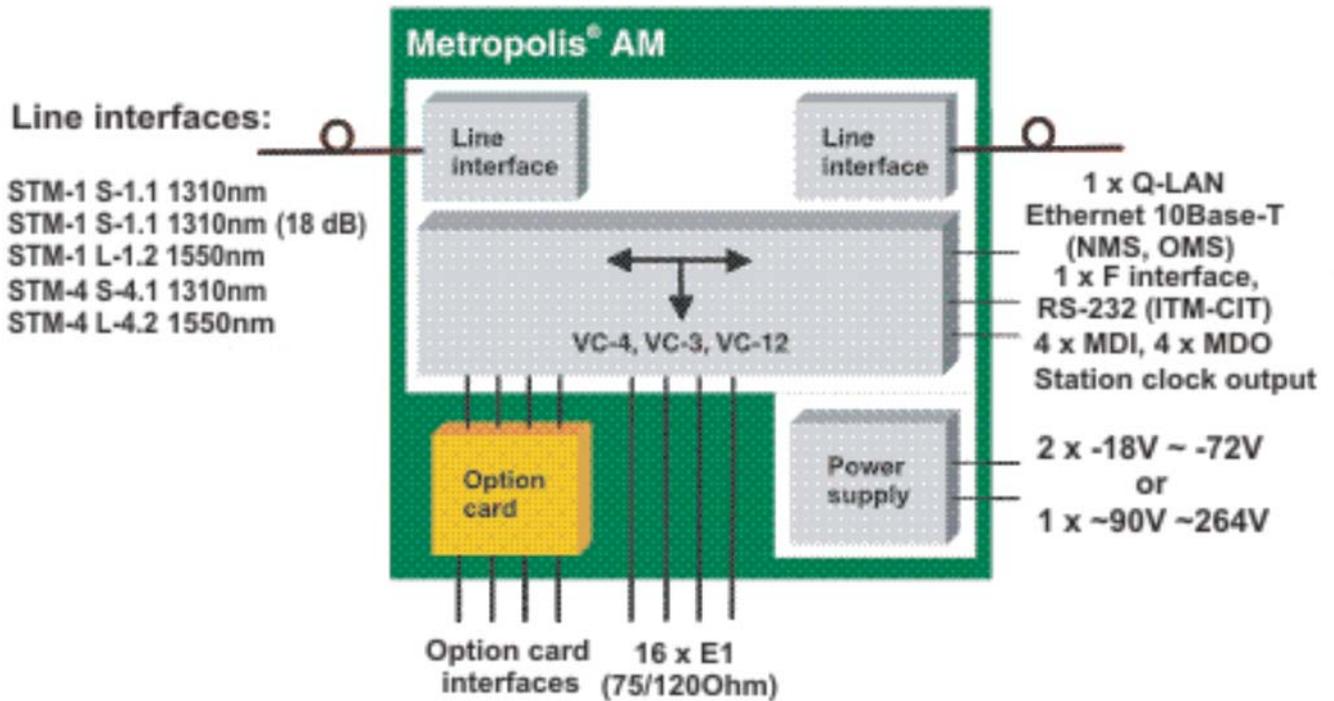
Option cards

The 1643 AM supports these option cards:

X2S11TRIB	2 × optical STM-1 tributary interfaces (short haul)
X2STM1ETRIB	2 × electrical STM-1 tributary interfaces
X16E1-V3	16 × E1 interfaces (75/120 Ω)
X16DS1	16 × DS1 interfaces (100 Ω)
X2E3-V2	2 × E3 interfaces
X2DS3-V2	2 × DS3 interfaces
X4X.21	4 × X.21 interfaces
X12SHDSL-V2	12 x SHDSL interfaces
X4IP	4 × 10/100BASE-T Ethernet LAN interfaces (*TransLAN®*)
X5IP	3 x 10/100BASE-T, 1 x 10/100/1000BASE-T, and 1 x 1000BASE-X Ethernet LAN interfaces (*TransLAN®*)
X8PL	8 × 10/100BASE-T Ethernet LAN interfaces in private line (PL) mode

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1643 AMS

This figure gives an outline of the basic 1643 AMS building blocks.
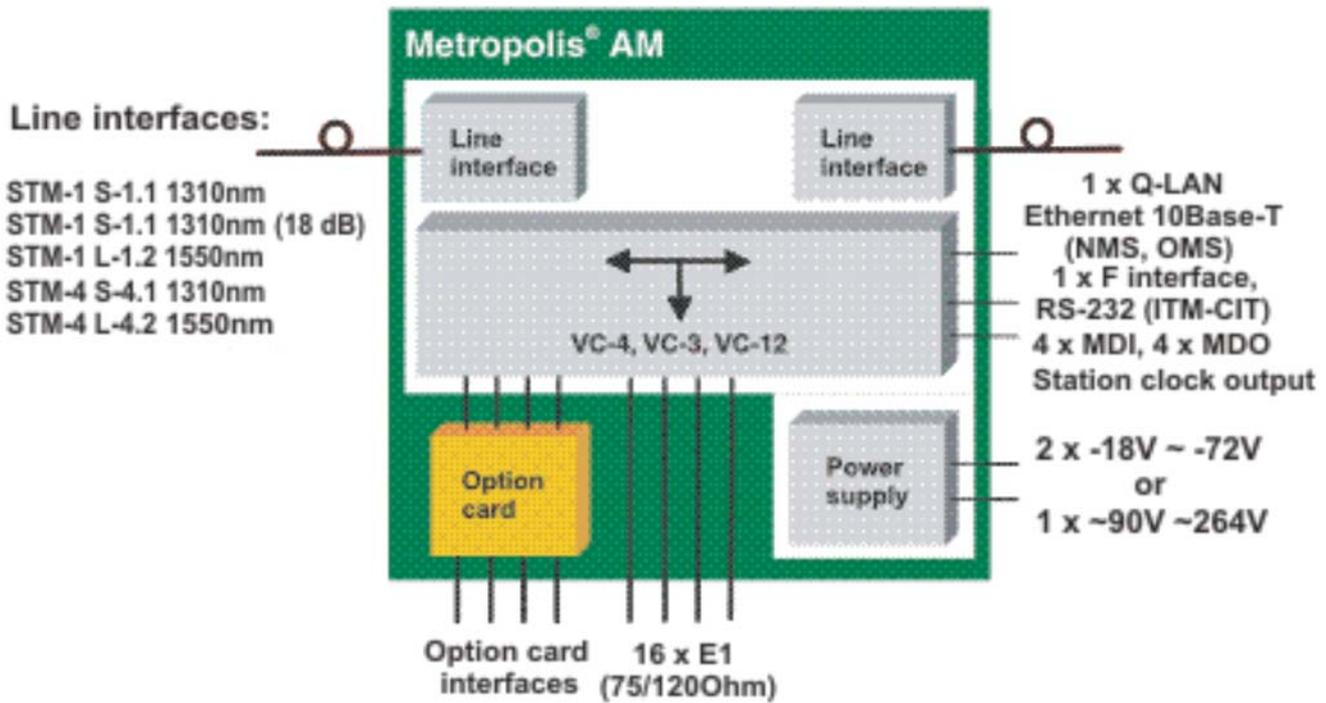
Option cards

The 1643 AMS supports these option cards:

X16E1-V3	16 × E1 interfaces (75/120 Ω)
X16DS1	16 × DS1 interfaces (100 Ω)
X2E3-V2	2 × E3 interfaces
X2DS3-V2	2 × DS3 interfaces
X4X.21	4 × X.21 interfaces
X12SHDSL-V2/V3	12 x SHDSL interfaces
X4IP	4 × 10/100BASE-T Ethernet LAN interfaces (*TransLAN®*)
X5IP	3 x 10/100BASE-T, 1 x 10/100/1000BASE-T, and 1 x 1000BASE-X Ethernet LAN interfaces (*TransLAN®*)
X8PL	8 × 10/100BASE-T Ethernet LAN interfaces in private line (PL) mode

References

A more detailed product description can be found in Chapter 4, "Product description".

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Key features

Key features of the 1643 AM/1643 AMS include the following:

- One or two STM-1 or two STM-4 optical line interface pairs (transmit/receive) for 1643 AM
- One or two STM-1 optical line interfaces with SFP for 1643 AMS
- Up to sixteen 2 Mbit/s interface ports
- General VC-12 , VC-3 and VC-4 SNC/N (only AM) protection
- 1+1 MSP protection (STM-1 interfaces only) in terminal applications
- Performance Monitoring
- E1 or DS1 loopbacks (only AMS)
- Cross-connect loopbacks
- Engineering orderwire (EOW) access (only AMS)
- Four Miscellaneous Discrete Inputs (MDI)
- Four Miscellaneous Discrete Outputs (MDO)
- 2 MHz station clock output
- IP Tunneling in the DCC channels for the management of elements (TCP/IP protocol) like "Any Media"
- Space-efficient for simple and rapid installation within racks, street cabinets (1643 AM only) or in customer premises.
- Supported by the user-friendly Alcatel-Lucent Optical Management Solutions for network management and the Alcatel-Lucent Optical Management System (OMS).
- AC/DC powered
- Working in extended temperature range.

It may also include one of the following features dependent on the use of a special option card:

- Two additional STM-1 (optical or electrical) tributary ports (1643 AM only)
- Sixteen 1.5 Mbit/s interfaces
- Sixteen 2 Mbit/s interfaces
- Two 34 Mbit/s interfaces
- Two 45 Mbit/s interfaces
- Four 2 Mbit/s X.21 interfaces
- Four 10/100BASE-T LAN interfaces
- 3 x 10/100 BASE-T, 1 x 10/100/1000BASE-T, and 1 x 1000BASE-X Ethernet LAN interfaces.
- Eight Ethernet interfaces in Private Line mode
- Twelve SHDSL interfaces.

These features make the 1643 AM/1643 AMS one of the most cost-effective, future-proof and flexible network elements available on the market today.

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Applications

1643 AM/1643 AMS are designed to cover STM-1 and STM-4 applications in the metro domain, whereby STM-4 applications are only supported by the 1643 AM.

The 1643 AM/1643 AMS support a large variety of configurations for various network applications:

- Linear application
- Folded ring application
- Ring application
- Single-homed ring application
- Linear extension application
- Grooming application
- IP tunneling in the DCC channel application
- GSM/UMTS application
- SHDSL application
- Multi-service application with the *TransLAN*® option board
- Point-to-point LAN connection

The above mentioned network applications can be found in Chapter 3, "Network topologies ".

Management

Like most of the network elements of the Alcatel-Lucent optical networking product portfolio, 1643 AM/1643 AMS are managed by the Alcatel-Lucent Optical Management Solution family. This includes the local craft terminal ITM-CIT which is available for on-site, but also for remote operations and maintenance activities and the Alcatel-Lucent Optical Management System (OMS) for integrated management of an entire transport network. Additionally, SNMP traps are supported.

Interworking

1643 AM/1643 AMS are members of the suite of next generation transmission products. The system can be deployed together with other products, for example 1643 AM/1643 AMS. This makes 1643 AM/1643 AMS one of the main building blocks for today's and future networks.

Besides the interworking with products of Alcatel-Lucent, the 1643 AMS can interwork as SHDSL LTU with several third party NTUs.

Please check with Alcatel-Lucent for a complete list of products that are able to interwork with 1643 AM/1643 AMS.

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2　Features

Overview

Purpose

This chapter briefly describes the features of the 1643 AM/1643 AMS.

For more information on the physical design features and the applicable standards, please refer to Chapter 4, "Product description".

Standards compliance

Alcatel-Lucent SDH products comply with the relevant SDH ETSI and ITU-T standards. Important functions defined in SDH standards such as the Data Communication Channel (DCC), the associated 7-layer OSI protocol stack, the SDH multiplexing structure and the Operations, Administration, Maintenance, and Provisioning (OAM&P) functions are implemented in Alcatel-Lucent product families.

Alcatel-Lucent is heavily involved in various study groups with ITU-T, and ETSI creating and maintaining the latest worldwide SDH standards.

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Physical interfaces

Overview

Purpose

This section provides information about all kinds of external physical interfaces of 1643 AM/1643 AMS. For detailed technical data and optical parameters of the interfaces please refer to Chapter 10, "Technical Specifications".

1643 AM/1643 AMS support a variety of additional interfaces dependent on the use of an option card. The choice of the option cards and data interfaces described below provides outstanding transmission flexibility and integration capabilities.

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Features
Physical interfaces

Transmission interfaces

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Transmission interfaces

SDH interface overview

1643 AM supports the synchronous transmission rates 155 Mbit/s (STM-1) and 622 Mbit/s (STM-4).

1643 AMS supports 155 Mbit/s (STM-1). All optical interface units support SDH formatted signals.

The following synchronous interfaces are available in the present release:

- One or two STM-1 or two STM-4 optical line interfaces for 1643 AM
- One or two optical STM-1 line interfaces with SFP (Small Form Factor Pluggable) for 1643 AMS. With the SFP several optical interface types can be realized in a modular way by only changing the SFP
- Two STM-1 tributary ports (optical or electrical) configurable via an option card (1643 AM only with STM-4 main motherboard, no SFP usage)
- STM-1 electrical SFP and SFP for single fiber working with 1643 AMS

PDH interface overview

1643 AM/1643 AMS provide the following integrated PDH interfaces:

- Up to sixteen 2 Mbit/s (E1) interface ports, configurable as G.703, G.704, and G.706 interfaces (75 Ω or 120 Ω)
- Up to sixteen 1.5 Mbit/s (DS1) interface ports (100Ω) in the 1643 AMS DS1 version

The following PDH interfaces can be configured via an option card:

- Sixteen 1.5 Mbit/s interfaces
- Sixteen 2 Mbit/s interfaces
- Two 34 Mbit/s interfaces
- Two 45 Mbit/s interfaces

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Data interfaces

LAN interfaces

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS support a variety of Ethernet interfaces, depending on the option cards in use.

- up to four 10/100BASE-T LAN interfaces, as part of the *TransLAN*® Ethernet SDH Transport Solution, at the X4IP option card

- up to three FE electrical Ethernet interfaces for 10/100BASE-T(X), one triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and one GE optical Ethernet interface via SFP for 1000BASE-X at the X5IP option card.

- up to eight Ethernet interfaces in Private Line mode at the X8PL option card.

SHDSL interfaces

Via an option card 12 SHDSL interfaces are available. They can be used in order to configure an LTU (Line Termination Unit). For Release 6.1 and later, there is a new version of the option card which supports new features. For more information, please refer to "Interworking with third party equipment" (p. 12-4).

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Timing interfaces

1643 AM/1643 AMS provide one external timing output for ITU-T compliant 2048 kHz timing signals, see also "Timing interface features" (p. 2-23). The timing output is realized as RJ45 connector suitable for symmetrical twisted pair cables with an impedance of 120 Ω or coaxial cables with an impedance of 75 Ω.

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Operations interfaces

Operations interfaces

The 1643 AM/1643 AMS offer a wide range of operations interfaces to meet the needs of an evolving Operations System (OS) network. The operation interfaces include:

- One Q interface

  The Q interface enables network-oriented communication between 1643 AM/1643 AMS systems and the element/network manager. This interface uses a Qx interface protocol that is compliant with ITU-T recommendation G.773-CLNS1 to provide the capability for remote management via the Data Communication Channels (DCCs). A Q LAN 10BASE-T connector (twisted pair Ethernet, for twisted pair cables) is used for the Q interface.

- One F interface for a local PC

  One RS-232 F-interface is provided, at the connection board of the 1643 AM/1643 AMS.

  This interface provides operation access for a locally installed PC, the Craft Interface Terminal - ITM-CIT

- User-settable Miscellaneous Discrete Interfaces

  The 1643 AM/1643 AMS provide 4 user-selectable Miscellaneous Discrete Inputs (MDIs) and 4 outputs (MDOs). The MDIs can be used to read the status of external alarm points, e.g. power supply detectors, open door detectors or fire alarm detectors. The MDOs indicate the alarm status of the equipment and drive external signalling devices. Labels can be associated to an MDI. An MDO can be coupled to an alarm event.

- Remote SHDSL Power Supply

  The 1643 AM/1643 AMS is also used as a Line Termination Unit (LTU) for third party Network Termination Units (NTUs). The Remote Power Supply (RPS) unit is used to power SHDSL Regenerator Units (SRU) that connect third party NTUs to SHDSL LTUs and can be connected from the MDI/MDO interfaces located on the NE. For more information about the Remote Power Supply unit, see "Remote SHDSL Power Supply (RPS) Support" (p. 12-21). For additional information, refer the 1643 AM/1643 AMS *Installation Guide*.

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Power interfaces

Optionally AC or DC powered

Both the 1643 AM /1643 AMS can optionally be AC powered or DC powered.

DC power supply

	1643 AM	**1643 AMS**
Nominal voltage range	–24 V DC to –60 V DC	
Permissible voltage range	–18 V DC to –72 V DC	
Power inputs	Two redundant power inputs that can protect each other. The system can operate completely normal on only one power feeder.	
Power connector	9-point male Sub-D connector	6-pin terminal block connector
Applicable standards	ETS 300132-2	

AC power supply

	1643 AM	**1643 AMS**
Realization	AC power input	
Permissible voltage range	120 V AC to 240 V AC with 50-60 Hz	
Power inputs	Single power input	
Power connector	3-pin IEC 60320 universal connector	
Applicable standards	ETS 300132-1	

Related information

Please also refer to the *1643 AM/1643 AMS Installation Guide*.

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Transmission features

Overview

Purpose

This section gives an overview of the transmission related features of the 1643 AM/1643 AMS. For more detailed information on the implementation of the switch function in the NE please refer to Chapter 4, "Product description".

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Cross-connection features

Cross-connection rates

1643 AM/1643 AMS support bidirectional cross-connections for VC-3, VC-4 (VC-4 only 1643 AM with STM-4 aggregate) and VC-12 payloads. One arbitrary VC-4 from each aggregate STM-1 or STM-4 (1643 AM only) signal can be used for connections at a time. It is possible to select different VC-4 timeslots from aggregate east and aggregate west.

VC-12 or VC-3 structured signals can be transported between the two aggregate lines without timeslot interchange.

Loopback cross-connections are possible on VC-12 and VC-3 level.

Cross-connect architecture of 1643 AMS

The AMS transmission architecture is the same as the transmission architecture of the STM-1 version of the 1643 AM. The main FPGA, the higher-order cross connect, and the associated circuitry that are only used on the STM-4 version of the 1643 AM are not present on 1643 AMS.

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Transmission protection

Supported protection mechanisms

To guarantee service availability, these transmission protection mechanisms are supported by the 1643 AM/1643 AMS:

- *Multiplex Section Protection (MSP)*
    - 1+1 MSP on optical STM-1 line interfaces

    The protection switching can be configured revertive and non-revertive as well as unidirectional and bidirectional (i.e. both directions of transmission are, respectively, switching separately or jointly). But the remote end of the Multiplex Section must support the necessary features for this operation.

    Forced, manual and lockout switch commands are supported. The MSP implementation is compliant with the ITU-T Rec. G.841/Clause 7.1 and ETS 300417-3-1 (i.e. the APS protocol is optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol also an alarm-free interworking mode with SONET defined MSP is supported.

    The maximum switch completion time is 50 ms.

    - *1+1 MSP on optical or electrical STM-1 tributary interfaces* (1643 AM only)

    The protection switching can be configured revertive and non-revertive and unidirectional and bidirectional (i.e. both directions of transmission are, respectively, switching separately or jointly), provided the remote end of the Multiplex Section supports the necessary features.

    Forced, manual and lockout switch commands are supported. The MSP implementation is compliant with the ITU-T Rec. G.841/Clause 7.1 and ETS 300417-3-1 (i.e. the APS protocol is optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol also an alarm-free interworking mode with SONET defined MSP is supported.

    The maximum switch completion time is 50 ms.

- *Subnetwork Connection Protection (SNCP)*
    - *VC-11 SNC/N protection (non-revertive)*

    A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-12 from the east aggregate and any arbitrary incoming TU-12 from the west aggregate line interface (VC-11s are mapped into TU-12s).

    Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

    The maximum switch completion time is 50 ms.

    - *VC-12 SNC/N protection (non-revertive)*

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A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-12 from the east aggregate and any arbitrary incoming TU-12 from the west aggregate line interface (VC-12s are mapped into TU-12s).

Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

The maximum switch completion time is 50 ms.

– *Lower order VC-3 SNC/N protection (non-revertive)*

A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-3 from the east aggregate and any arbitrary incoming TU-3 from the west aggregate line interface.

Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

The maximum switch completion time is 50 ms.

– *Higher order VC-4 SNC/N protection (non-revertive)*

In 1643 AM with STM-4 aggregates a non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming AU-4 from the east aggregate and any arbitrary incoming AU-4 from the west aggregate line interface.

Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

The maximum switch completion time is 50 ms.

Ethernet features

Ethernet and Fast Ethernet applications

The *TransLAN®* option cards (X4IP and X5IP) can be used for Ethernet and Fast Ethernet applications.

Please refer to "X4IP option card (*TransLAN®*)" (p. 4-21) for a more detailed description of the *TransLAN®* option card.

For a detailed description of the X5IP option card, refer to "X5IP option card" (p. 4-24).

Ethernet private line applications

The X8PL option card can be used for Ethernet private line applications in 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS

Please refer to "X8PL option card" (p. 4-20) for a more detailed description of the X8PL option card.

Main features of the X4IP, X8PL, and X5IP option cards

The following table lists the main features and differences of the X4IP, X8PL, and X5IP option cards.

X4IP	X8PL	X5IP
4 ports	8 ports	5 ports
provides a Layer 2 switch	no switch	Ethernet switch
supports advanced networking applications like ring connections or point-to-multi-point connections	cost optimized option card for point-to-point applications	supports advanced networking applications like ring connections or point-to-multi-point connections
no LCAS (Link capacity adjustment scheme) support	supports the LCAS (Link Capacity Adjustment Scheme) protocol	supports the LCAS (Link Capacity Adjustment Scheme) protocol
EoS (Ethernet over SDH) mapping or GFP (Generic Framing Procedure)	GFP or LAPS (Link Access Procedure SDH) (please refer to "Ethernet mapping schemes" (p. 2-15))	GFP (Generic Framing Procedure)

Link Capacity Adjustment Scheme (LCAS)

LCAS

The X8PL and X5IP option cards for Ethernet private line applications support the Link Capacity Adjustment Scheme (LCAS).

LCAS defines a synchronization protocol between two termination points of a virtual concatenated path that allows in-service dynamic sizing of the VCn-Xv bandwidth that is available for Ethernet-over-SDH transmission. This bandwidth change can occur either in response to a failure condition on one member or a requirement for a change in bandwidth at an NE (provisioning action).

In the case of a failure, the bandwidth will be restored automatically after the failure clears. The size of the VCn-Xv is increased or decreased in steps of one VCn. The provisioning is performed by adding/removing paths to/from the Ethernet tributary card.

The LCAS feature is supported for VC3-Xv and VC12-Xv.

The X5IP option card supports the latest LCAS standards as per ITU-Ts G.806 at 2006.3 and G.7042 at 2005.5 recommendations. The following enhancements are implemented.

- G.806 at 2006.3: modified defect and alarm correlation process; hold-off timer is now part of the defect-alarm process
- G.7042 at 2005.5: error corrections implemented.

Ethernet mapping schemes

Introduction

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS support the following schemes for the mapping of Ethernet packets into SDH frames:

- Link Access Procedure SDH (LAPS encapsulation)
- Ethernet over SDH (EoS encapsulation)
- Generic Framing Procedure (GFP encapsulation)

LAPS encapsulation

LAPS encapsulation is implemented according to ITU-T X.86. It is supported when using the respective option card.

EoS encapsulation

EoS encapsulation is implemented according to T1X1.5/99-268. It is supported when using the option card X4IP.

GFP encapsulation

GFP encapsulation is implemented according to T1X1.5/2000-147. It is supported when using the X8PL, X4IP, and X5IP option cards.

GFP provides a generic mechanism to adapt traffic from higher-layer client signals over a transport network.

The following GFP encapsulation are possible:

- Mapping of Ethernet MAC frames into Lower Order SDH VC12–Xv
- Mapping of Ethernet MAC frames into Lower Order SDH VC3–Xv

VC12-Xv GFP encapsulation

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS supports virtual concatenation of Lower Order SDH VC-12 as an inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC12-Xv, where X = 1...5 when using the X4IP option card and X = 1...63 when using the X8PL option card. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000).

Additionally, the use of G.707 Extended Signal Label is supported using V5 (bits 5-7) field.

VC3-Xv GFP encapsulation

The 1643 AM/1643 AMS support virtual concatenation of Lower Order SDH VC-3 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET

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network. This is noted VC3–Xv, where X = 1...3 for the X8PL and X = 1...2 for the X4IP option card. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000) and T1X1 T1.105 Clause 7.3.2 (2001 Edition).

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Equipment features

Overview

Purpose

This section provides information about 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS features concerning hardware protection, inventory and failure reports.

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Hardware concept

Standard units and option units

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS are compact and cost-effective Add-Drop-Multiplexers designed to be installed at the customer's premises for fiber-to-the-business applications. The space-efficient design allows for wall-mounting within various locations, e.g. interior closets or street cabinets.

The basis of the hardware concept is a compact standard design which includes a central cross-connect, two aggregate interfaces, basic tributary interfaces, power supply and operation interfaces on the main board. The adaptions to specific network requirements are realized by the use of several types of options boards which provide additional tributary interfaces with various bitrates, LAN or SHDSL interfaces. For a more detailed hardware description please refer to Chapter 4, "Product description".

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Equipment reports

Equipment inventory

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS automatically maintain an inventory of the following information of each installed circuit pack:

- Serial number

- ECI code

- Functional name

- Item code

- Software release (of the NE)

- Comcode

- Interchangeability Marker

You can obtain this information by an inventory request command.

1643 AMS additionally supports an inventory of the used SFPs. Besides the administrative state the following information can be retrieved for the currently present and last accepted SFP:

- Physical identifier

- Connector type

- Transceiver code

- Revision number

- Vendor serial number

- Comcode

- Compatibility byte

- Alcatel-Lucent unique ID

- WES SFP vendor ID

- SFP length

- Module qualifier

- Module type

For detailed information on these parameters please refer to the *User Operations Guide, Chapter Equipment provisioning - Parameters for viewing SFP inventory data*.

Equipment failure reports

Failure reports are generated for equipment faults and can be forwarded via the ITM-CIT or Alcatel-Lucent OMS interfaces.

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Digital Diagnostics Monitoring (DDM) of SFPs

Overview

This section provides information on 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS features related to Digital Diagnostics Monitoring (DDM) of SFPs.

SFP module information

The user can view the performance parameters information of an SFP optical interface module. This data known as "digital diagnostics" depends on the manufacturer and type of SFP module in use.

The "digital diagnostics" feature provides the following information:

- optical input power in dBm (± 3 dB accuracy). This number is displayed as an average value (AVG) or as an optical modulation amplitude (OMA) value. The lowest value reported is −40 dBm

- optical transmit power in dBm (± 3 dB accuracy). The lowest value reported is −40 dBm.

- Laser bias current in mA (± 10% accuracy)

- internal temperature of the module in °C (± 3°C accuracy)

- supply voltage of the module in V (± 3% accuracy)

For each parameter, four thresholds are displayed in the same units. A flag appearing against a parameter indicates deviation from the upper and lower warning and alarm threshold values specified by the manufacturer of the SFP.

The system does not monitor the SFP parameters and no alarms are raised if the SFP thresholds deviate from the specified values.

Note: The system generates an "unavailable" response if:

- digital diagnostics is not supported by the SFP module

- the administrative state of the module is not in the "ACCEPTED" state

- the data in the SFP contains checksum errors

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Synchronization and timing

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Overview

Purpose

This section provides information about synchronization features, timing protection and timing interfaces of 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

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Timing features

Synchronization modes

Several synchronization configurations can be used. 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS can be provisioned for the following timing modes:

*   free-running operation
*   holdover mode
*   locked mode

In locked mode, the internal SDH Equipment Clock (SEC) is locked to:

*   one of the STM-1 or STM-4 (1643 AM only) aggregate signals.
*   one of the sixteen 2 Mbit/s tributary signals from the main board or the respective option card

    Note: The 1643 AMS supports one of the sixteen 1.5 Mbit/s tributary signals from the main board or option card in locked mode.

*   one of the STM-1 signals (1643 AM only) from the respective option card

Timing interface features

Synchronization Status Message (SSM) signal

A timing marker or synchronization status message signal can be used to transfer the signal-quality level throughout a network. This will guarantee that all network elements are always synchronized to the highest-quality clock that is available.

On the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS systems the SSM algorithm or the timing marker is supported according to ITU-T recommendation G.781 and ETSI recommendation ETS 300-417-6-1. The SSM is supported on all STM-N interfaces.

Timing input

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS do not support a timing input.

2 Mbit/s and 1.5 Mbit/s tributary retiming

The user can choose whether individual 2 Mbit/s (E1 or X.21) or 1.5 Mbit/s tributary outputs operate in "self-timed" or "re-synchronized" mode. In the (standard) self-timed mode, the phase of the outgoing signal is a moving average of the phase of the 2 Mbit/s/1.5 Mbit/s signal because the signal is embedded in the VC-12 that is disassembled. In the re-synchronized mode the 2 Mbit/s/1.5 Mbit/s signal is timed by the SDH Equipment Clock (SEC) of the network element; frequency differences between the local clock and the 2 Mbit/s/1.5 Mbit/s signal embedded in the VC-12 to be disassembled are accommodated by a slip buffer.

There is also the following option: whenever the traceability of the local clock drops below a certain threshold, the re-timing 2 Mbit/s/1.5 Mbit/s interfaces automatically switch to self-timing. When this fail condition disappears, these interfaces return to re-timing. These changes do not involve any hits in the traffic.

> **Important!** Re-timing should only be applied when the network element which performs the re-timing and the network element which generated the 2 Mbit/s or 1.5 Mbit/s signal have traced back their SECs to the same synchronization source. Otherwise a continuous stream of 2 Mbit/s/1.5 Mbit/s frame slips or skips will occur at the re-timing point which is indicated by a FCS threshold crossing alarm.

> The user has the option of operating individual 2 Mbit/s or 1.5 Mbit/s outputs in the "re-synchronized" mode. In this mode the 2 Mbit/s or 1.5 Mbit/s output signal is timed by the system clock of the network element. However, when operating the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS with the additional option card, jitter requirements for the 32nd port operating in this mode may exceed ITU-T Recommendations G.783, G.813 (option 1), G.823 and G.825.

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Operations, Administration, Maintenance and Provisioning

Overview

Purpose

The following section provides information about interfaces for Operations, Administration, Maintenance, and Provisioning (OAM&P) activities and the monitoring and diagnostics features of 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

Contents

Remote maintenance, management and control

First maintenance tier

The maintenance procedures of the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS systems are built on two levels of system information and control. The first maintenance tier consists of the LEDs on the equipment. There are two LEDs on the front of the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS. Additionally there are LEDs on option cards and near to the SFPs for 1643 AMS. The LEDs indicated basic alarms or basic operation states.

Second maintenance tier

The second maintenance tier employs the Alcatel-Lucent network management system. Detailed information and system control are obtained by using the ITM-CIT (Craft Interface Terminal), which supports provisioning, maintenance and configuration on a local basis. A similar facility (via a Q-LAN connection or via the DCC channels) is remotely available on the element manager, the Alcatel-Lucent OMS, which provides a centralized maintenance view and supports maintenance activities from a central location.

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS support SNMP management via the Q-LAN interface.

Alcatel-Lucent Optical Management System

At network level (customer's network management center), Alcatel-Lucent Optical Management System (OMS) performs all the tasks that are necessary to supervise, operate, control and maintain an SDH network with the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

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Tunneling of TCP/IP over DCN

IP tunneling

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS are capable of tunneling IP traffic through the OSI DCN network. The tunnel provides a virtual interconnection for IP traffic between the "Ethernet interfaces (LAN)" and/or "end points of other IP-tunnels (terminating in the NE)" of two NE's that support this feature.

Refer to the following figure for an example of IP tunneling:
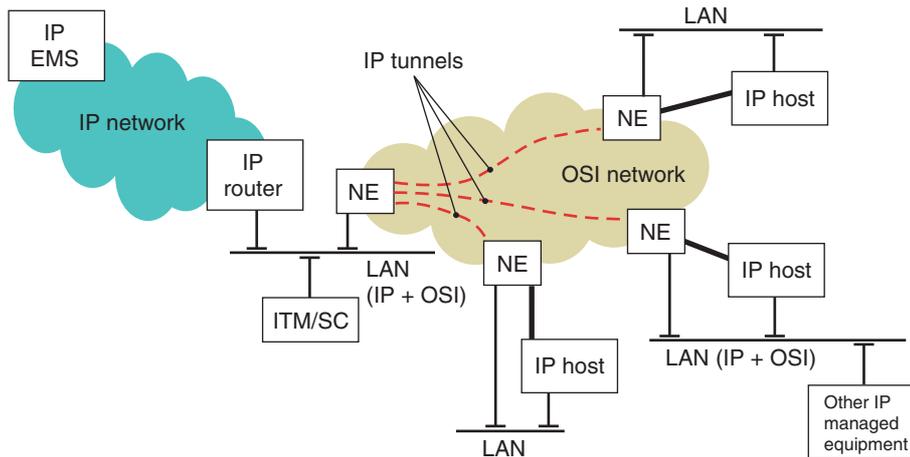
Note that a tunnel may forward IP traffic to many destinations, that can either be connected to the Q-LAN of the far end tunneling NE, or must be reached through subsequent routing towards/through other IP-tunnels and/or towards/through external IP routers.

The LAN interface supports both IP and OSI traffic simultaneously. Tunneling is achieved by encapsulating the IP packets in CLNP (OSI) packets.

This feature has no effect on the OSI management of the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS itself, apart from the performance impact of additional IP traffic. This feature requires the NE to act as an IP router itself. The IP router supports ports to the Ethernet Interface (Q-LAN) and to the CLNP (OSI) network (i.e. a number of tunnels).

IP tunneling and purposes

This feature is intended to forward IP traffic between IP managed equipment at the borders of the SDH network and their IP-based management system.

In order to use the tunneling feature it is necessary to provision the following using the Alcatel-Lucent OMS or the ITM-CIT:

- map a "tunnel far-end" to each (masked) IP-destination, where all IP-addresses are implied that fulfil the most significant bits (non-masked) part of the IP-destination. Only the far-end of a tunnel needs to be identified through its NSAP address (the near-end is implicitly this NE). Resources for a maximum of 50 tunnels must be provided.

- provision its own IP-address in the NE.

- enable IP routing.

- add routing information for forwarding towards an external IP router, when the IP-destination is not connected to the Q-LAN of the NE.

- enable (when desired) automatic creation of tunnels, towards all other NEs in this area that have automatic creation enabled. Note that manual provisioning is needed for a tunnel that spans a number of areas, while subsequent tunneling within the destination area can make use of automatically created tunnels.

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Alarm severity assignment profile

Overview

An Alarm Severity Assignment Profile (ASAP) is a list of alarms with an associated severity value for every alarm. ASAPs allow the user to control alarm reporting with more flexibility, and to create multiple alarm profiles for each alarm category and to assign these profiles to entities within the system. The supports flexible alarm reporting through the Alarm Severity Assignment Profiles (ASAP).

All alarms are classified into a particular alarm category and are pre-defined. The categories containing the alarms are referred to as pre-defined alarm profile types. Each profile type has a default profile and a set of profiles created by users. These profiles and the default profiles within the profile types are referred to as ASAPs. The assigned alarm severity levels refer to each alarm within each ASAP. For each alarm in the alarm profile, users can assign a severity value and reported state. The alarm severity values and reported state constitute the Alarm Severity Assignment Profile. The default profiles are available after system installation. When a failure occurs, the ASAPs created by customers are used to specify the alarm severity level.

All the alarms are categorized into 15 different ASAP types. For example, equipment, DCN, timing, and so on. The default ASAPs contain default settings for the severity and reporting values and can be edited. In addition to the default ASAP, multiple ASAPs can be created, edited, and deleted. For each alarm profile type, a default ASAP is available and can be edited but cannot be deleted. Users can assign labels for each ASAP. However, ASAP values created by customers can only be deleted when they are not assgined to a port or termination point. The default ASAP values are effective, whereas, every new ASAP profile created by customers must be assigned to a functional system entity such as a specific port or termination point to be effective.

During provisioning, ASAPs can be assigned to functional system components such as a circuit pack or a specific port. Each ASAP can be uniquely identified by its type and name. Note that predefined or default alarms or profile types can be edited but the profile name cannot be changed or deleted by the user. Only the profiles created by the user can be changed or deleted.

The severity and reported values are enabled when the ASAP is assigned to a port or termination point that can raise the alarms contained in the alarm profile type. Individual ASAPs can also be assigned to a multiple set of functional system entities according to their ASAP type.

The supports 64 ASAPs including the default profile. In addition to the default ASAPs, customers can create up to 49 new ASAPs.

For more information on how to create, modify, delete, assign or retrieve ASAPs, refer the *1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS User Operations Guide*.

Alarm severities

These alarm severity levels are used in the following description of the ASAP types:

1. Prompt (Urgent alarm that requires immediate (prompt) maintenance action)

2. Deferred (Non-urgent alarm that requires deferred maintenance action)

3. Info (Informational alarm).

Reporting state

Each alarm can be assigned one of the following reporting states:

Reporting state	Meaning
Reported	The alarm - when raised - will be reported towards the management systems, and displayed on the graphical user interfaces.
Not reported	The alarm - when raised - will *not* be reported.

Please note that changing the alarm reporting state does not affect the display of currently present and history alarms. Especially, the display of already present alarms cannot be removed if their reporting state is changed from "Reported" to "Not Reported".

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3 Network topologies

Overview

Purpose

This chapter illustrates different applications of the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS (respective NE capabilities have to be considered).

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Linear applications

Point-to-point applications without MSP protection

The figure below shows an example of a point-to-point application without MSP protection.

STM-1 or STM-4

Metropolis AM/AMS

E1   E3

Metropolis AM/AMS

E1   E3

Metropolis AMS: STM-1 only
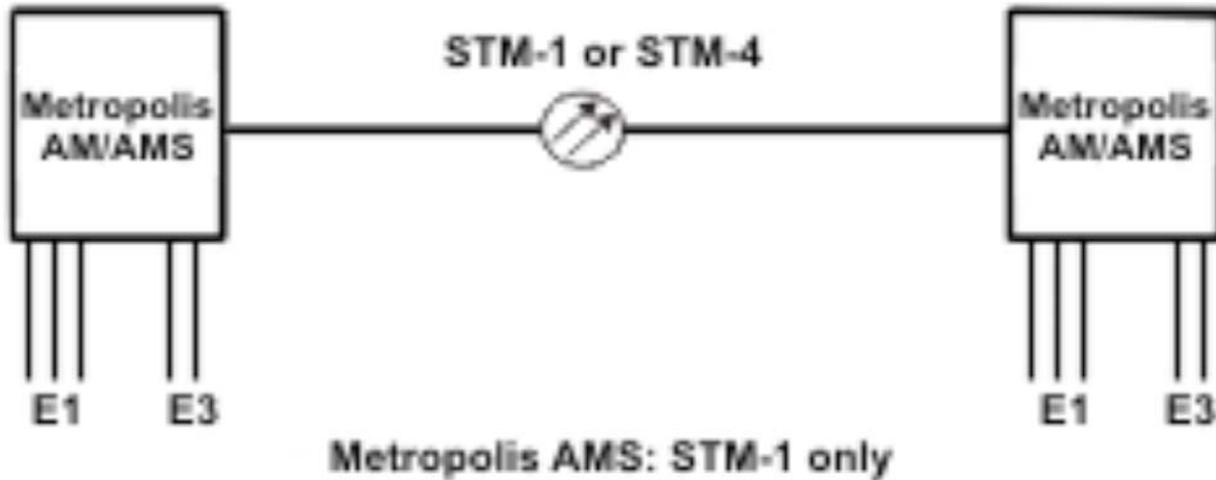
Point-to-point application with MSP protection

The figure below shows an example of a point-to-point application with MSP protection. Note that 1 + 1 MSP protection is only available for STM-1 transmission.

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Metropolis AMS: STM-1 only
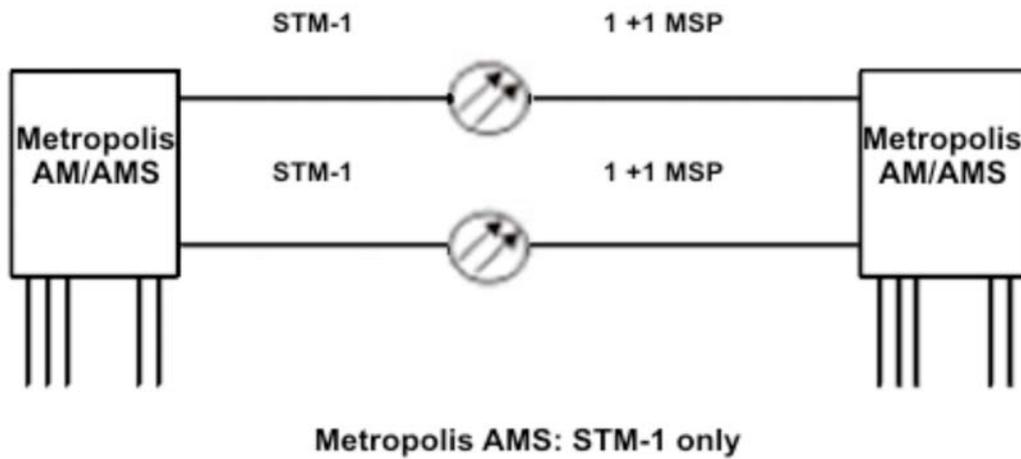
LAN-to-LAN linear unprotected application

When cost is a major factor, this application requires a minimum amount of equipment and fiber. It is well suited for LAN-to-LAN traffic on campus networks or between business locations requiring cost-effective and reliable communications. Management requirements of this application are minimal.

Metropolis AMS: STM-1 only

....
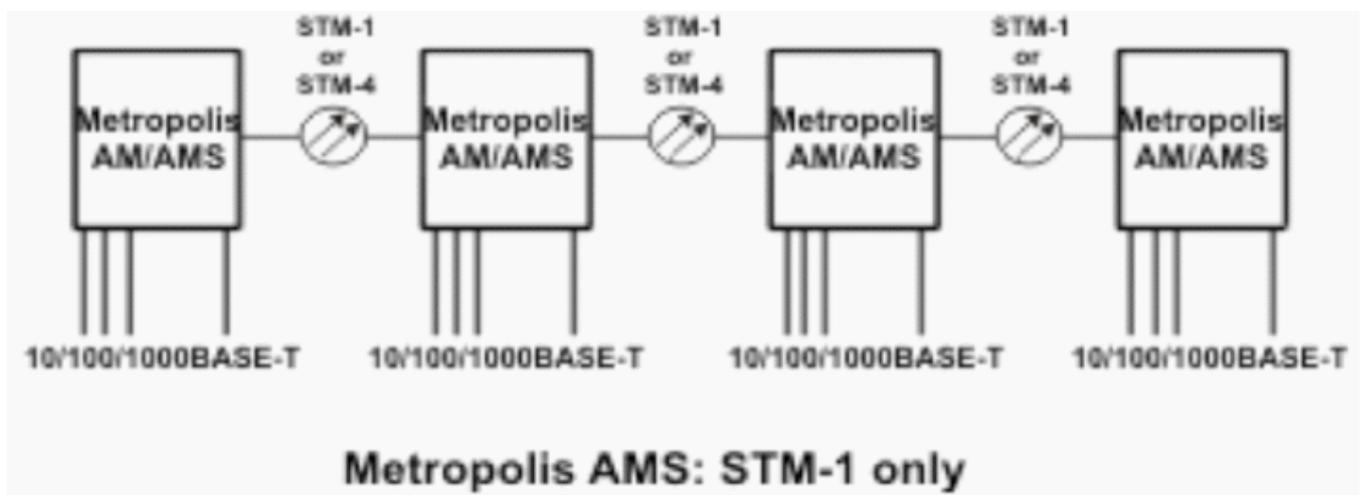
Folded ring application

The figure below shows an STM-1 or STM-4 Folded Ring application.

Compared to the linear application in "LAN-to-LAN linear unprotected application" (p. 3-3), the folded-ring provides extra reliability by protecting the NE chain by building a ring. Within the chain NEs can flexibly be added or removed while the protection within the ring remains untouched. However, note that 1 + 1 MSP protection is only available for STM-1 transmission.
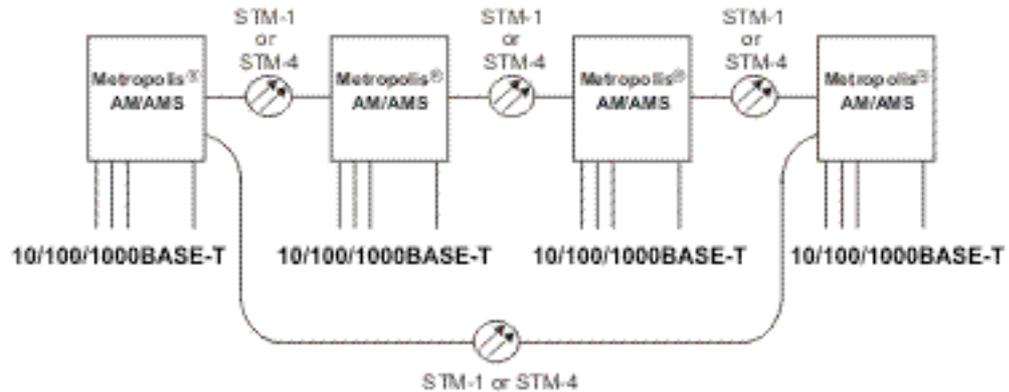
Metropolis® AMS: STM-1 only

Ring application

The STM-1 or STM-4 Ring application illustrated in the figure below is an example of a simple and inexpensive way of transporting all signals that can be connected to a 1643 AM, like STM-1 tributary, E1, DS1, E3, DS3, X.21 and 10/100 BASE-T. The individual nodes can be managed remotely or locally by either Alcatel-Lucent OMS or ITM-CIT.

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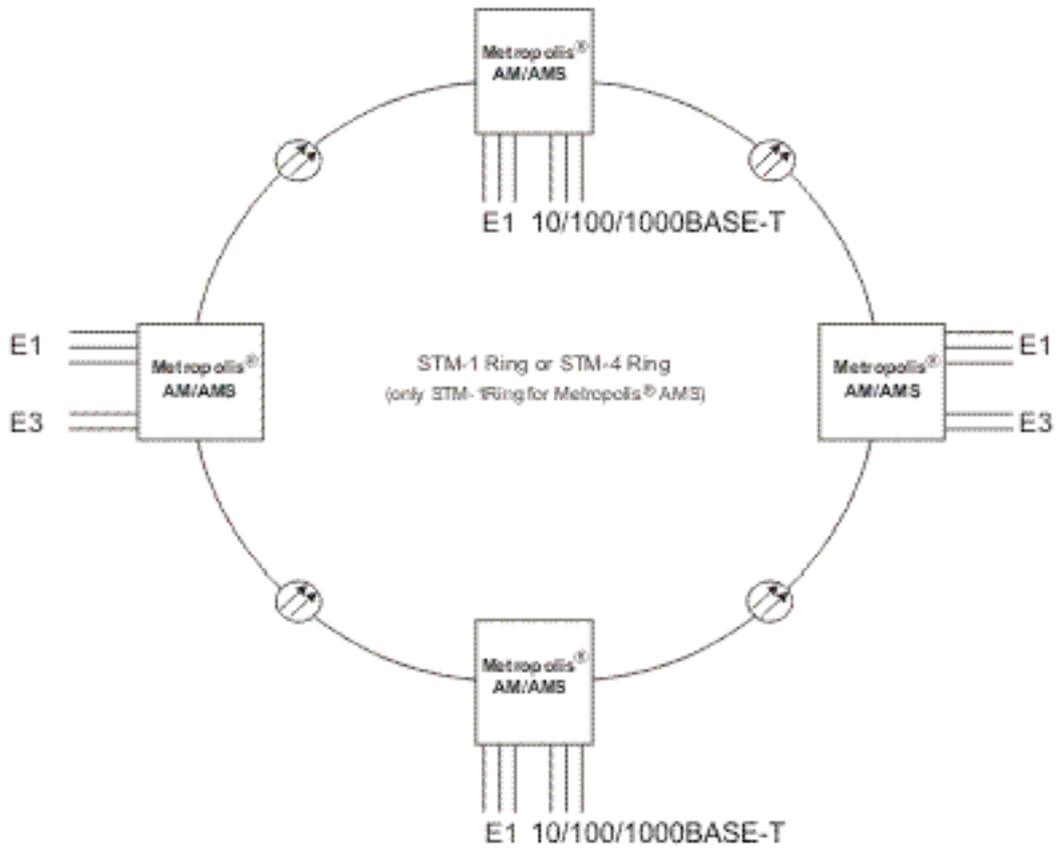
Single-homed ring application

The figure below illustrates a single-homed ring application. This configuration connects the STM-4 ring to the STM-N network through a host node.

An STM-1 line (STM-1 tributary interface) with MSP protection allows the connection between e.g. two 1643 AM.
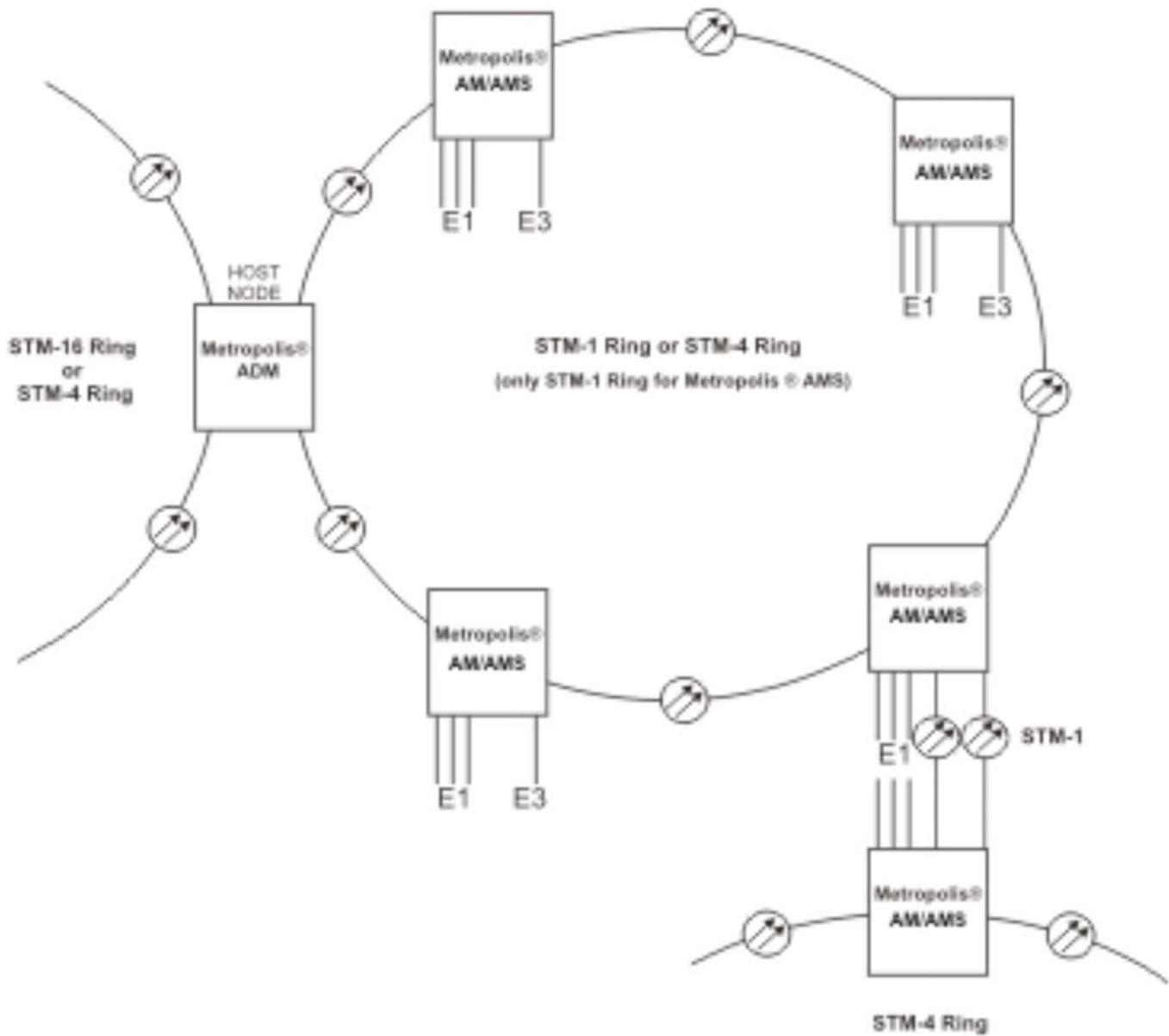
Dual-homed ring application

The figure below shows an example of a dual-homed ring application. Similar to the single-homed example in the previous chapter, access to the STM-N network is through two hosts. This may be preferable to the single-host application where completing the STM-1 or STM-4 ring may be difficult due to geographical features. It also provides protection against node failure through the second host node.
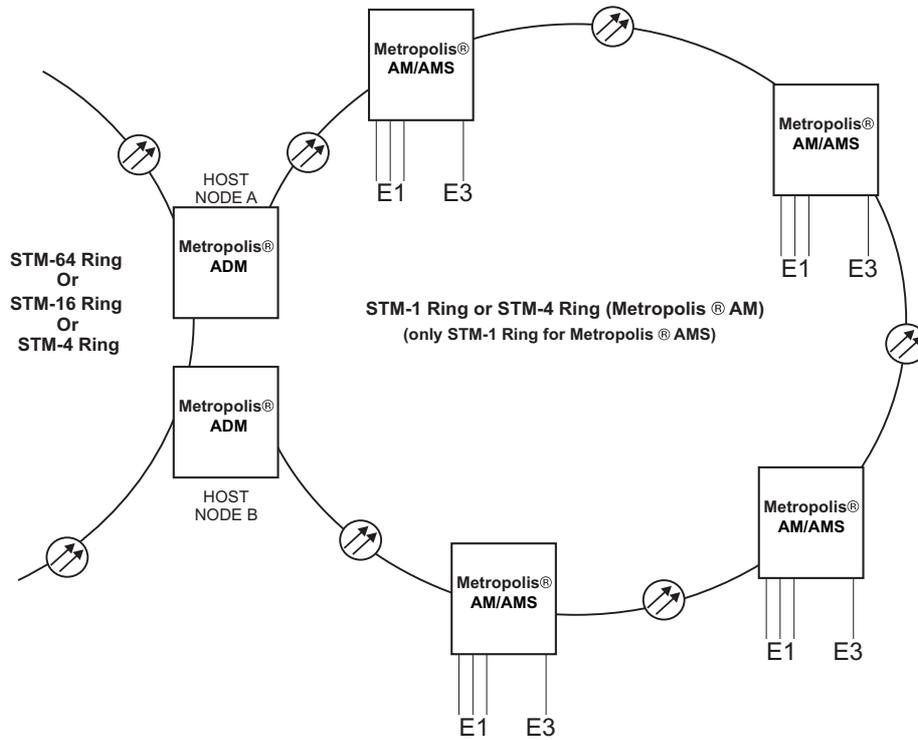
Linear extension application

The figure below shows a linear extension hosted by a 1663 ADMu NE. It is a low cost solution for extending E1 and E3 services from the STM-N ring.

Metropolis® AMS: STM-1 only

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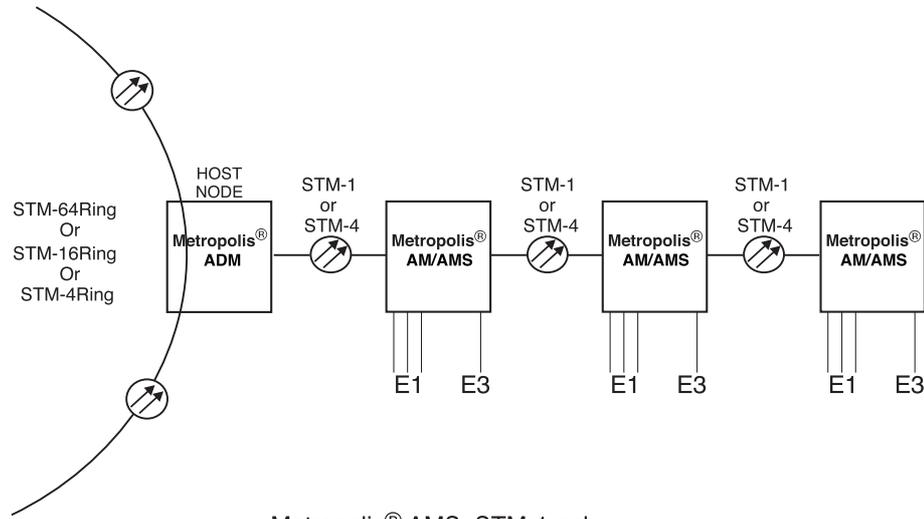
IP Tunneling in the DCC channels application

The figure below shows an example of the IP tunneling in the DCC channels application. This feature provides a way to manage IP devices through the Data Communication Network (DCN). An IP EMS (Element Management System) is used to manage NEs which use IP based management protocols (IP NEs).

The embedded overhead channel (Data Communication Channel) of the 1643 AM/1643 AMS is used to transport the management data between the IP EMS and the different NEs.

An IP tunnel can be seen as a set of two static routing entries in nodes on the edge of the OSI network and the corresponding static entries in the routing table. The LAN used by IP EMS can also be used by the Alcatel-Lucent OMS.

ds NE = Network Element with dual stack
NE = Other Network Element
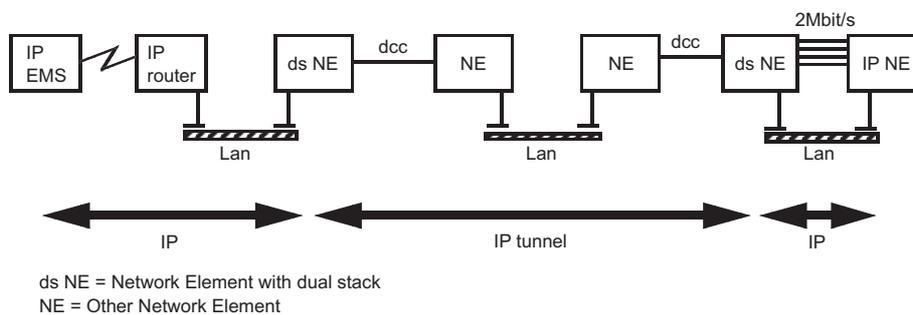
The figure below shows an application with AnyMedia Access equipments (AAS). The EMS for AAS realizes the management of the different AAS equipments via the Q-LAN interfaces and using the DCC channels of the different 1643 AM/1643 AMS.

········ = IP tunneled via OSI DSN

= Equipped as Metropolis AM/AMS

....
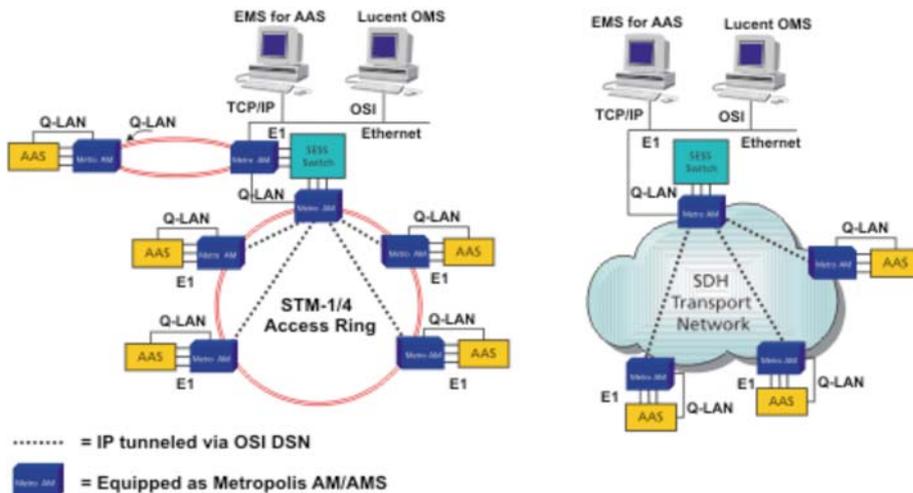
GSM/UMTS application

The 1643 AM/1643 AMS is an attractive offer in a ring topology for serving GSM/UMTS base stations.

The figure below illustrates an example of 1643 AM/1643 AMS in a GSM/UMTS application.

....
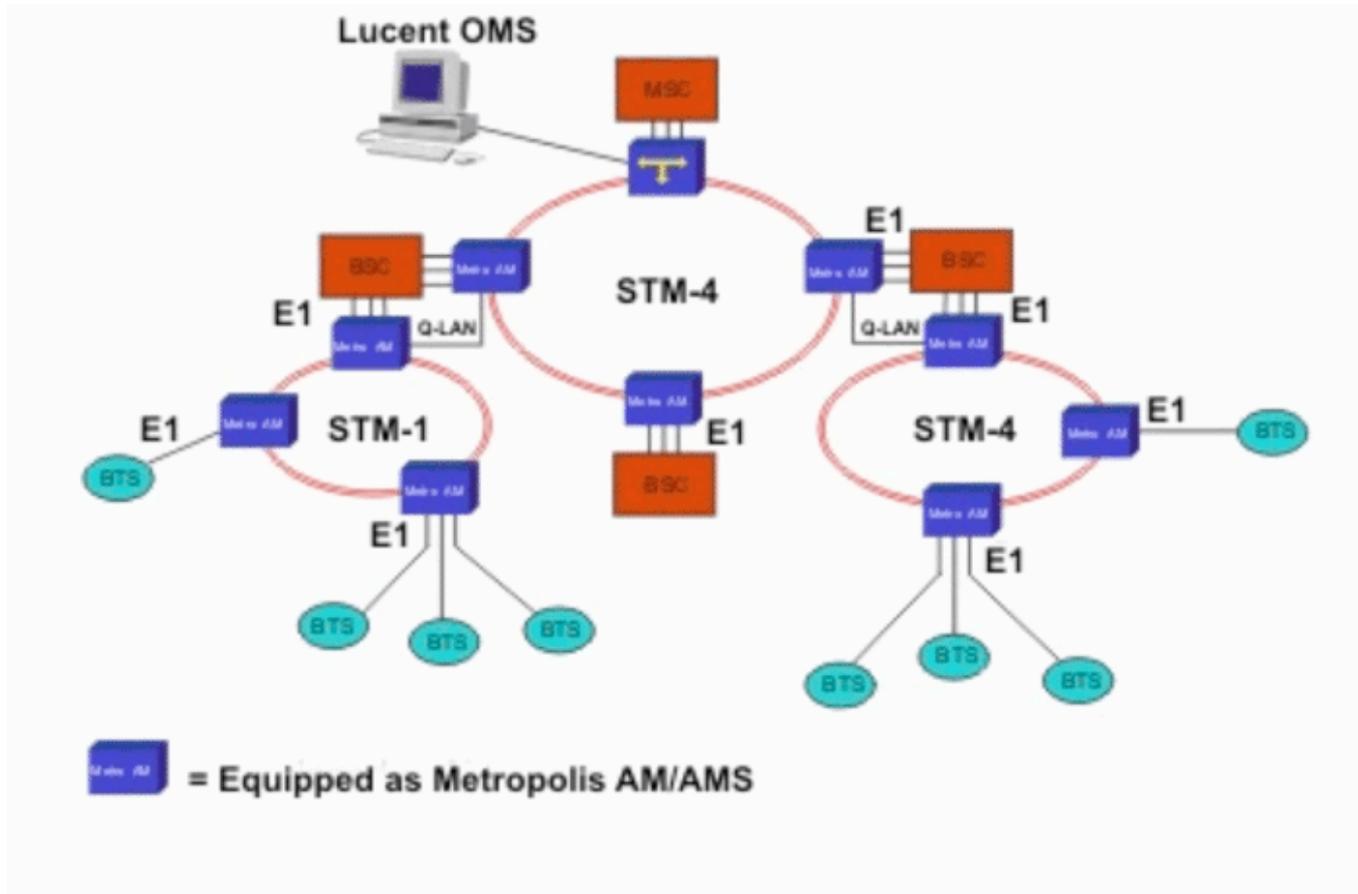
SHDSL applications

E1 over SHDSL

For locations that cannot be reached via fiber, the 1643 AM/1643 AMS offer an SHDSL extension option board. This allows the transmission of E1s in a frame structure over copper lines. Distances of up to 3.5 km can be reached. The E1s are either directly mapped to the SHDSL structure or first mapped into a TU-12 and then into SHDSL. The latter allows full SDH path monitoring for the path which is terminated in the SHDSL Network Termination Unit (NTU). The 12 SHDSL ports on the 1643 AM/1643 AMS option board allow for a cost effective solution.

Alcatel-Lucent supports a variety of E1 and TU-12 third party NTU modems.
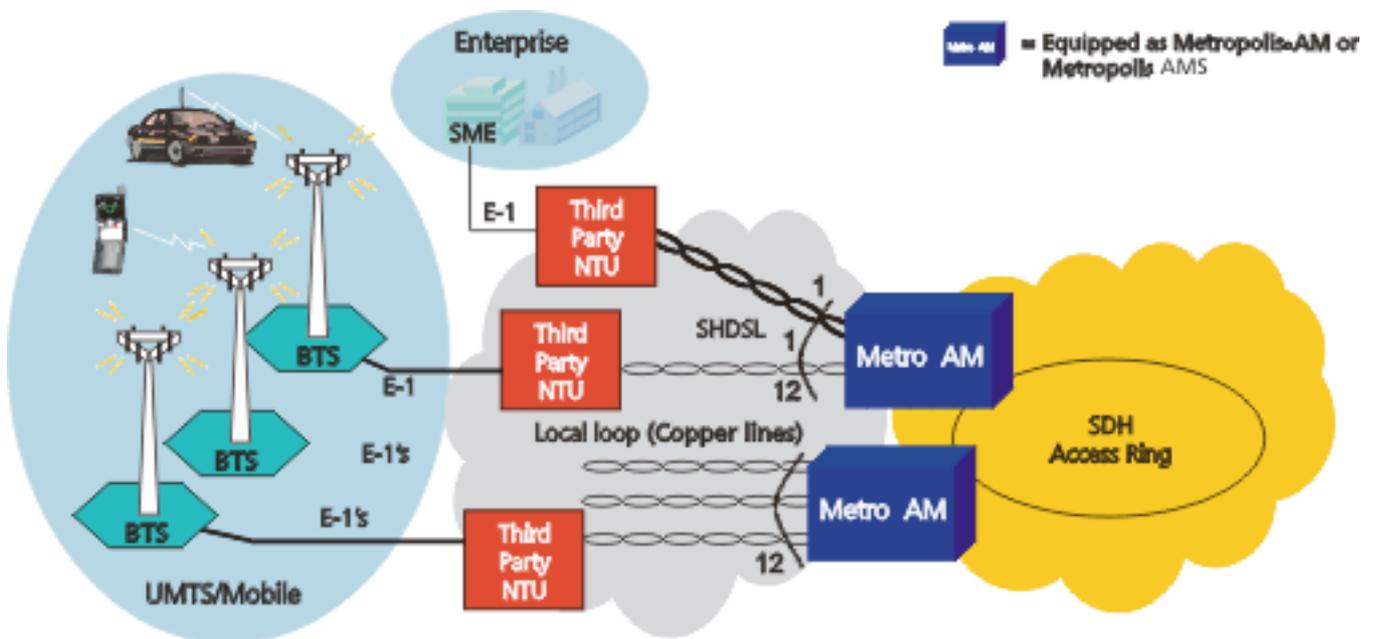
Ethernet over SHDSL

Ethernet data can be transmitted over SHDSL by using a third party TU-12 NTU modem. The data are first mapped into a TU-12 and then into the SHDSL structure according to GFP mapping. Two examples are shown in the figure below. The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS facilitate the transmission of Ethernet data from an NTU via the SDH network to another NTU. But they provide also the compatibility for a connection between an NTU and the Ethernet option cards X4IP, X5IP or X8PL within the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

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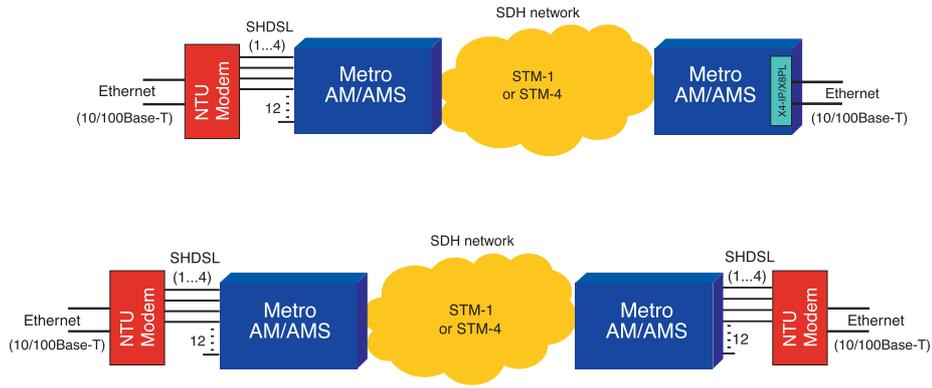
For a detailed description of enahnced SHDSL features, refer to Chapter 12, "SHDSL Overview".

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Multi-service application with the *TransLAN*® option board

The *TransLAN*® option board, enables the SDH network elements to provide Ethernet over SDH, and offers variable data applications on top of the traditional TDM applications. This results in cost-effective, simple and reliable multi-service solutions for customers. *TransLAN*® can provide VLAN functions, and bandwidth can be shared for different customers.

Direct LAN-to-LAN interconnect (two LAN's)

The most straightforward application of the *TransLAN*® option board is to interconnect two LAN segments that are at a distance that cannot be reached with a simple Ethernet repeater, since that would violate the collision domain size rules. Both LAN's do not have to be of the same speed. It is possible to interconnect a 10BASE-T and a 100BASE-T LAN this way. This application is shown in the figure below:
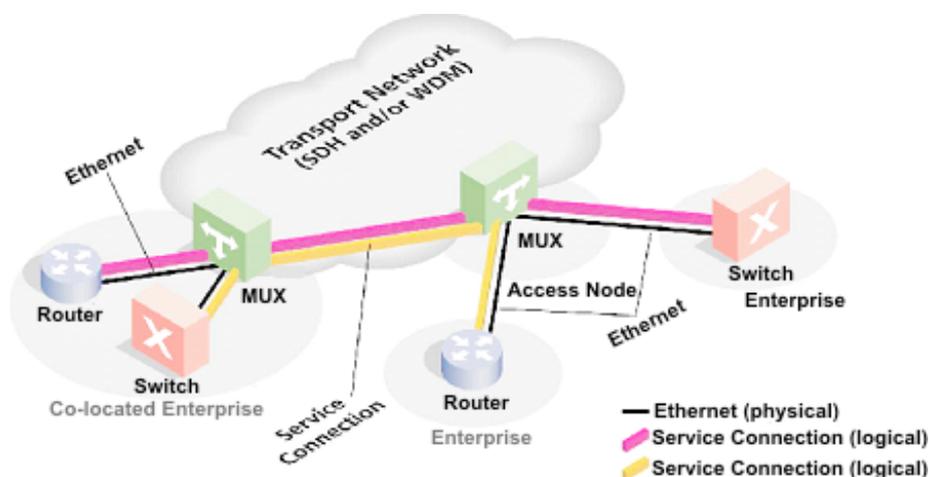
Direct LAN-to-LAN interconnect (Multiple LAN's)

A next step in complexity is to interconnect multiple LAN's, more than two, at different locations. It is possible to associate a single LAN port with two or more WAN ports. In this way multiple sites can be interconnected, forming a fully Layer 2 switched WAN Ethernet network. This application is shown in the figure below.
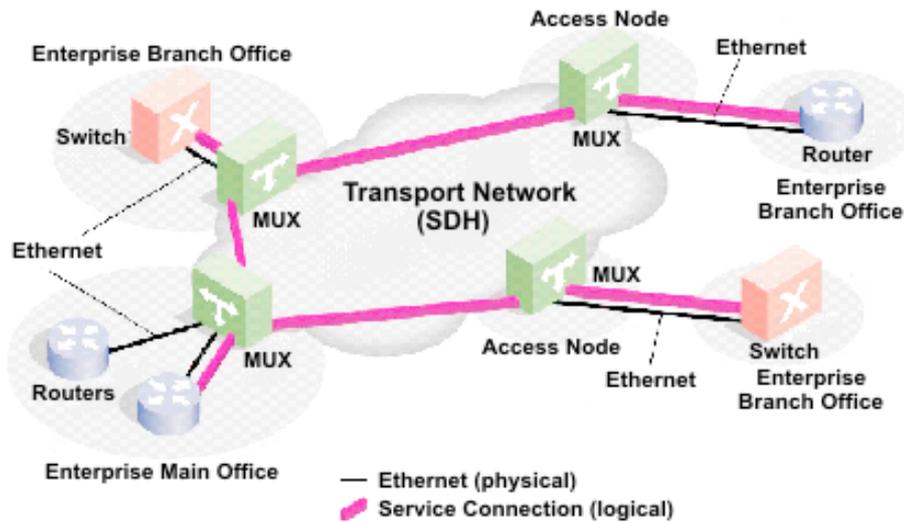
LAN-ISP interconnect

An extension of the previous application is to have one LAN drop of a multi-point LAN-to-LAN interconnection at the point of presence of an ISP (Internet Service Provider), to provide for instance Internet access to the users in the company LANs.

Multiple customers sharing a WAN connection

To increase the efficiency of the bandwidth usage, it is possible to route the Ethernet traffic of multiple end-users over the same SDH facilities. This feature is called LAN-VPN and makes use of customer VPN tags, a tagging scheme derived from the IEEE802.1Q VLAN standard to separate the traffic of the different users. Via the IEEE 802.1ad provider bridge mode it is additionally possible to use provider-defined tags for different customers and thus to be independent from customer VPN tags. A respective application is shown in the figure below.
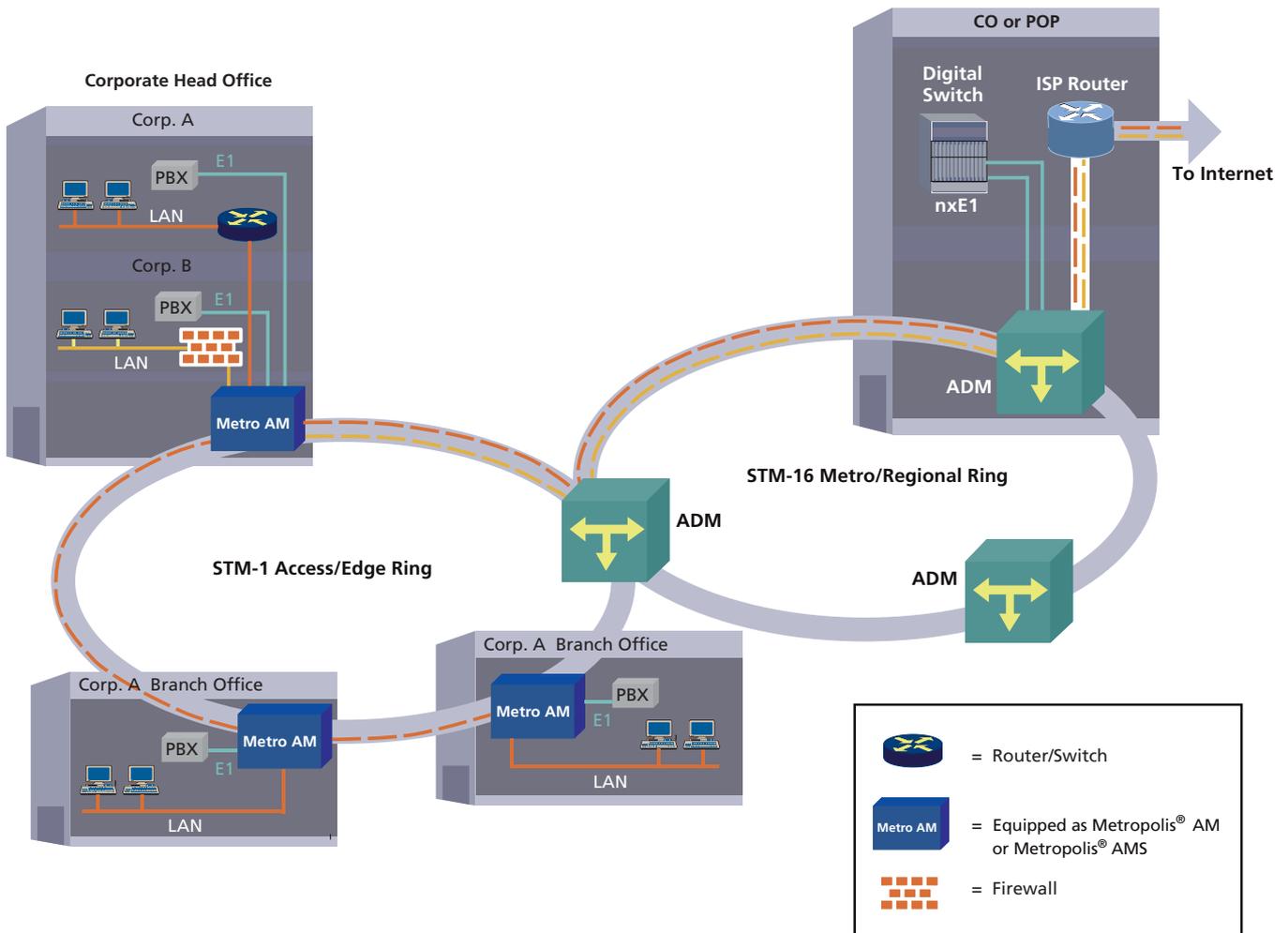
VLAN Trunking

At the ISP premises, the aggregated LAN traffic from multiple customers (i.e. multiple VLANs) via one single high capacity Ethernet link (Fast Ethernet) to data equipment in a Central Office or ISP POP such as an IP edge Router, IP Service Switch or ATM Switch, can be handled by means of the VLAN trunking feature. VLAN trunking is a possible application of the IEEE 802.1Q and IEEE 802.1 ad VLAN tagging scheme. Main benefit of the VLAN trunking feature is that *TransLAN*® cards can hand off end user LAN traffic via one high capacity LAN port instead of multiple low speed LAN ports, thus reducing port, space and cabling costs. The following figure illustrates an example of VLAN Trunking.

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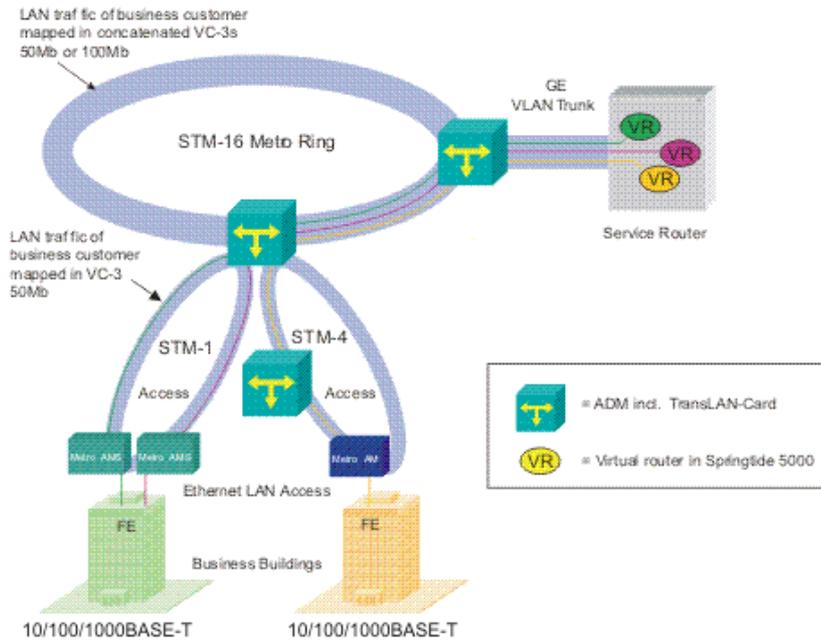
DCN support with the *TransLAN®* unit

The *TransLAN®* option board can also be used for DCN engineering purposes. An important application in this respect is to use the Ethernet interfaces to make a long distance Q-LAN connection. This solution can replace the current solution that uses external modems or routers. It is often cheaper and easier to manage if the long distance Q-LAN connection can be made over the SDH infrastructure (at the cost of the bandwidth of a few VC-12s). The DCN application of the *TransLAN®* option board assumes the Alcatel-Lucent OMS is collocated with at least one of the NEs equipped with a *TransLAN®* card (e.g., 1643 AM/1643 AMS, 1663 ADMu). In such a case, one can

....

connect the Ethernet port of the Alcatel-Lucent OMS to one of the designated
10BASE-T/100BASE-TX LAN ports and configure the associated WAN port with
desired bandwidth (e.g., VC12) to carry the management traffic.

Additionally it is possible to integrate 1643 Access Multiplexer AM/1643 Access
Multiplexer Small AMS in other vendor's networks and to pass through their DCC_R
transparently.

....
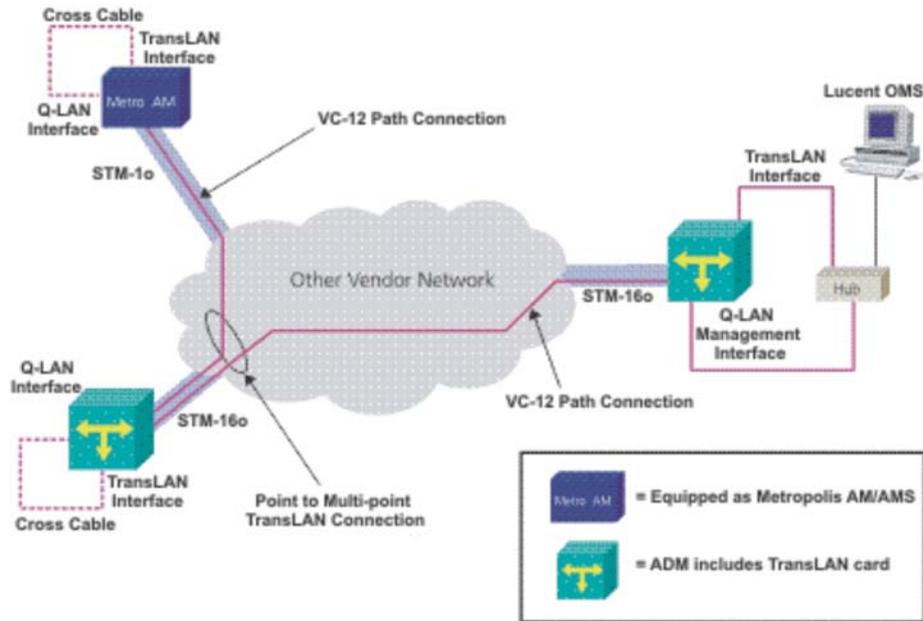
Point-to-point LAN connection

The point-to-point LAN connection is used to interconnect two sites of a customer each of which has a LAN interface. Another application is the interconnection of the sites of two service providers that have Ethernet interfaces.

Some dedicated SDH bandwidth is allocated to the connection between both end points. Virtual concatenation allows the operator to assign a customized SDH bandwidth. Such an application can cost-effectively be realized with 1643 AM/1643 AMS using the X8PL option card which provides the GFP and LAPS Ethernet mapping schemes and the LCAS protocol (please refer to "Ethernet features" (p. 2-13), "Ethernet mapping schemes" (p. 2-15) and "Link Capacity Adjustment Scheme (LCAS)" (p. 2-14)).

The following figure shows an example of a point-to-point LAN connection:
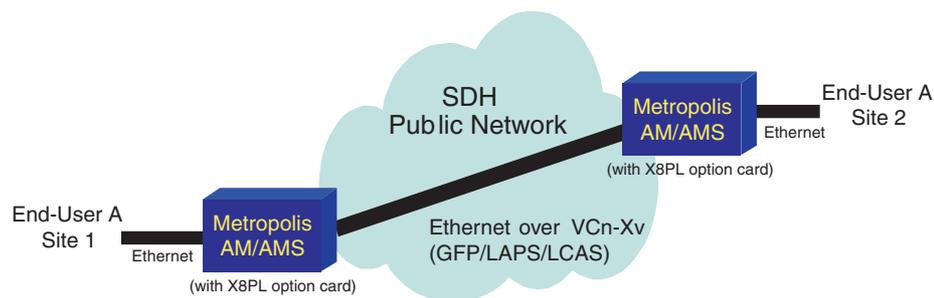
4 Product description

Overview

Purpose

This chapter describes the 1643 AM/1643 AMS in terms of physical configuration and circuit packs.

Chapter structure

After a description of the basic architecture, the hardware is presented. A closer look is taken to the switch function. Additionally the option cards are described.

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Hardware overview of the 1643 AM

This section provides a hardware description of the 1643 AM Add-Drop-Multiplexer.

Hardware description of 1643 AM

The 1643 AM is a compact and cost-effective STM-1 or STM-4 Add-Drop-Multiplexer designed to be installed at the customer's premises for fiber-to-the-business applications. Its space-efficient design allows for horizontal or vertical wall-mounting and horizontal rack-mounting within controlled or non controlled environment locations (for example interior closet) or in street cabinets. Please refer to the *1643 AM/1643 AMS Installation Guide* for details.

The unit has the following characteristics:

- Dimensions (H x W x D) 83 x 439 x 295 mm (without the wall or rack mounting system)
- main board including:
  - One or two STM-1 or two STM-4 optical aggregate line interface pairs (transmit/receive) with a universal connector type allowing SC, FC/PC, ST connector types without external optical cable conversion.
  - Sixteen 2 Mbit/s electrical tributary interfaces with RJ45 connectors suitable for symmetrical twisted pair cables with an impedance of 120 Ω or suitable for coaxial cables with an impedance of 75 Ω
- F-interface (RJ45) complying with V.10/RS-232 for the Craft Interface Terminal (ITM-CIT)
- Q-LAN interface to connect to the EMS or to other NEs is available with an RJ-45 (LAN-10BaseT) connector
- External Synchronization Output at 2048 kHz (SYNC-OUT) with RJ45 connector suitable for symmetrical twisted pair cable with an impedance of 120 Ω or coaxial cable with an impedance of 75 Ω
- Two LEDs (Red, Green) to indicate the status of the unit.
- Four Miscellaneous Discrete Inputs (MDIs) to read the status of external alarm points, and four Miscellaneous Discrete Outputs (MDOs) to drive external devices are available from a 25 pin male Sub-D connector.
- The possibility of power supply of the equipment is DC power supply or AC power supply:
  - DC power supply is connected to a 9-point male Sub-D 9 connector
  - AC power supply is connected to an AC socket (IEC 60320 standard).

    The power cord with the appropriate power plug for the country of use is not supplied.

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- Option cards:

   – Two STM-1 optical tributary line interface pairs (transmit/receive) with a universal connector type allowing SC, FC/PC, ST connector types without external optical cable conversion.

   – Sixteen 2 Mbit/s tributaries with RJ45 connectors suitable for symmetrical twisted pair cables with an impedance of 120 Ω or coaxial cables with an impedance of 75 Ω

   – Sixteen 1.5 Mbit/s tributaries with RJ45 connectors suitable for symmetrical twisted pair cables with an impedance of 100 Ω

   – Two 34 Mbit/s electrical tributaries with DIN 1.6/5.6 coaxial female connectors for coaxial cable with an impedance of 75 Ω

   – Two 45 Mbit/s electrical tributaries with DIN 1.6/5.6 coaxial female connectors for coaxial cable with an impedance of 75 Ω

   – Four 2,048 kbit/s X.21 electrical tributaries with 15-pole DCE female connector complying with ISO 4903 recommendation

   – Two STM-1 electrical line interfaces with DIN 1.6/5.6 coaxial female connectors for coaxial cable with an impedance of 75 Ω.

   – Twelve SHDSL electrical interfaces with RJ45 connectors wired per RJ48C standard with metal shell for grounding.

   – Eight 10/100BASE-T interfaces for Private Line mode with RJ45 connectors.

   – Four 10/100BASE-T electrical tributaries with RJ45 connectors.

   – 3 x 10/100BASE-TX electrical FE interfaces, 1 x 10/100/1000BASE-T(X) electrical GbE interface, 1 x 1000BASE-X GbE optical interface via SFP.

Front view

The figure below shows an illustration of the 1643 AM.

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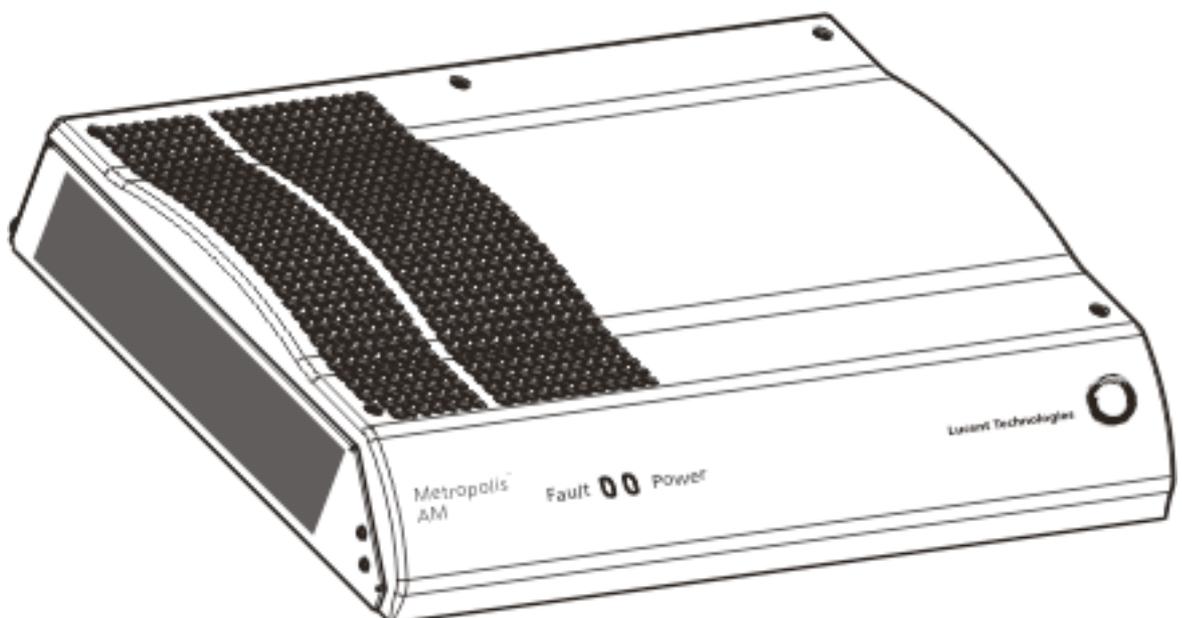
Front view without cover

The figure below shows a front view of the 1643 AM without cover. It shows the location and connectors P1 and P2 intended for the installation of one option card.

Dummy panel

P2   P1
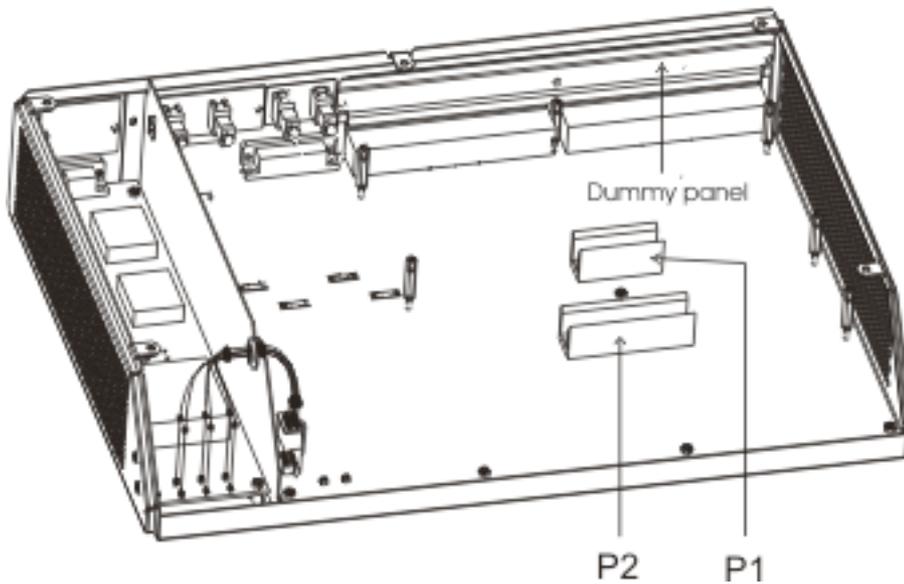
Option card installed

The figure below shows an option card installed.
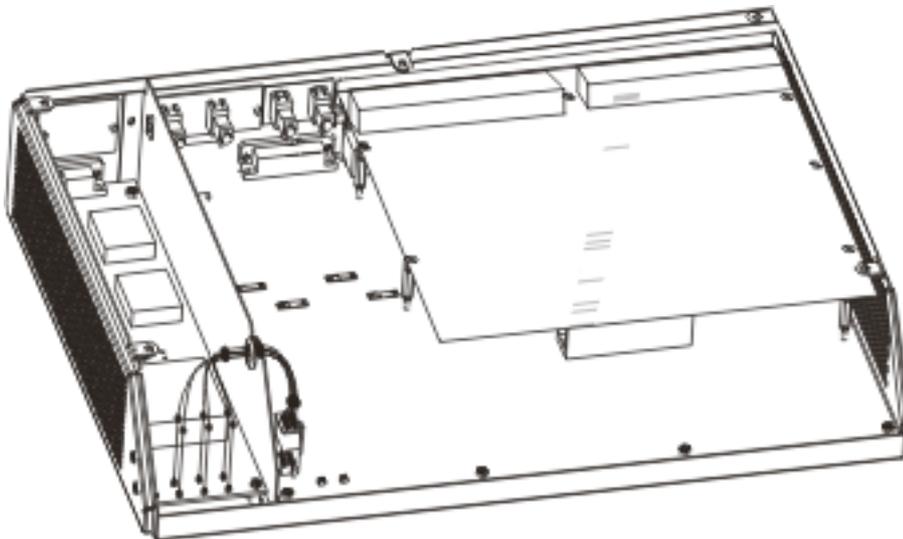
Rear view

The following figure shows the different rear views of the equipment in function of the option card installed.

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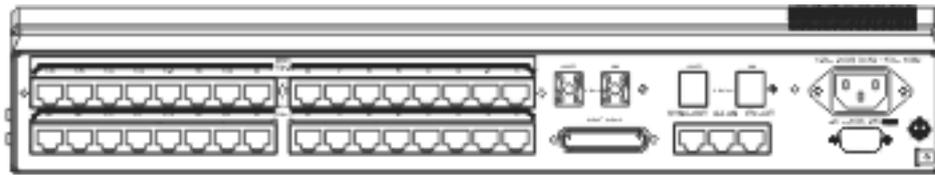
One STM-1 - X16DS1 Option card - AC Power Supply
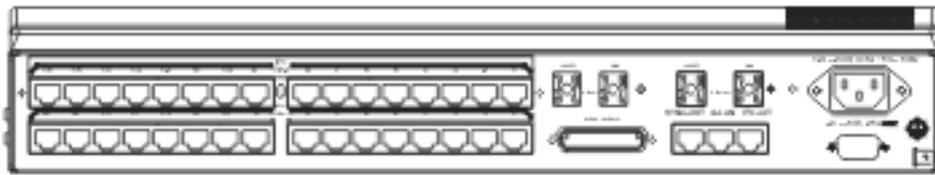
Two STM-n - X16E1-V3 Option card - AC Power Supply
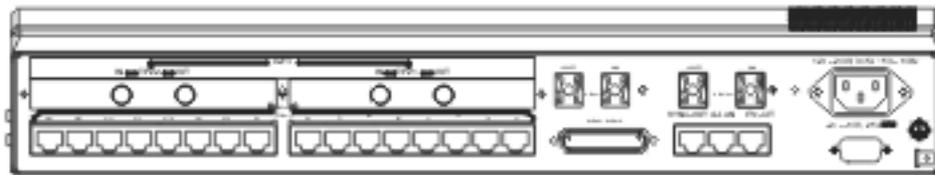
Two STM-n - X2E3-V2 Option card - AC Power Supply
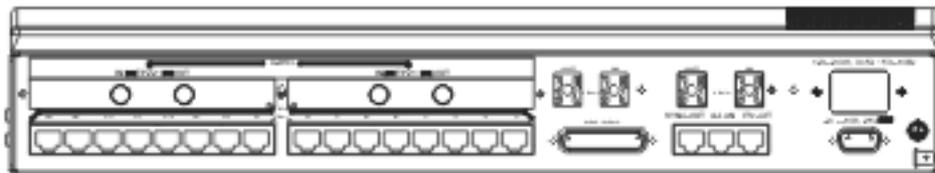
Two STM-n - X2DS3-V2 Option card - DC Power Supply

Two STM-n - X4IP-V2 Option card - DC Power Supply
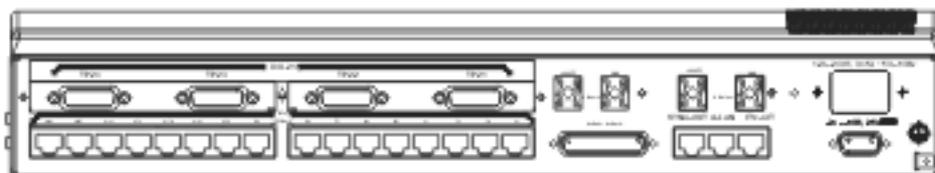
Two STM-n - X4X.21 Option card - DC Power Supply
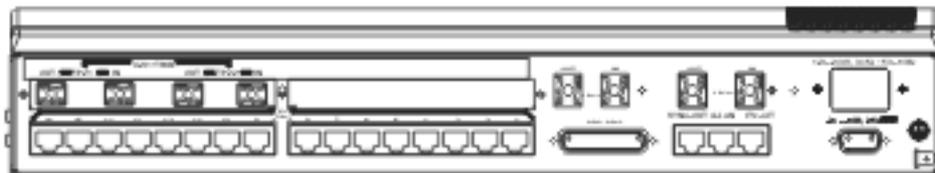
Two STM-4 - X2S1 fTRIB Option card - DC Power Supply

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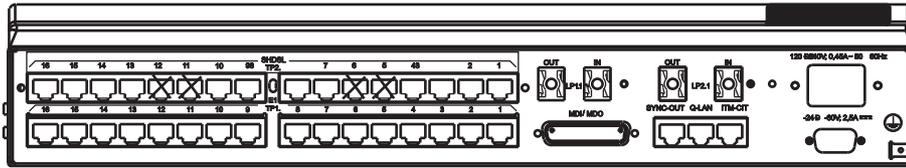
Two STM-n - X12 SHDSL Option card - DC PowerSupply
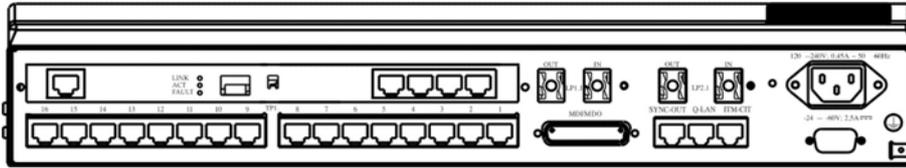
Two STM-n - X5IP option card - DC Power Supply

Not all combinations with option cards and with AC/DC power supply are shown.

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Hardware overview of the 1643 AMS

This section provides a hardware description of the 1643 AMS Add-Drop-Multiplexer.

Hardware description 1643 AMS

The 1643 AMS is a compact and cost-effective STM-1 Add/Drop multiplexer designed to be installed at the customer's premises for fiber-to-the-business applications. Its space-efficient design allows for horizontal or vertical wall-mounting and horizontal rack-mounting within controlled or non controlled environment locations (for example interior closet) or in street cabinets. Please refer to the *1643 AM/1643 AMS Installation Guide* for details.

The unit has the following characteristics:

- 70 x 448 x 204 mm (H x W x D) unit size (without wall or rack mounting system)
- main board including:
  - Two STM-1 optical aggregate line interface pairs (transmit/receive) for SFP usage.
  - 1643 AMS E1 version: Sixteen 2 Mbit/s electrical tributary interfaces (E1) with RJ45 connectors suitable for symmetrical twisted pair cables with an impedance of 120 Ω or suitable for coaxial cables with an impedance of 75 Ω
  - 1643 AMS DS1 version: Sixteen 1.5 Mbit/s electrical tributary interfaces (DS1) with RJ45 connectors suitable for symmetrical twisted pair cables with an impedance of 100 Ω.
- F-interface (RJ45) complying with V.10/RS-232 for the Craft Interface Terminal (ITM-CIT)
- Q-LAN interface to connect to the EMS or to other NEs is available with an RJ-45 (LAN-10BaseT) connector
- External Synchronization Output at 2048 kHz (SYNC-OUT) with RJ45 connector suitable for symmetrical twisted pair cable with an impedance of 120 Ω or coaxial cable with an impedance of 75 Ω
- Two LEDs (Red, Green) to indicate the status of the unit.
- Four Miscellaneous Discrete Inputs (MDIs) to read the status of external alarm points, and four Miscellaneous Discrete Outputs (MDOs) to drive external devices are available from a 25 pin male Sub-D connector.
- The 1643 AMS provides two connectors that allow access to the RS EOW byte E1 or MS EOW byte E2 of the two STM-1 line interfaces.

  By default, the 1643 AMS directs the 64 kbit/s data supplied at the input pins of the EOW connector to the E2 byte of the associated STM-1 line interface. If no data is supplied, i.e. the connector is unconnected, an all-zeros patterns must be sent in the E2 byte.

  By default, the 1643 AMS directs the 64 kbit/s data carried by the E2 byte of each STM-1 line interface to the output pins of the associated EOW connector.

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- The possibility of power supply of the 1643 AMS is DC power supply or AC power supply:

  – DC power supply is connected to a 6-pin terminal block DC connector.

  – AC power supply is connected to an AC socket (IEC 60320 standard).

    The power cord with the appropriate power plug for the country of use is not supplied.

- The 1643 AMS can be equipped with the same option cards like the 1643 AM except for the additional STM-1 interfaces.

1643 AMS version with DC power supply

The following figure shows the 1643 AMS with DC power supply.
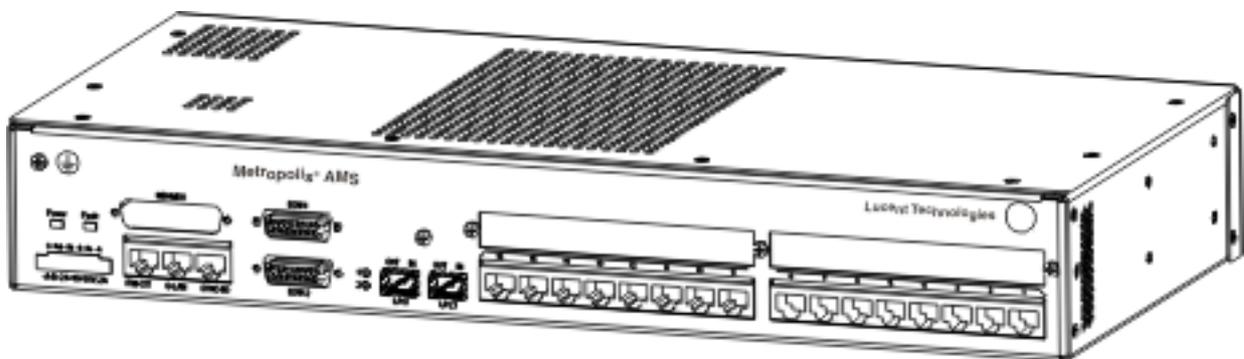
1643 AMS version with AC power supply

The following figure shows the 1643 AMS with AC power supply.
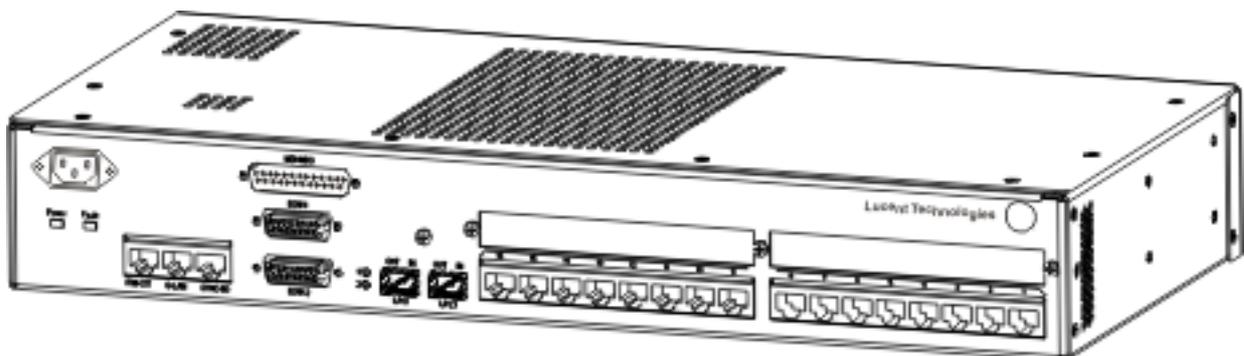
1643 AMS unit with option card

The figure below shows the installation of an option card.

1. top cover

2. connectors of installed option card

3. option card

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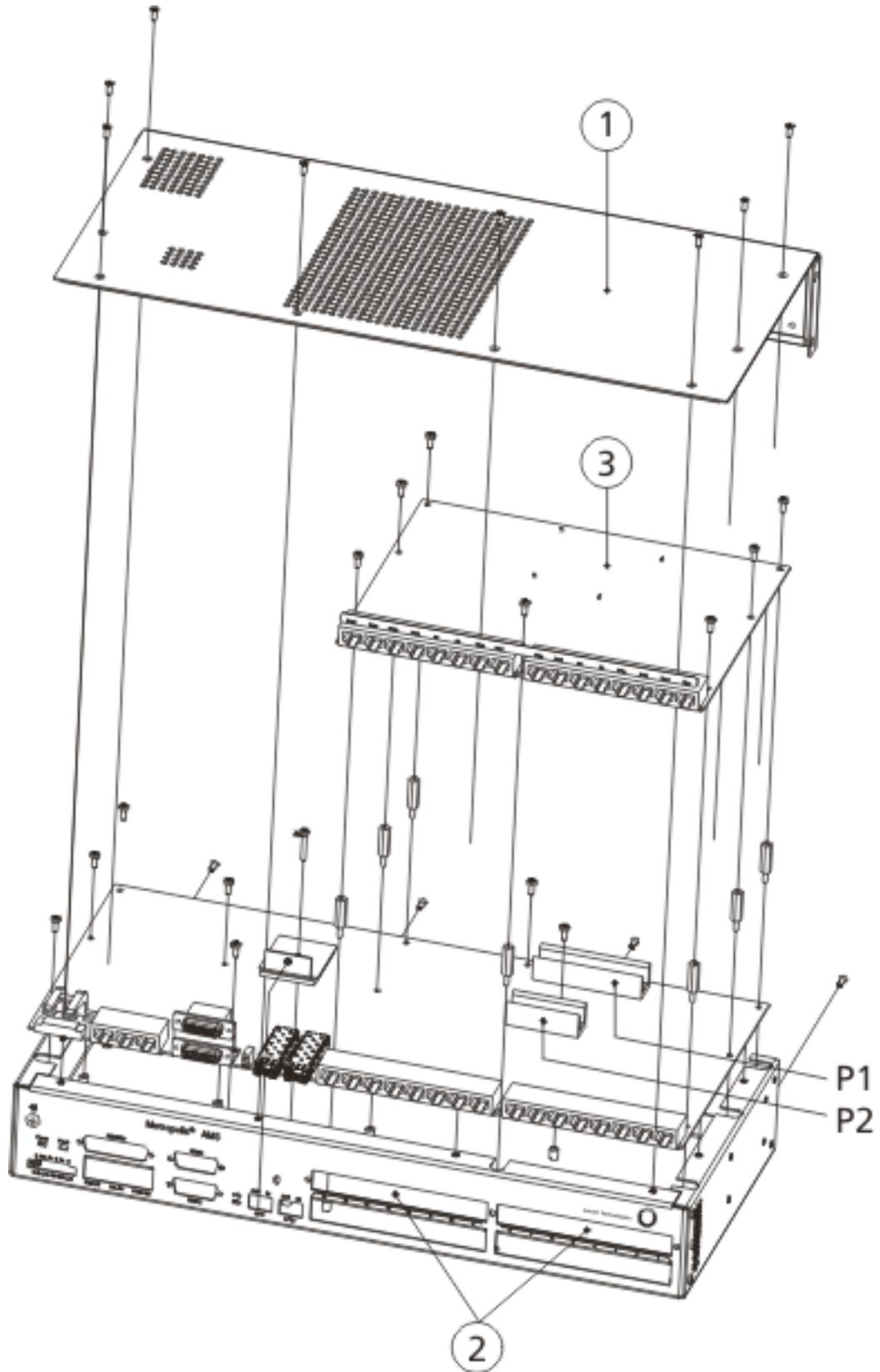
System Architecture

Introduction

This section describes the architecture of the equipment and the architecture and function of the option cards.

Block diagram

The different functions provided by the main board are (see next figure):

- Microprocessor and control circuits.

  The microprocessor and control circuits manages the different elements of the board, the interfaces (F-interface, LAN-Q) and the LEDs

- Two STM-N (N=1 for 1643 AM; N=1 or 4 for 1643 AM) optical aggregate interfaces. One interface is referred to as the "LP1", while the other the "LP2".

  In case of MSP protection (STM-1 only), LP1 is the "working" side and LP2 the "protection" side.

- STM-4 Line Interface used in STM-4 applications:
  - In the transmit direction, the STM-4 Line Interface performs the collection of four AU4s and the STM-4 assembly. It performs RSOH/MSOH insertion
  - In the receive direction, the STM-4 Line Interface performs the STM-4 disassembly, the RSOH/MSOH extraction, the management of the four AU4s and the regeneration of data transmitted to the Higher Order (HO Cross-connect).

- The Higher Order (HO) Cross-connect function is dedicated to STM-4 applications:

  A single VC4 is accessible in add/drop mode. The three others are fully flexible cross connected to the other side.

  The HO Cross-connect also performs DCC processing.

- The Lower Order Cross-connect contains 32 E12 assemblers and disassemblers.

- HDB3 drivers and receivers are dedicated to the sixteen 2 Mbit/s interfaces of the board.
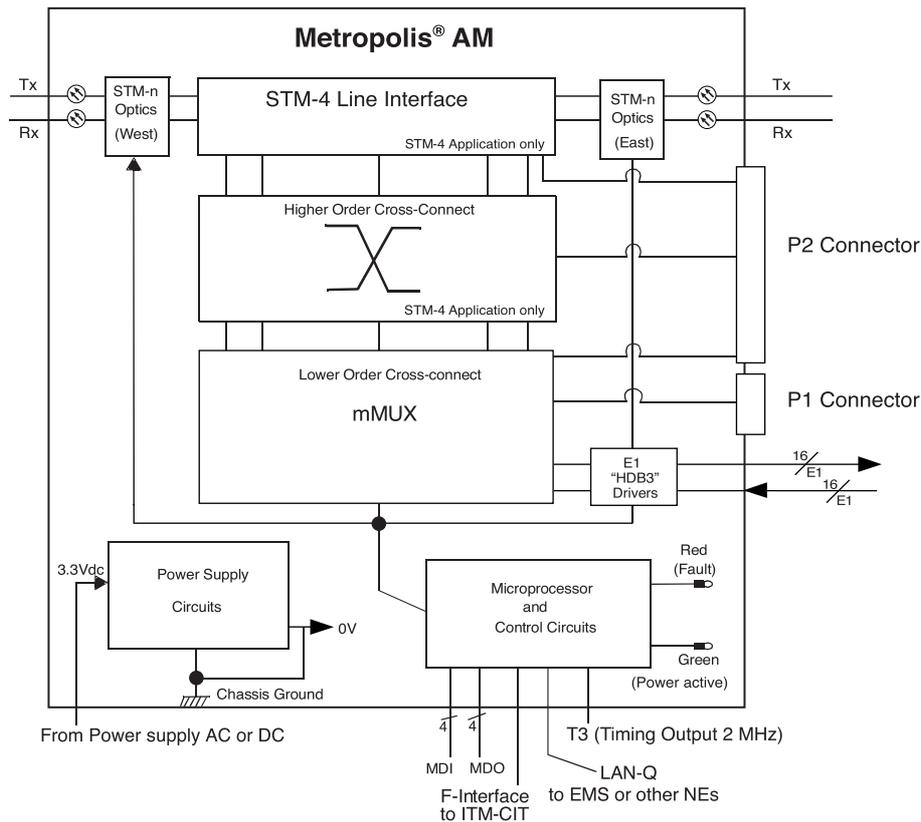
Important! The equipment can process IT0 on the 2 Mbit/s G.703 interfaces to G.704/I.431/ETSI ETS 300 011. The bits reserved for national usage support the loop-back command (Sa6 in ETR001/I.604) and the loop signaling. It is possible to replace IT0 in both the PDH to SDH direction and in the SDH to PDH direction.

Cross-connect flexibility

The 1643 AM Cross Connect architecture consists of two cross-connects. A Lower-Order Cross Connect (LO-CC) for VC-12 and VC-3 cross-connection and a Higher Order Cross Connect (HO-CC) for VC-4 cross-connection.

High Order Cross-Connects

On STM-1 units, the HO-CC is fixed such that both the VC-4 from east and the VC-4 from west are terminated at the LO-CC.

On STM-4 units (1643 AM) the HO-CC is flexible; it allows for the cross-connection of:

- One VC-4 (the operator can pick any) from west to the LO-CC
- One VC-4 (the operator can pick any) from east to the LO-CC.
- Two VC-4s from east or two VC-4s from west or one VC-4 from east and one VC-4 from west to the STM-1 tributaries
- Any VC-4 from east to any VC-4 to west.

The above mentioned flexibility offers the possibility to create add-drop rings where the lower-order signals from a VC-4 can be add-dropped, VC-4s can be add-dropped to the STM-1 tributaries and remaining VC-4s can be passed through. For VC-4 cross-connections to the STM-1 tributaries, one can apply SNC/N protection.

Lower-Order Cross-Connects

The Lower-Order Cross-Connect allows the user to cross-connect any VC-12 or VC-3 from one of the tributary ports to one of the two VC-4s that have been cross-connected to the LO-CC (see Higher-Order Cross-Connect). For VC-12 and VC-3 cross-connection one can apply SNC/N protection.

....

Option cards

This chapter describes the option cards which can be used together with 1643 AM/1643 AMS in order to provide additional interfaces for various data rates or special applications.

X2S11TRIB/X2STM1ETRIB option card

The different functions of the X2S11TRIB (two STM-1 optical tributary line interfaces) option card are (see next figure):

- Two STM-1 optical tributary interfaces. One interface is referred to as the "TP2.1", while the other the "TP2.2".

  In case of MSP protection, TP2.1 is the "working" side and TP2.2 the "protection" side.

  Clock and data recovery circuit separates the clock and data signals which are transmitted to ASIC circuit.

- The circuit ASIC performs :
  - In the transmit direction, the circuit ASIC performs the collect of data from the main board and the STM-1 assembly. Data are sent to the optical transmitters TP2.1 and TP2.2.
  - In the receive direction, the circuit ASIC performs the STM-1 disassembly, the management of data transmitted to the main board (HO-CC) via the P2 connector.
  - RSOH/MSOH extraction/insertion, DCC processing, VC-4 SNC/N, STM-1 MSP and switching of timing reference signal for the synchronization of the equipment.

- Circuit Alarm manager performs:
  - reception of different alarms signals from optical interfaces
  - dialogue with the microprocessor of the main board.

X2S11TRIB option card

The X2S11TRIB option card provides two optical STM-1 short-haul tributary interfaces for an 1643 AM equipped with STM-4 line interfaces.

The X2S11TRIB option card is plugged into the P2 connector as described in "Front view without cover" (p. 4-4).

The X2S11TRIB option card supports two STM-1 input and two STM-1 output signals. The physical interface is a universal optical connector which is designed for standard single mode fibers with an operating wavelength of 1310 nm.

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The following figure shows the block diagram of the X2S11TRIB option card:
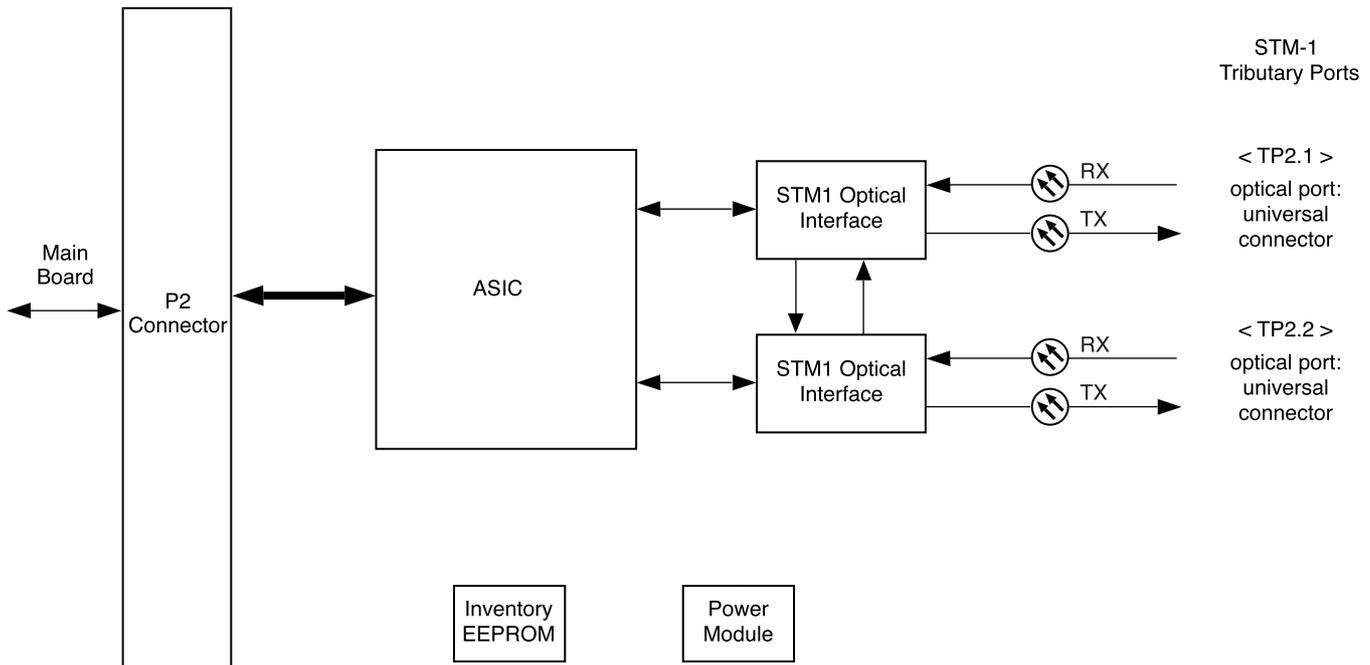
In the receive direction for both STM-1 interfaces, the optical signals are converted to electrical signals in the optical receiver. Clock and data recovery circuits separate the clock and data signals and feed them to the main ASIC. The main ASIC transmits two preprocessed STM-1 signals to the Higher Order Cross-connect on the main board via the P2 connector for further processing. The broadcast for the HO SNC/N is performed on the main board as well.

On the X2S11TRIB option card itself the following functions are performed:

* RSOH/MSOH extraction/insertion
* DCC processing
* 1+1 VC-4 SNC/N
* STM-1 MSP
* Timing reference signal switching

  Important! The power of the 1643 AM must be switched off before the option card is inserted.

  Note: The STM-1 optical option cards do not utilize SFP usage.

X2STM1ETRIB option card

The X2STM1ETRIB option card provides 2 electrical STM-1 tributary interfaces for an 1643 AM equipped with STM-4 line interfaces.

The X2STM1ETRIB option card is plugged into the P2 connector as described in "Front view without cover" (p. 4-4).

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The X2STM1ETRIB option card supports two STM-1 input and two STM-1 output signals. The physical interface for the STM-1 signals is a coaxial 1.6/5.6 connector.

The following figure shows the block diagram of the X2STM1ETRIB option card:
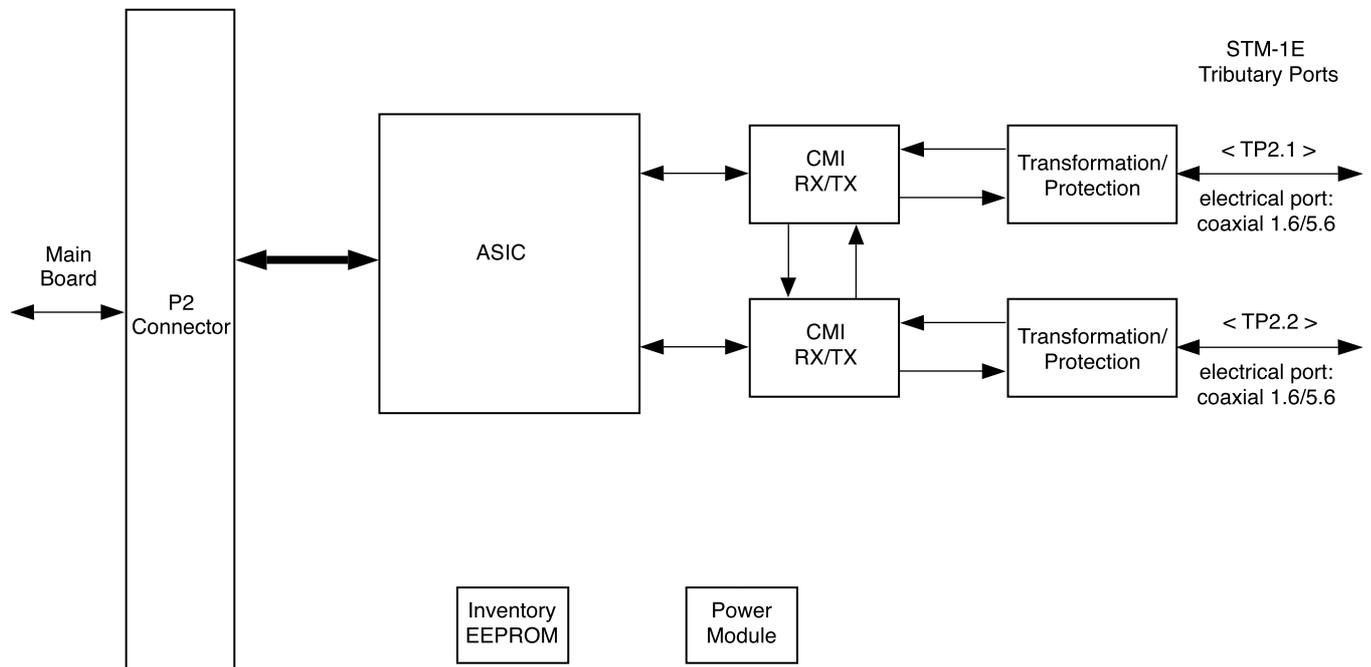
In the receive direction for both STM-1 interfaces the clock is recovered and the electrical CMI signals are decoded into the NRZ format and fed to the main ASIC. The main ASIC transmits two preprocessed STM-1 signals to the Higher Order cross-connect on the main board via the P2 connector for further processing. The broadcast for the HO SNC/N is performed on the main board as well.

On the X2STM1ETRIB option card itself the following functions are performed:

- RSOH/MSOH extraction/insertion
- DCC processing
- 1+1 VC-4 SNC/N
- STM-1 MSP
- Timing reference signal switching

  Important! The power of the 1643 AM must be switched off before the option card is inserted.

X2E3-V2 option card

The X2E3-V2 option card provides two bidirectional 34 Mbit/s (E3) interfaces.

The X2E3-V3 option card is plugged into the P2 connector as described in . Physical interfaces to the additional E3 ports are four DIN1.6/5.6 coaxial connectors (one for the transmit and one for the receive directions for each E3 port).

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The following figure shows the block diagram of the X2E3-V2 option board.
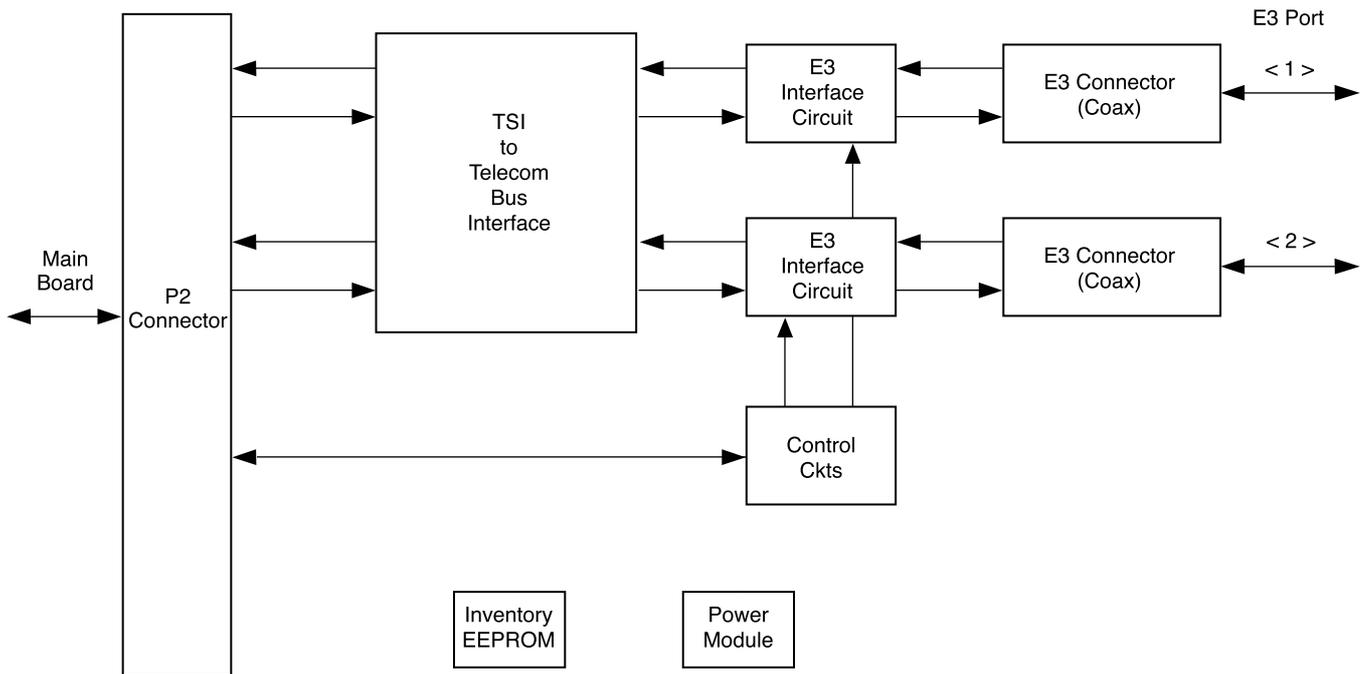
Important! The power of the 1643 AM/1643 AMS must be switched off before the option card is inserted.

X2DS3-V2 option card

The X2DS3-V2 option card provides two additional 45 Mbit/s (DS3) interfaces.

The X2DS3-V3 option card is plugged into the P2 connector as described in "Front view without cover" (p. 4-4). Physical interfaces to the additional DS3 ports are four DIN1.6/5.6 coaxial connectors (one for the transmit and one for the receive directions for each DS3 port).

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The following figure shows the block diagram of the X2DS3-V2 option card.
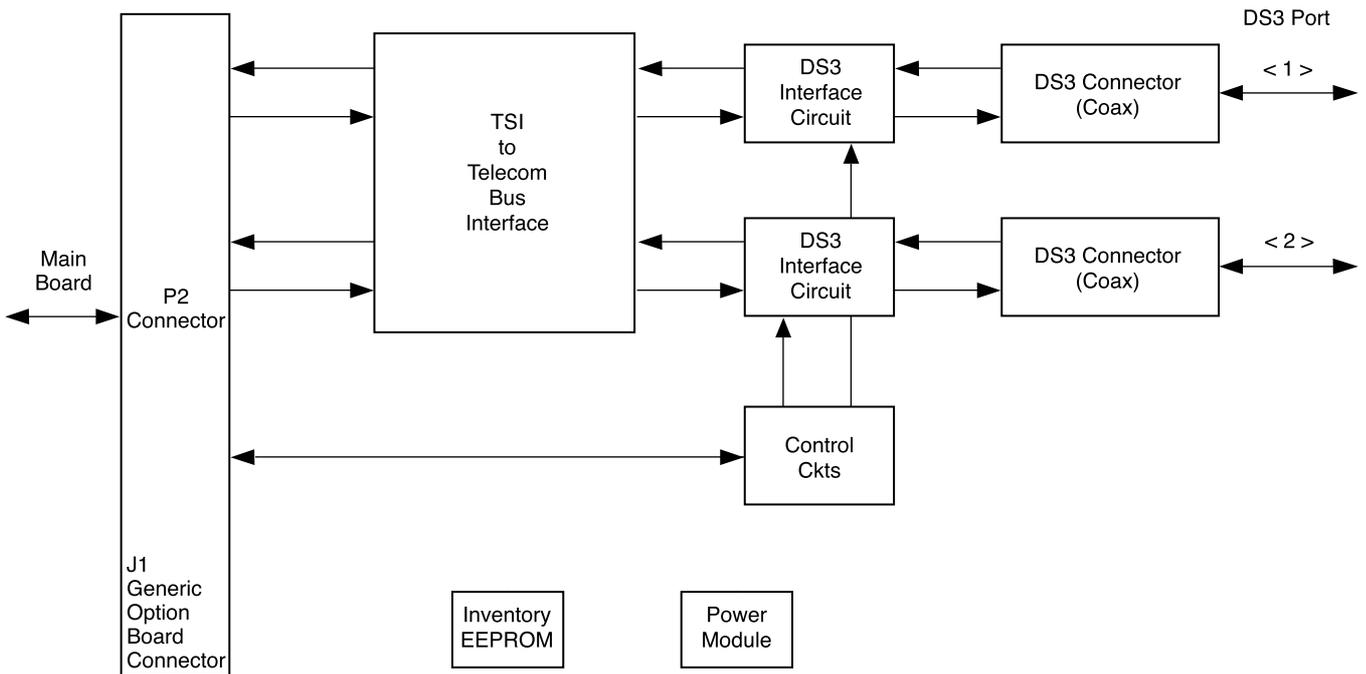
Important! The power of the 1643 AM/1643 AMS must be switched off before the option card is inserted.

X16E1-V3 option card

The X16E1-V3 option card provides 16 additional 2 Mbit/s (E1) interfaces.

The X16E1-V3 option card is plugged into the P1 connector as described in "Front view without cover" (p. 4-4). Physical interfaces to the additional E1 ports are 16 RJ45 connectors for the use of shielded twisted pair cables.

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The following figure shows the block diagram of the X16E1-V3 option card.
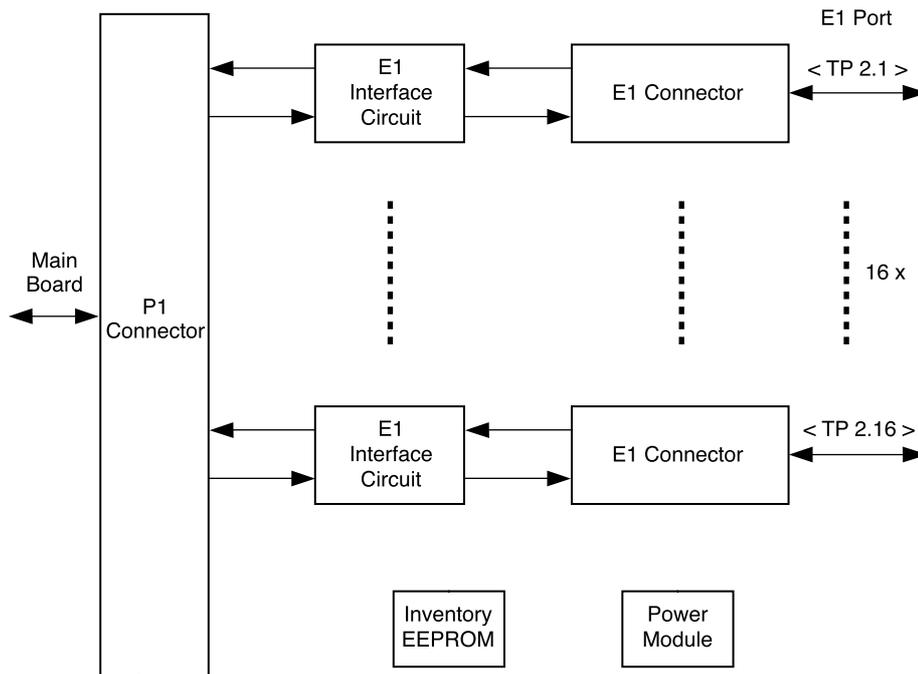
```
                                                                    E1 Port

                          ┌──────────┐              ┌──────────────┐
                          │    E1    │ ◄──          │              │   < TP 2.1 >
                    ◄──── │Interface │ ◄──────────  │ E1 Connector │   ◄───────►
                          │  Circuit │ ──────────►  │              │
                    ────► └──────────┘              └──────────────┘

   Main          ┌─────────┐
   Board         │   P1    │           ⋮                ⋮               ⋮  16 x
   ◄───►         │Connector│
                 └─────────┘
                          ┌──────────┐              ┌──────────────┐
                          │    E1    │ ◄──          │              │   < TP 2.16 >
                    ◄──── │Interface │ ◄──────────  │ E1 Connector │   ◄───────►
                          │  Circuit │ ──────────►  │              │
                    ────► └──────────┘              └──────────────┘


                          ┌──────────┐              ┌──────────┐
                          │Inventory │              │  Power   │
                          │ EEPROM   │              │  Module  │
                          └──────────┘              └──────────┘
```

Important! The power of the 1643 AM/1643 AMS must be switched off before the option card is inserted.

X16DS1 option card

The X16DS1-V3 option card provides 16 additional 1.5 Mbit/s (DS1) interfaces.

The X16DS1-V3 option card is plugged into the P1 connector as described in "Front view without cover" (p. 4-4). Physical interfaces to the additional DS1 ports are 16 RJ45 connectors for the use of shielded twisted pair cables.

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The following figure shows the block diagram of the X16DS1 option card.
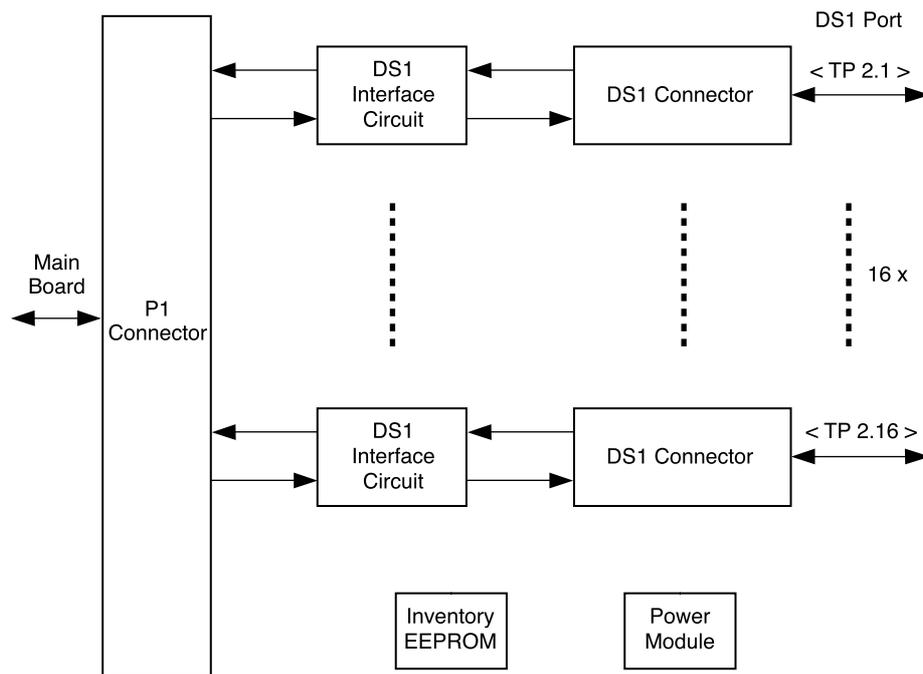
Important! The power of the 1643 AM/1643 AMS must be switched off before the option card is inserted.

X4X.21 option card

The X4X.21 option card provides four additional X.21 2 Mbit/s interfaces.

The X4X.21 option card is plugged into the P1 connector as described in "Front view without cover" (p. 4-4). The physical interfaces are realized as four 15-pin female Sub-D connectors.

It provides the following features:

- Four X.21 interfaces. The X.21 signals are bit-mapped into asynchronous 2 Mbit/s PDH signals.

- Loopback of the external X.21 signals

- Support of LOS defect detection and AIS insertion as consequent action

- Support of re-timing via the X.21 2 Mbit/s

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The following figure shows the block diagram of the X4X.21 option card.
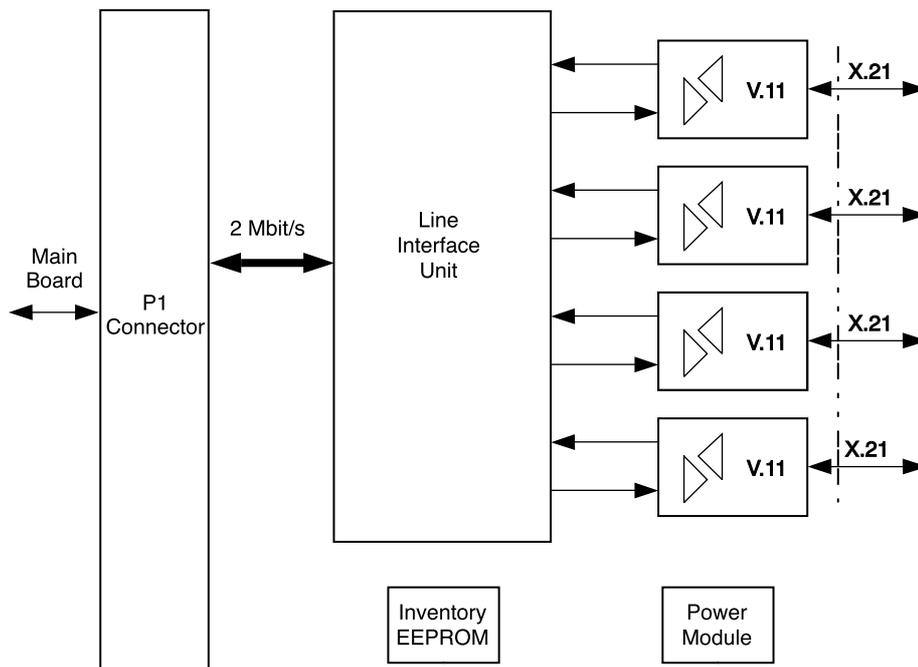
Important! The power of the 1643 AM/1643 AMS must be switched off before the option card is inserted.

X8PL option card

The X8PL option card provides eight Ethernet interfaces in Private Line mode for the 1643 AM/1643 AMS. The Private Line mode enables traffic to be mapped from each Ethernet port one-to-one into an SDH container. Thus a private connection from an Ethernet port through an SDH network to another Ethernet port at the remote end of the link is possible.

The X8PL option card supports a flexible allocation of SDH bandwidth to LAN ports by making use of the Link Capacity Adjustment Scheme (LCAS, see "LCAS" (p. 2-14)). All LAN ports have the same capabilities. Each WAN port supports VC-12-Xv (X = 1...63) or VC-3-Xv (X = 1...3).

The VC-12s that form one VCG can be chosen from any TUG-3, in any timeslot order. However, it is recommended to select the VC-12s in sequential order, preferably in one TUG-3. In this way the end-to-end network design can be kept simple and easy to maintain.

The X8PL option card supports loopbacks on outgoing Ethernet and Fast Ethernet signals.

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The following figure shows the block diagram of the X8PL option card:
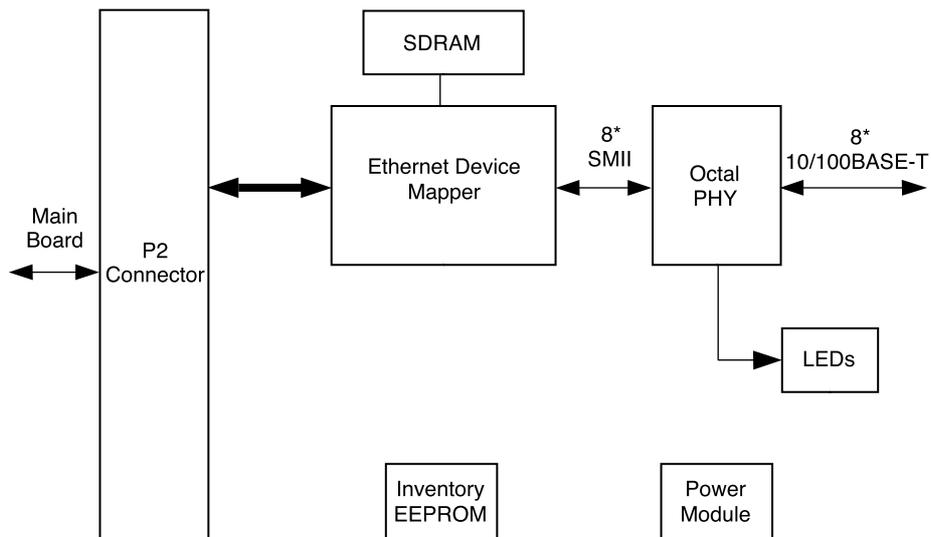
X4IP option card (*TransLAN*®)

On the 1643 AM/1643 AMS an Ethernet LAN option board (X4IP) is available providing four 10/100BASE-T Ethernet interfaces. This option board is based on *TransLAN*®. When equipped with a *TransLAN*® option board, Alcatel-Lucent SDH multiplexers can offer 10/100BASE-T Ethernet interfaces.

The LAN interfaces that are supported are 10BASE-T and 100BASE-TX. The numbers "10" and "100" indicate the bit-rate of the LAN, 10 Mbit/s and 100 Mbit/s respectively. The "T" or "TX" indicates the wiring and connector type: Twisted pair wiring with RJ-45 connectors. The actual LAN speed does not need to be configured, since the Ethernet interfaces support the auto-negotiation protocol, which enables them to select the proper LAN speed automatically. The auto-negotiation function on the *TransLAN*® board is configurable per LAN port. This feature allows the auto-negotiation function to be manually overridden from the Alcatel-Lucent OMS or the ITM-CIT. If this auto-negotiation function is disabled, it is possible to select a specific operational mode (10 or 100BASE-T, Half/Full-Duplex).

The X4IP option card supports Enhanced Flow Classification - IEEE 802.1Q mode and IEEE 801.2ad mode. Network traffic from end users can be classified into flow categories on the edge ports of a TransLAN® domain. As a result, ports can be provisioned as "Edge" or "Interior" ports. Edge ports are either Customer Role ports (UNI) or "Virtual ports" on a Trunk port (E-NNI). A virtual port is the traffic over a trunk port belonging to a single end-user and is characterized by an S-VID tag.

On edge ports, up to seven provisionable flows can be defined with a combination of the following criteria:

- port
- C-Tag (C-VID, C-UP) previously known as: VID, UP

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- IP-TOS field (DSCP)
- Destination Address Mask (for broadcast/multicast and for customer control traffic)

Additionally, a default flow for each user is already present. When ports are designated as "Interior", the flow classification is completely based on the S-UPT bits. There is no rate control and the S-UPT bits are transparently transported through the device. Virtual ports on a trunk port can be provisioned to behave as "Interior" ports, i.e. to use the S-UPT bits for classification instead of the freely provisionable flow. By provisioning a (virtual) port as an "Interior" port, the flow definition is fixed.

The X4IP option card supports addition of static MAC address entries into the filtering database. These entries are not submitted to the ageing time process. Conversely, users can delete MAC address entries from the filtering database using configuration commands.

The X4IP option card supports the programmable ageing pass time feature. To learn the MAC address entries automatically, the ageing pass timer can be provisioned for a duration between 10 seconds to 630 seconds in steps of 10 seconds for the whole filtering database. The default value is 300 seconds. The X4IP option card supports queries for whole and static MAC address entries and dynamic MAC address entries by specifying the MAC address and V-LAN tag.

The X4IP option card enables users to set a port in locked mode. All the new frames that are transmitted into the locked port will be dropped and the SA cannot be learnt. Alarming is reported against new frames in locked port mode.

The X4IP option card supports Committed Burst Size (CBS) and Peak Burst Size (PBS) provisioning. Users can provision the CBS and PBS parameters to QoS profiles for IEEE 802.1Q and IEEE 802.1ad modes.

The X4IP option card supports enhanced Ethernet Performance Monitoring features.

The X4IP option card supports Enhanced Basic Ethernet PM features. For detailed information, refer to "Enhanced Basic Ethernet PM Counters " (p. 11-66).Note that the PM points for the 1643 AM/1643 AMS are limited.

The X4IP option card supports PM counters for high quality traffic load per TC/port. For detailed information , refer to "PM counters for high quality traffic load (per TC/port)" (p. 11-66).

The X4IP option card supports PM counters for low quality traffic load per TC/port. For detailed information, refer to "PM counters for low quality traffic load (per TC/port)" (p. 11-67).

The X4IP option card supports a performance monitoring counter for Ethernet service flow. For more information, refer to "PM counters for Ethernet service flow (per flow)" (p. 11-68).

The X4IP option card supports end-to-end Ethernet RTD measurement. For more information, refer to "End-to-end Ethernet PM - Round Trip Delay (RTD) measurement" (p. 11-68).

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The X4IP option card supports RTD PM counters and provides RTD/TCA support. For more information, refer to "RTD PM Counters" (p. 11-68).

A detailed description of the Ethernet features is given in chapter Chapter 11, "Ethernet Overview".

The X4IP option card supports loopbacks on outgoing Ethernet and Fast Ethernet signals.

The following figure shows the block diagram of the X4IP option card:

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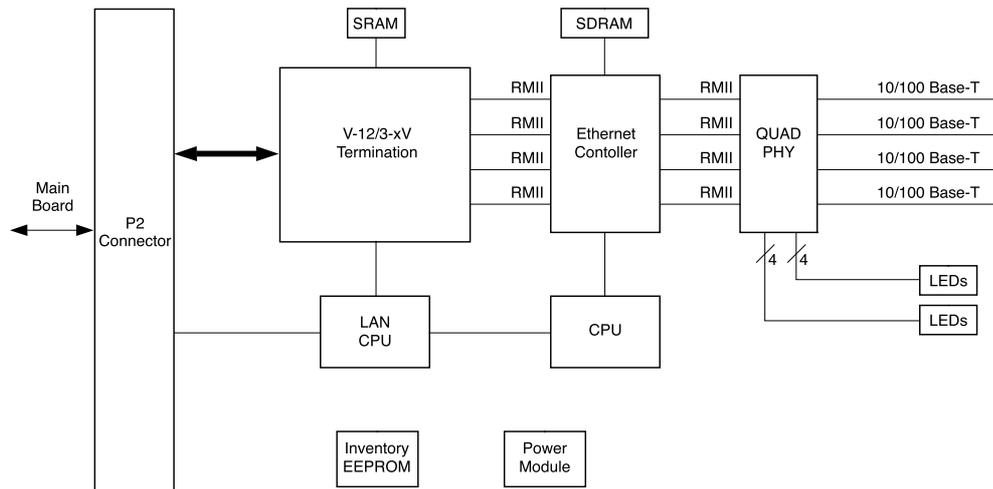
X5IP option card

Feature Overview

The X5IP option card provides the following features:

- Repeater mode
- IEEE 802.1Q/IEEE 802.1ad STP switch
- Flexible VCG assignment on VC-3-Xv (X=1..3) and VC-12-Xv (X=1..63)
- rSTP, GVRP
- LPT
- LCAS for VC-3-Xv (X=1..3) and VC-12-Xv (X=1..63)
- TransLAN QoS features: Flow - V-LAN tag and C-port, Provisionable PIR/CIR, Fixed scheduling
- Basic and Enhanced Performance Monitoring (PM) counters
- GFP options
- TransLAN QoS features: Flow - IP-TOS and D-MAC mask, SP/WRR scheduling
- Provisionable CBS/PBS
- Round Trip Delay (RTD) measurement
- MAC address table retrieval and configuration

Interfaces

On the faceplate, the X5IP option card provides the following interfaces.

- 10/100/1000BASE-T(X) electrical Ethernet interface using RJ-45 connector supports 10BASE-T, 100BASE-T(X) or 1000BASE-T specifications. Note that this interface is only applicable to the ESW4_E14 option card.
- 10/100BASE-T(X) electrical Ethernet interface using RJ-45 connector supports 10BASE-T and 100BASE-TX specifications.
- 1000BASE-SX optical Ethernet interface, covers a distance of 550 m over 50 μm MMF with an operating wavelength of 770-860 nm.
- 1000BASE-LX optical Ethernet interface, covers a distance of 5 km over 10 μm SMF with an operating wavelength of 1310 nm.
- 1000BASE-ZX optical Gigabit Ethernet interface in single fiber working mode, covers a distance of 70 km with an operating wavelength of 1550 nm for long haul transmission.

Alcatel-Lucent Connectors

A Alcatel-Lucent Connector (LC) based on SFP modules can be used to realize optical Gigabit Ethernet access.

A triple rate Ethernet (10/100/1000BASE-T) access is realized with an RJ-45 connector.

Configurable Auto-negotiation

The X5IP option card supports configurable Auto-negotiation for 1000BASE-X PHYs, 10/100/1000BASE-T(X), and 10/100BASE-T(X) rates.

1000BASE-X PHYs

1000BASE-X Ethernet PHYs support Auto-negotiation for Duplexity (Full/Half Duplex) and pause operations (none, Rx only, Tx only or both directions). The X5IP option card only supports the Full-Duplex mode. Pause operations can only be enabled or disabled by provisioning point-to-point Ethernet services. Other services can only disable this feature.

10/100/1000BASE-T(X)

Triple rate electrical Ethernet PHYs (10/100/1000BASE-T(X)) support Auto-negotiation for Duplexity (Full/Half Duplex), Port Rate (10/100/1000 Mbit/s), and Pause operation (None, Rx only, Tx only or both directions). Users can override the Auto-configuration mechanism with fixed settings or trigger a new Auto-negotiation procedure.

10/100BASE-T(X)

The Alcatel-Lucent OMS and the ITM-CIT can be used to manually override the Auto-negotiation function. If this function is disabled, users can select a specific operational mode such as port speed, Half/Full Duplex, and Flow Control.

Ethernet Mapping Schemes

The following sections describe the mapping schemes for VC3-Xv and VC12-Xv Ethernet frames.

Mapping Ethernet frames into VC3-Xv: GFP Encapsulation

The X5IP option card supports the following mapping scheme for Ethernet frames.

- AU4 < - > VC4 < - > m *
- TUG3 < - > X *
- TU3 < - > X *
- VC3 < - > VC3-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC3 containers ranges from 1 to 3.

Mapping Ethernet frames into VC12-Xv: GFP Encapsulation

The X5IP option card supports the following mapping scheme for Ethernet frames.

- AU4 < - > VC4 < - > m *
- TUG3 < - > n *
- TUG2 < - > X*TU12 < - > X*VC12 < - > VC12-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC12 containers ranges from 1 to 63.

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Flexible Bandwidth Assignment

The X5IP option card supports flexible assignment of VC capacity to create various size VCGs. The available capacity of one VC4 can be divided in three TUG3s. Each TUG3 can be used a single VC3 or as 21 VC12s.

These VC3 and VC12 containers can be assigned to a maximum number of 8 VCGs. For each VCG, users can choose between VC12-Xv (X=1-63) and VC3-Xv (X=1-3), based on the total number of containers that are available for each container type.

Link Capacity Adjustment Scheme (LCAS)

The 1643 AM/1643 AMS supports the LCAS function for VC3-Xv concatenated signals on the X5IP option card. According to ITU-T G.7042/Y.1305 standard, this function is implemented using H4[1,4] bits of multiframe positions 2, 3, 8, 9, and 10.

The 1643 AM/1643 AMS also supports the LCAS function for VC12-Xv concatenated signals on the X5IP option card. According to ITU-T G.7042/Y.1305 standard, this function is implemented using K4[2] multiframe bits 12 through 32.

LAN modes

The X5IP option card supports the following LAN modes.

- LAN bridge mode
- LAN promiscuous mode

LAN bridge mode

According to the IEEE802.1D standard, the Ethernet bridge provides the following functions.

- Point-to-point LAN bridge
- Multiport bridge for 13 ports
- MAC address filtering via self learning protocol (up to 8k MAC addresses)
- Spanning-tree algorithm
- Transparency to VLAN tagged packets from end customers
- Broadcasting, including end user BPDUs

All L2 switching relations can process packets at wire speed. In case of congestion on a specific port, packets will be arbitrarily dropped from the tail.

LAN promiscuous mode

In addition to the L2 switching capabilities of the LAN bridge mode, the X5IP option card supports operations in promiscuous mode. In this mode, the L2 switching function forwards all Ethernet packets that are received without address filtering. This function is only supported for a point-to-point switching relation and can be configured for each switch relation.

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VLAN tagging - IEEE 802.1Q

The X5IP option card supports an IEEE 802.1Q compliant VLAN tagging, classification, and filtering standard on all of its external Ethernet LAN ports or internal WAN ports. However, note that this tagging mode is incompatible with the port based VPN customer tagging mode.

The Ethernet packets are processed as follows:

A customer's VLAN tagged packets are VLAN classified according to the VLAN ID contained in the VLAN tag. The system performs VLAN ingress filtering based on the port membership of the receiving port for a specific VLAN.

A customer's untagged and priority-tagged packets are VLAN classified according to a default port VLAN ID (PVID identification for customers through port-based VPN customer tagging) that is assigned to the receiving port. The system inserts the PVID in the VLAN tag. A unique VLAN ID can be provided to customers.

E/FE/GbE VLAN trunking

The X5IP option card aggregates E/FE/GbE traffic of multiple end-users over a single external Ethernet or Fast Ethernet or Gigabit Ethernet port. Such a VLAN trunk port is a shared member of multiple VLANs from different end-users. The VLAN ID list is configurable during the VLAN classification process.

GARP VLAN Registration Protocol (GVRP)

The 1643 AM/1643 AMS supports the GARP VLAN Registration Protocol (GVRP) on the X5IP option card. This protocol is used to maintain VLAN identification consistency and connectivity throughout the switched WAN network.

For more information about GVRP, see

Rapid spanning tree protocol (rSTP)

The 1643 AM/1643 AMS supports the Rapid Spanning Tree Protocol for each virtual switch on the X5IP option card based on the IEEE 802.1D standard.

For more information about the Rapid Spanning Tree Protocol, see

Overlength Ethernet Frames

The X5IP option card supports forwarding, encapsulation, and mapping of Ethernet frames with lengths up to 1650 octets/bytes.

The X5IP option card hardware also supports Ethernet frames with length from 64 bytes to 9216 bytes called Jumbo Frames in repeater mode and VLAN mode.

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Enhanced Flow Classification

The X5IP option card supports Enhanced Flow Classification - 802.1Q mode and 801.2ad mode. Network traffic from end users can be classified into flow categories on the edge ports of a TransLAN® domain. As a result, ports can be provisioned as "Edge" or "Interior" ports. Edge ports are either Customer Role ports (UNI) or "Virtual ports" on a Trunk port (E-NNI). A virtual port is the traffic over a trunk port belonging to a single end-user and is characterized by an S-VID tag.

The QoS edge ports support up to seven provisionable flows of 1k per unit and can be defined with a combination of the following criteria:

- flow = port
- flow = C-Tag (C-VID, C-UP) previously known as: VID, UP
- flow = IP-TOS field (DSCP)
- flow = Destination address mask (for broadcast/multicast and for customer control traffic)

Additionally, a default flow for each user is already present. When ports are designated as "Interior", the flow classification is completely based on the S-UPT bits. There is no rate control and the S-UPT bits are transparently transported through the device. Virtual ports on a trunk port can be provisioned to behave as "Interior" ports, i.e. to use the S-UPT bits for classification instead of the freely provisionable flow. By provisioning a (virtual) port as an "Interior" port, the flow definition is fixed.

Enhanced Flow Properties

The 1643 AM/1643 AMS supports enhanced flow classification properties that can be provisioned for each flow. Users can provision the properties of each flow by assigning a traffic class and provisioning the threshold rate. The threshold rate (CIR/PIR) can be provisioned in 1 kbit/s steps above 150 kbit/s. A policy can be provisioned for traffic above this threshold rate. For example, immediate dropping (strict policing: CIR=PIR) or marking with high dropping precedence (over-subscription: CIR<= PIR<=MAX). The assigned traffic class and dropping precedence are coded into the S-UPT bits of the frame on the egress side.

The X5IP option card supports Committed Burst Size (CBS) and Peak Burst Size (PBS) provisioning. Users can provision the CBS and PBS parameters to QoS profiles for IEEE 802.1Q and IEEE 802.1ad modes.

QoS provisioning in Provider Bridge Mode (PBM)

The X5IP option card supports Flow Classification of ingress traffic into the L2 switch based on the IEEE 802.1ad tagging mode. For every Flow Classification, users can assign a Flow Profile containing the QoS parameters that are to be applied to the flow.

A Flow Profile can be labelled and pre-provisioned. It can be assigned to multiple flows and contains the following parameters:

- Traffic conditioning parameters such as TransLAN® ingress rate control parameters including dropping precedence marking.

Frames below CIR are classified as "green" (low dropping precedence). Frames between CIR and PIR are classified as "yellow" (high dropping precedence). Frames above PIR are classified as "red" and are dropped. The high or low dropping precedence is encoded in the LSB of the user_priority field of the S-TAG.

- Traffic class flow assignment including traffic class marking indicating a certain service level.

  Users can assign a traffic class for each flow which determines the value of the 2 MSB user_priority bits in the S-TAG of the frames that are classified to the flow. The relation between the assigned traffic class and the 2 MSB user_priority bits is fixed. Based on the traffic class, the frame will be assigned to a certain queue by a fixed traffic class to queue mapping function that is present in each switch.

- Limits: maximum 250 profiles per system including traffic class and rate control parameters.

Q-tagging mode

The X5IP option card supports Flow Classification in the IEEE 802.1Q tagging mode. Users can assign a similar flow profile as described above for the IEEE 802.1ad tagging mode. Note that the QoS classification operations will only modify the end-user priority (UP) bits.

CQS - Provider Bridge Mode (PBM) and Q-tagging mode

The X5IP option card supports classification, queuing, and scheduling functions for four traffic classes, associated with three queues in the Provider Bridge Mode and Q-tagging mode.

Note: In the Q-tagging mode, this function is a non-standard conformance operation mode in which the customer's user priority (UP) bits will be modified.

Ingress rate control in Provider Bridge Mode (PBM) and Q-tagging mode

The X5IP option card supports ingress rate control values through rate policing per flow at customer role ports in provider bridge mode and Q-tagging mode. This function is based on 'Strict policing' values where (PIR=CIR) and 'Oversubscription' values where (PIR>CIR).

Note: In the Q-tagging mode, this function is a non-standard conformance operation mode in which the third user priority (UP) bit of the customer tag will be modified.

LAN port provisioning

The following sections describe LAN port provisioning capabilities that are supported by the X5IP option card.

Maximum number of IEEE mode V-LANs and Provider Bridge Mode CIDs

In combination with the X5IP option card, the 1643 AM/1643 AMS supports a maximum number of 64 IEEE mode V-LANs and Provider Bridge Mode CIDs based on the 'per NE' rule.

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LAN port as network port or customer port

The X5IP option card can be used to operate a LAN port as a network port or customer port. Based on the IEEE 802.1Q and IEEE 802.1ad modes, the 1643 AM/1643 AMS supports a flexible operational port role assignment per LAN port. During port provisioning, a LAN port can be set to a 'network' role.

The following properties are applicable to a port in a 'network' port role:

- No V-LAN tagging operations
- Provider based Spanning Tree Protocol (provisionable, default=enabled)
- GVRP operations (provisionable , default=enabled)

The following properties are applicable to a port in a 'customer' port role:

- V-LAN tagging operations
- No provider based Spanning Tree Protocol
- No GVRP operations

WAN port as network port or customer port

In IEEE 802.1Q and IEEE 802.1ad modes, the Network Element supports a flexible operational port role assignment per WAN port. Next to the default "network" port role, a WAN port can be set to "customer" role.

The following properties apply to a port in "network" port role:

- No VLAN tag/untag operation
- Provider Spanning Tree Protocol (provisionable, default is enabled)
- GVRP operation (provisionable, default is enabled)

The following properties apply to a port in "customer" port role:

- VLAN tag/untag operation
- No provider Spanning Tree Protocol
- No GVRP operation

Configurable rSTP and GVRP participation

The participation of network ports in the rSTP is configurable for virtual switches that are operating in IEEE 802.1Q and IEEE 802.1ad modes. The network port participation enables BPDUs to be transmitted, received, and interpreted.

The participation in GVRP for network ports that participate in rSTP is user-provisionable. The network port participation in rSTP enables BPDUs to be transmitted, received, and interpreted.

Maximum V-LANs under GVRP control

The X5IP option card supports a maximum number of 64 active IEEE 802.1Q or IEEE 802.1ad CIDs on GVRP enabled virtual switches per unit.

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MAC address management

The X5IP option card supports addition of static MAC address entries into the filtering database. These entries are not submitted to the ageing time process. When required, users can delete MAC address entries from the filtering database using configuration commands.

The X5IP option card supports the programmable ageing pass time feature. To check the MAC address entries automatically, the ageing pass timer can be provisioned for a duration between 10 seconds to 630 seconds in steps of 10 seconds for the whole filtering database. The default value is 300 seconds. The X5IP option card supports queries for whole static MAC address entries and dynamic MAC address entries by specifying the MAC address and V-LAN tag.

Security - locked port mode

The X5IP option card enables users to set a port in locked mode. All the new frames that are transmitted into the locked port will be dropped and the SA cannot be learnt. Alarming is reported against new frames in locked port mode.

Link Pass-through

The Fast Ethernet electrical interface and Gigabit Ethernet electrical and optical interfaces on the X5IP option card support Link Pass-through modes. The Ethernet port transmitter is shutdown in the upstream network due to the following failures.

- loss of signal reported on a remote TransLAN Ethernet option card due to Ethernet cable or fiber failure.

- SDH/SONET network failure

- upstream equipment failure.

Remote failures are reported in-band through the GFP-Client Signal Fail message. The Link pass-through mode is only supported on ports that operate on a one-to-one association with a WAN port using GFP encapsulation. Users can enable or disable the Link pass-through mode per port.

The X5IP option card supports loopbacks on outgoing Ethernet, Fast Ethernet, and Gigabit Ethernet signals.

The following figure shows the block diagram of the X5IP option card.

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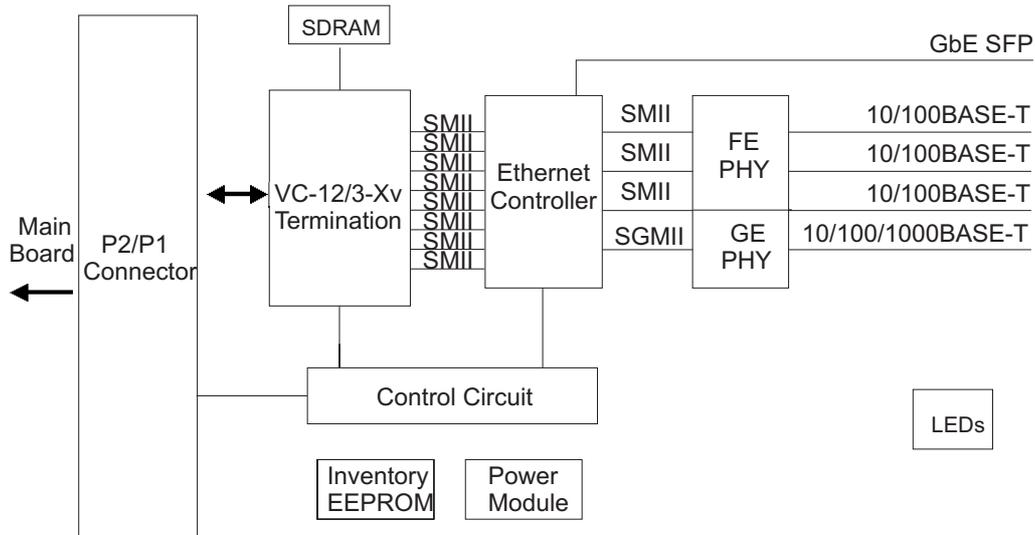
Performance Monitoring

The X5IP option card supports enhanced Ethernet performance monitoring features.

The X5IP option card supports Enhanced Basic Ethernet features. For more information, refer to "Enhanced Basic Ethernet PM Counters " (p. 11-66).

The X5IP option card supports PM counters for high quality traffic load per TC/port. For detailed information , refer to "PM counters for high quality traffic load (per TC/port)" (p. 11-66).

The X5IP option card supports PM counters for low quality traffic load per TC/port. For detailed information, refer to "PM counters for low quality traffic load (per TC/port)" (p. 11-67).

The X5IP option card supports a performance monitoring counter for Ethernet service flows. For more information, refer to "PM counters for Ethernet service flow (per flow)" (p. 11-68).

The X5IP option card supports RTD measurement. For more information, refer to "End-to-end Ethernet PM - Round Trip Delay (RTD) measurement" (p. 11-68).

The X5IP option card supports RTD PM counters and provides RTD/TCA support. For more information, refer to "RTD PM Counters" (p. 11-68).

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X12SHDSL-V2/V3 option card

The X12SHDSL-V2/V3 option card provides additional interfaces for the 1643 AM (DC version) and 1643 AMS in order to integrate sites with 2 Mbit/s access into an existing network in cases where no fiber is available.

The X12SHDSL-V2/V3 option card could, for example, be used for the following applications:

- Connection of UMTS/GSM base stations to the SDH network via copper lines
- Delivery of ISDN traffic to customers via copper lines
- Connection of industrial parks or major customers.

Applications

The following figures show two typical network examples for the connection of UMTS base stations via copper lines:

In this example a 1643 AM/1643 AMS provides the interfaces to several third party NTUs to which a base station is connected. The connection to the SDH network is realized via a 1643 AM/1643 AMS which serves as LTU (Line Termination Unit) in this case. The two units are connected via twisted copper pairs.

For the data transmission the SHDSL protocol is used. In this case the copper pairs can have a maximum length of 3.5 km. It is also possible to connect base station directly via 2 Mbit/s (E1) lines as shown in the example. In such an application a maximum length of 400 m can be bridged.

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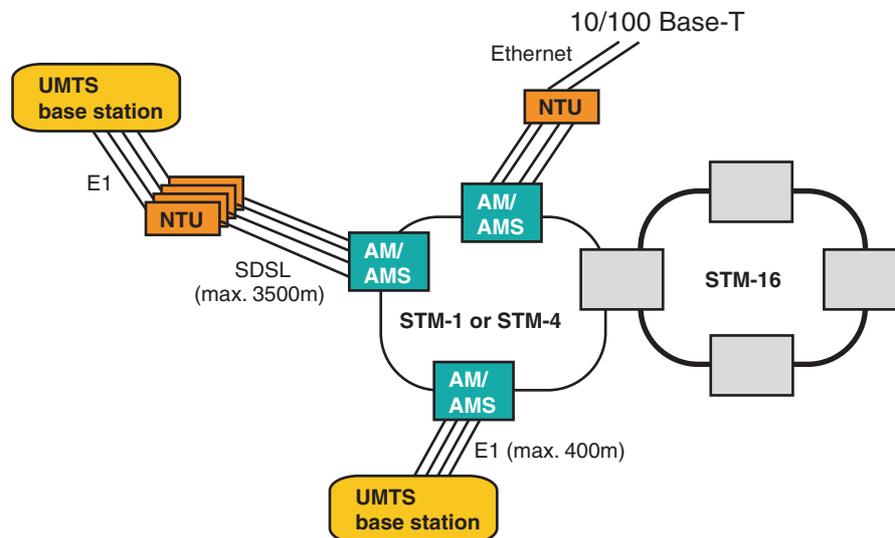
Functional description of the X12SHDSL-V2/V3 option card

The following figure shows the architecture of the X12SHDSL-V2/V3 option card. The option card provides 12 SHDSL interfaces compliant to ITU-T G.991.2. The data rate of each SHDSL interface depends on the selected operation mode. The X12SHDSL-V2/V3 option card uses both the P1 and the P2 connector for the communication with the main board.
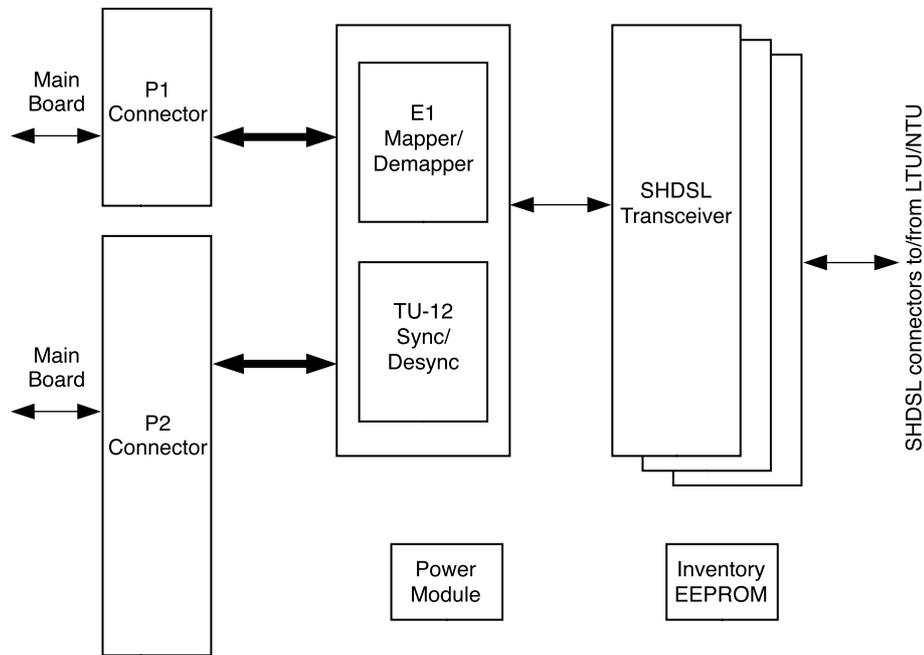
Operation modes

The 1643 AM/1643 AMS can be configured as LTU and operated in E1 or TU-12 mode.

The mode selections apply to the 1643 AM/1643 AMS as a whole. The selections cannot be made to individual ports.

The E1 or TU-12 mode can be provisioned using ITM-CIT or Alcatel-Lucent OMS. The TU-12 mode offers the possibility to utilize SDH functionalities for the SDH link, e.g. Performance Monitoring or Fault Management.

SHDSL line rates

The SHDSL line rate of the X12SHDSL-V2/V3 option card depends on the TU-12/E1 mode selection:

In TU-12 mode, the SHDSL rate 2320 kbit/s, i.e. 2x 8 kbit/s overhead and 2304 kbit/s payload.

In E1 mode, the SHDSL rate 2056 kbit/s, i.e. 8 kbit/s overhead and 2048 kbit/s payload.

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5 Operations, Administration, Maintenance and Provisioning

Overview

Purpose

This chapter describes the OAM&P of the 1643 AM/1643 AMS.

It includes the following:

- Operations Interfaces
- Maintenance supervision
- Software maintenance
- Maintenance testing
- Performance monitoring (G.826 and G.784)
- Self-diagnostics
- System alarm indicators
- Four Miscellaneous Discrete Input (MDI) contacts
- Four Miscellaneous Discrete Output (MDO) contacts.

Contents

Operations Overview

Operations interfaces and administration

The 1643 AM/1643 AMS are configured for remote and local operations management via the Alcatel-Lucent Optical Management Solution and SNMP management solution. Remote management can be realized via the STM-1 or STM-4 DCC and the Alcatel-Lucent OMS or ITM-CIT software.

1643 AM/1643 AMS is configured for remote and local operations management via the Alcatel-Lucent Optical Management Solution. Remote management can be realized via the STM-1 DCC and the Alcatel-Lucent OMS or locally via ITM-CIT.

Local connection is available via an RJ45 socket on the main board to connect a PC loaded with the ITM-CIT software.

Management access features include:

- Simultaneous access by the element management system and local workstations

- Remote access to other 1643 AM/1643 AMS in the same network by ITM-CIT

- NE level security via three password controlled authorization levels: ADMIN, CONFIGURE and VIEW.

Maintenance supervision

Transmission and equipment fault supervision is monitored remotely via the Alcatel-Lucent OMS and locally via LEDs on the unit and via the ITM-CIT. The local ITM-CIT may also be used to remotely access other 1643 AM/1643 AMS nodes in the same network.

Alarm and port termination monitoring features include:

- Physical port provisioning of STM-1 or STM-4 aggregate, STM-1 tributary, E1, E3, DS1, DS3, SHDSL, X.21 and Ethernet ports in three different modes: automatic (AUTO), monitored (MON), or non-monitored (NMON)

- VCx (x=11,12,3,4) and P12 (egress) path termination point provisioning in either the MON or NMON mode

- Alarm severity levels of PROMPT, DEFERRED and INFORMATION provisionable for each alarm type by provisioning the alarm severity assignment profile (ASAP)

- The user can assign an alarm message and severity to each MDI (miscellaneous discrete input) by provisioning the alarm severity assignment profile (ASAP).

Failure reporting features:

- Failure reports are generated for equipment, configuration and software faults with sufficient information to identify the next step in the fault correction process

- Alarm forwarding to the remote EMS (Element Management System) is supported via Alcatel-Lucent OMS (LAN-10BaseT) and to the local workstation via the F-interface (ITM-CIT)

- The NE can store the 500 most recent alarm events and can be accessed by either the local or remote monitoring stations

- Transmission failures are reported as defined in G.783 and ETS 300417

- Centralized supervision alarm system. The ITM-CIT informs of each new alarm change for each accessible NE.

Software maintenance

Software maintenance includes the following:

- Local and remote software download via Alcatel-Lucent OMS or ITM-CIT, non-service affecting. Minor LAN traffic interruption may occur in case of switch of the software backup store in order to upgrade/downgrade the system.

- Faster MIB download duration. The ARC timer is set to five minutes. If a local CIT or OMS connection is established within five minutes, the ARC process will continue. If the local CIT or OMS confirms the MIB download within five minutes, the 1643 AM/1643 AMS will restart. However, if the MIB download is not confirmed within five minutes, the 1643 AM/1643 AMS opens the DCC according to the parameters in the safeplace.

- The 1643 AM/1643 AMS supports MIB upload and download functions to and from a PC via the local Q-LAN interface. The MIB image can be saved as a binary file. This feature is supported by the 1643 AM/1643 AMS and the ITM-CIT.

  The MIB image that is uploaded from the 1643 AM/1643 AMS can be downloaded via the Q-LAN interface to the other NEs with hardware variations. For more information about the hardware variations, refer .

- The 1643 AM/1643 AMS NEQ value is 0.25 and is compatible with the requirements of network management system.

- Database upload/download from the Alcatel-Lucent OMS.

- In-service database reprovisioning available via the local workstation running ITM-CIT software.

- The 1643 AM/1643 AMS supports the ITM-CIT and EMS to display a dynamic software download progress indicator per module. This module also indicates the software download percentage for the SHDSL module.

The "Fast download" tool permits to load the current software of the equipment via a PC connected to the Q-LAN interface of the equipment.

Important! Please note that the SHDSL feature is realized differently in Release 6.1 and later versions than in the previous releases. Thus it cannot be upgraded to Release 6.1 and later versions.

The following table describes the hardware variations that are available for MIB image downloads.

MIB Upload/Download between	Network Element/port
All NE item code with same item code	Same AM1+ or AMS system
CMB403, CMB407, CMB411	ADM-S1.1 (AM1+)
CMB404, CMB408, CMB412	TM-S1.1 (AM1+)
CMB405, CMB409, CMB413	ADM-S4.1 (AM1+)

CMB406, CMB410, CMB414	ADM-L4.2 (AM1+)
CMB403, CMB407, CMB411, CMB418, CMB420	ADM-S1.1 (AM1+ - AMS)
CMB404, CMB408, CMB412	TM-S1.1 (AM1+)
CMB415, CMB418, CMB420	ADM-L1.1 (AM1+ - AMS)
Upload from (CMB404 or CMB408 or CMB412) Download to (CMB418 or CMB420)	TM-S1.1 (AM1+ to AMS)

Maintenance testing

For circuit testing during maintenance operations, the system provides:

- Loopbacks on incoming E1 , DS1, E3, DS3 and X.21 signals (loopbacks on E1/DS1/X.21 are exclusive)
- Loopbacks on outgoing E1, DS1, E3, DS3, SHDSL and X.21 signals
- Cross-Connect loopbacks at AU level
- NT1 (Network Termination) loop-back on a 2 Mbit/s line dedicated to ISDN.

SDH performance monitoring

Provisioning and retrieval of performance monitoring parameters are derived from the overhead bytes (SOH, POH of each VC) and are in accordance with ITU-T Recommendations G.874 and G.826. This is accomplished via Alcatel-Lucent OMS and ITM-CIT. Performance threshold counts are user settable. Each managed NE has a current data register for 15 minutes or 24 hours.

The following parameters are monitored:

- Severely Errored Seconds (SES)
- Errored Seconds (ES)
- Background Block Errors (BBE)
- Unavailable Seconds (UAS).

Ethernet performance monitoring

Ethernet (LAN and WAN) performance monitoring information can be derived from bytes sent, bytes received and packets dropped. This information is available in 15 minutes or 24 hours registers.

ISDN performance monitoring

ISDN Performance monitoring information can be derived for 2 Mbit/s signal from pN_EBC (Near-end Errored Block Count).

This information is available from:

- Egress (Egress refers to the SDH to PDH transmission direction)
- Ingress (Ingress refers to the PDH to SDH transmission direction).

E1 non-intrusive monitoring

For transparent E1 interfaces, it is possible to do near-end performance monitoring on each 2 Mbit/s signal in both directions (PDH to SDH and SDH to PDH) at the 2 Mbit/s system interface. Near-end information is obtained from CRC-4 violations and defects.

Self-Diagnostics and recovery

The 1643 AM/1643 AMS support the following diagnostic and recovery features:

- The equipment continuously runs self-diagnostic tests to monitor the health of the transmission system

- Anomalies are reported via system indicators (FAIL LED) or Alarms on the Element Management System and/or *WaveStar*® CIT

- The equipment auto-recovers after a power failure

- The equipment will auto-recover from a database failure by requesting the backup database be downloaded from the Alcatel-Lucent OMS.

System indicator information

The 1643 AM/1643 AMS support two LEDs which provide the following maintenance information:

- A green LED to indicate power

- A red LED to indicate unit fault or signal failure.

Miscellaneous Discrete Inputs/Outputs

The 1643 AM/1643 AMS provide four miscellaneous discrete inputs (MDIs) which can be used to read external devices assigned by the customer. Examples are monitoring temperature, humidity, open doors, etc.

The equipment provides four miscellaneous discrete outputs (MDOs) which can be used to drive external devices assigned by the customer. Examples are signaling devices, temperature conditioning, etc.

When not assigned by the customer, the 1643 AM/1643 AMS behave such that MDO 1 has been assigned to indicate a power failure (normally open contacts will close), MDO 1, MDO 2, MDO 3, MDO 4 are respectively assigned to power failure, Prompt, Deferred, Information alarms.

HDLC-transparent DCC

The 1643 AM/1643 AMS systems support one bidirectional HDLC-transparent DCCR connection between the two STM-1 line ports. Note that, selectable per port, either the MS channel or the RS channel can be used at the same time. This feature facilitates the interworking with third party equipment.

AITS/UITS protocol on LAPD

The user can select the LAPD protocol (ITU-T Q.921) for OSI layer 2 to be based on AITS (Acknowledged Information Transfer Service) or UITS (Unacknowledged Information Transfer Service). In the AITS mode the receive side sends an acknowledgement back to the transmit side, if a data packet has been received. If this acknowledgement does not arrive, the transmitter sends the packet again. In the UITS mode no acknowledgements are sent.

6 System Planning and Engineering

Overview

Purpose

This chapter provides a high level overview of planning considerations for the 1643 AM/1643 AMS Add-Drop-Multiplexers.

Contents

General Planning Information

Planning considerations 1643 AM

When planning your system with the 1643 AM, the following items should be considered:

- Synchronous Capacity – one or two STM-1 or two STM-4 optical aggregate interface pairs

- Plesiochronous Capacity – sixteen 2 Mbit/s E1 interfaces (basic unit)

  – Optional two STM-1 tributary signals (total of sixteen E1 and two STM-1 tributary)

  – Optional sixteen additional 2 Mbit/s signals (total of thirty-two E1)

  – Optional sixteen additional 1.5 Mbit/s signals (total of sixteen E1s and sixteen DS1s)

  – Optional two 34 Mbit/s signals (total of sixteen E1s and two E3s)

  – Optional two 45 Mbit/s signals (for a combination of sixteen E1s and two DS3s)

  – Optional four 2 Mbit/s X.21 signals (for a combination of sixteen E1s and four X.21s)

  – Optional four 10/100BASE-Ts (for a combination of sixteen E1s and four 10/100BASE-Ts)

  – Optional twelve SHDSL signals (for a combination of sixteen E1s and twelve SHDSLs)

  – Optional eight Ethernet interfaces in Private Line mode

  – 3 x 10/100BASE-TX electrical FE interfaces, 1 x 10/100/1000BASE-T(X) electrical GbE interface, 1 x 1000BASE-X GbE optical interface via SFP.

- Synchronization: STM-1 or STM-4 aggregate line interface timing or via STM-1o tributary line or via a 2 Mbit/s data input

- Protection: VC-12/VC-3/VC-4 SNC/N

- Protection: 1+1 MSP (STM-1 interfaces only)

- Operations Systems: remote and local management with Alcatel-Lucent OMS and local and remote (remote to other 1643 AM) with ITM-CIT, SNMP management is supported

- Three possibilities for Power supply :

  – DC (unit contains DC connector)

  – AC (unit contains AC connector)

  – AC via an external AC/DC connector.

- The 1643 AM provides four miscellaneous discrete inputs (MDIs) which can be used to read external devices assigned by the customer. Examples are monitoring temperature, humidity, open doors, etc.

  The equipment provides four miscellaneous discrete outputs (MDOs) which can be used to drive external devices assigned by the customer. Examples are signaling devices, temperature conditioning, etc.

When not assigned by the customer, the 1643 AM behaves such that MDO 1 has been assigned to indicate a power failure (normally open contacts will close), MDO 1, MDO 2, MDO 3, MDO 4 are respectively assigned to power failure, Prompt, Deferred, Information alarms.

Planning considerations 1643 AMS

When planning your system with the 1643 AMS, the following items should be considered:

- Synchronous Capacity – two STM-1 aggregate interface ports.

  This interface can be equipped with various SFPs (Small Form-factor Pluggable units): S1.1, L1.1, L1.2, STM-1 e and STM-1 single fiber. All optical SFPs are equipped with LC connectors.

- Plesiochronous Capacity – sixteen 2 Mbit/s E1 interfaces or sixteen 1.5 Mbit/s DS1 interfaces (basic unit)
  – Optional sixteen 2 Mbit/s signals (for a total combination of sixteen DS1 and sixteen E1 or thirty-two E1)
  – Optional sixteen 1.5 Mbit/s signals (for a total combination of sixteen DS1 and sixteen E1 or thirty-two DS1)
  – Optional two 34 Mbit/s signals (for a total combination of sixteen E1/DS1 and two E3s)
  – Optional two 45 Mbit/s signals (for a total combination of sixteen E1/DS1 and two DS3s)
  – Optional four X.21 interfaces (for a total combination of sixteen E1/DS1 and four X.21s)
  – Optional four 10/100BASE-T LAN interfaces (for a combination of sixteen E1/DS1 and four 10/100BASE-Ts).
  – Optional twelve SHDSL electrical tributary interface pairs (for a combination of sixteen E1/DS1 and twelve SHDSL on 1643 AM/1643 AMS DC version)
  – Optional eight Ethernet interfaces in Private Line mode
- Synchronization: STM-1 aggregate line interface timing or via a E1/DS1 data input
- Protection: VC-12/VC-3 SNC/N
- Operations Systems: remote and local management with Alcatel-Lucent OMS and local and remote (remote to other 1643 AMS) with ITM-CIT, SNMP management is supported
- Three possibilities for Power supply :
  – DC (unit contains DC connector)
  – AC (unit contains AC connector)
  – AC via an external AC/DC connector.
- The 1643 AMS provides four miscellaneous discrete inputs (MDIs) which can be used to read external devices assigned by the customer. Examples are monitoring temperature, humidity, open doors, etc.

The equipment provides four miscellaneous discrete outputs (MDOs) which can be used to drive external devices assigned by the customer. Examples are signaling devices, temperature conditioning, etc.

When not assigned by the customer, the 1643 AMS behaves such that MDO 1 has been assigned to indicate a power failure (normally open contacts will close), MDO 1, MDO 2, MDO 3, MDO 4 are respectively assigned to power failure, Prompt, Deferred, Information alarms.

• Order wire: An external orderwire system can be connected which uses this orderwire channel for transparent data transmission via the transmission network.

7   Ordering

Overview

Purpose

This chapter provides an overview of the ordering process and the current ordering information for 1643 AM/1643 AMS

The different comcodes listed hereafter can change. Contact your Alcatel-Lucent representative for updated information.

Contents

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Ordering information

1643 AM/1643 AMS has been carefully engineered and all equipment kitted to simplify the ordering process. In this section the current ordering information are shown, as available on the issue date of this document.

Contact and further information

For all questions concerning ordering of 1643 AM/1643 AMS, for any information about the marketable items and their comcodes, and for ordering the equipment please contact your Account Executive for 1643 AM/1643 AMS or your Alcatel-Lucent local customer team.

Orderable 1643 AM/1643 AMS products

The tables below list the comcodes of the 1643 AM and 1643 AMS Products. Software needs to be ordered together with the network element. To get the ordering information for available software versions please contact your local customer team.

The following table is intended to give an overview of the orderable 1643 AM/1643 AMS products.

1643 AM Products	Short unit name	Comcode	Comments
1643 AM AD-S4.1 - 16 x E1 75/120 - B - DC PS	AM1-X2S41-B-DC	109164434	STM-4 SH Add Drop Multiplexer (with two STM-4 and 16xE1 75/120 Ω without MSP possibility) -24/-48/-60 V DC power supply, loaded with software R1.0 through 7.2.
1643 AM AD-L4.2 - 16 x E1 75/120 - B - DC PS	AM1-X2L42-B-DC	109164442	STM 4 LH Add Drop Multiplexer (with two STM-4 and 16xE1 75/120 Ω without MSP possibility) -24/-48/-60 V DC power supply, loaded with software R1.0 through 7.2.
1643 AM AD-S4.1 - 16 x E1 75/120 -B - AC PS	AM1–X2S41-B-AC	109164475	STM-4 SH Add Drop Multiplexer (with two STM-4 and 16xE1 75/120 Ω) 120/240 V AC power supply, loaded with software R1.0 through 7.2.

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1643 AM Products	Short unit name	Comcode	Comments
1643 AM AD-L4.2 - 16 x E1 75/120 - B - AC PS	AM1–X2L42-B-AC	109164483	STM-4 LH Add Drop Multiplexer (with two STM-4 and 16xE1 75/120 Ω) 120/240 V AC power supply, loaded with software R1.0 through 7.2.

The following table is intended to give an overview of the orderable 1643 AMS products.

1643 AMS Products	Apparatus code	Comcode	Comments
1643 AMS E1 16	CMB418	109445643	STM 1 LH Add Drop Multiplexer (with two STM1 and 16 x E1, also configurable as STM1 Terminal Multiplexer with/without MSP possibility) -24/-48/-60 V DC power supply, loaded with software R1.0 through 7.2
1643 AMS E1 16	CMB418	109819201 (ROHS6)	STM 1 LH Add Drop Multiplexer (with two STM1 and 16xE1, also configurable as STM1 Terminal Multiplexer with/without MSP possibility) -24/-48/-60 V DC power supply, loaded with software R7.2.11 or upper
1643 AMS E1 16 AC	CMB420	109528018	STM 1 LH Add Drop Multiplexer (with two STM1 and 16 x E1, also configurable as STM1 Terminal Multiplexer with/without MSP possibility) 100 V - 240 V AC power supply, loaded with software R1.0 through 7.2

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1643 AMS Products	Apparatus code	Comcode	Comments
1643 AMS E1 16 AC	CMB420	109819193 (ROHS6)	STM 1 LH Add Drop Multiplexer (with two STM1 and 16 x E1, also configurable as STM1 Terminal Multiplexer with/without MSP possibility) 100V - 240 V AC power supply, loaded with software 7.2.11 or upper
1643 AMS DS1-16	CMB419	109445650	STM 1 LH Add Drop Multiplexer (with two STM1 and 16 x DS1, also configurable as STM1 Terminal Multiplexer with/without MSP possibility) -24/-48/-60 V DC power supply, loaded with software R1.0 through 7.2

Note: 1643 AMS ROHS6 main boards (109819201, 109819193) only can work with SHDSL option cards (109782565, 109579912) and X5IP option cards (109819185, 109667931,109599845).

1643 AM/1643 AMS option cards

The table below lists the comcodes of the 1643 AM/1643 AMS option cards.

Unit short name	1643 AM/1643 AMS Products	Comcodes	AM	AMS
X2S11TRIB	1643 AM - optional 2 STM-1 short haul tributary option card	109018044	x	
X16E1-V3	1643 AM/1643 AMS - optional 16 E1 75/120 Ω option card	109011528	x	x
X16DS1	1643 AM/1643 AMS - optional 16 DS1 option card	108756081	x	x
X2E3-V2	1643 AM/1643 AMS - optional 2 E3 option card	108756107	x	x
X2DS3-V2	1643 AM/1643 AMS - optional 2 DS3 option card	108756099	x	x
X12SHDSL-V2	1643 AM/1643 AMS - optional 12 SHDSL option card with features from R6.1 and later versions	109579912	x	x

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Unit short name	1643 AM/1643 AMS Products	Comcodes	AM	AMS
X12SHDSL-V3	1643 AMS - optional 12 SHDSL option card with features from R7.2.11 and later versions	109782565 ROHS6		x
X4IP	1643 AM/1643 AMS - optional 4 10/100BASE-T LAN interfaces (*TransLAN*®) option card	108865064	x	x
X5IP	1643 AM/1643 AMS- 3 x FE electrical Ethernet interfaces for 10/100BASE-T(X), 1 x triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and 1 x GE optical Ethernet interface via SFP for 1000BASE-X.	109599845	x	x
X5IP-V2	1643 AM/1643 AMS- 3 x FE electrical Ethernet interfaces for 10/100BASE-T(X), 1 x triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and 1 x GE optical Ethernet interface via SFP for 1000BASE-X	109667931	x	x
X5IP-V3	1643 AMS- 3 x FE electrical Ethernet interfaces for 10/100BASE-T(X), 1 x triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and 1 x GE optical Ethernet interface via SFP for 1000BASE-X	109819185 (ROHS6)		x
X8PL	1643 AM/1643 AMS - optional 8 Ethernet PL option card	109480707	x	x

Notes:

1. ROHS6 X5IP-V3 option card can only work with 1643AMS ROHS6 main boards (109819201, 109819193) and 1643 AMS ROHS5 main boards (109445643, 109528018).

2. The ROHS6 card is provisioned as ROHS5 card because of software compatibility. It can be identified by new comcode from the remote inventory.

1643 AM/1643 AMS SFPs

1643 AM/1643 AMS Products	Apparatus code	Comcodes	AM	AMS
1643 AMS STM-1 S1.1 SFP short range	OM155T101	109469809		x
1643 AMS STM-1 L1.1 SFP middle range	OM155T103	109469825		x
1643 AMS STM-1 L1.2 SFP long range	OM155T102	109469817		x
1643 AMS STM-1 electrical SFP	OM155T104	109543561		x
1643 AMS STM-1/STM-4 LH 1490, single fiber bidirectional SFP long haul	OM155T105	109559492		x
1643 AMS STM-1/STM-4 SH 1310, single fiber bidirectional SFP short haul	OM155T106	109559500		x

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1643 AM/1643 AMS Products	Apparatus code	Comcodes	AM	AMS
1643 AMS1000 BASE-SX, 550m, 770-860nm	OMGBET101	109526483	x	x
1643 AMS1000 BASE-LX, 5 km, 1310nm	OMGBET102	109526491	x	x
1643 AMS1000 BASE-ZX, 40-90 km, 1550nm	OMGBET103	109534347	x	x

1643 AM/1643 AMS accessories

The table below lists the comcodes of the 1643 AM/1643 AMS Accessories.

1643 AM/1643 AMS accessories	Comcode	AM	AMS
Battery back-up facility for 1643 AM 1 - 8.0 Amp Hours	108626110	x	x
Connecting Cable ITM-CIT Interface to Computer	848069795	x	x
1643 AM AC to DC Ext.Power Converter.	408876472	x	x
FAN UNIT for 1643 AM/1643 AMS	848949657	x	x
Heat Baffle Plate for 1643 AM/1643 AMS	408905057	x	x

Recommended cables

Please refer to the 1643 AM/1643 AMS Installation Guide.

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8 Product support

Overview

Purpose

This chapter provides information about the support for the 1643 AM/1643 AMS.

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Installation services

This section describes the installation services available to support 1643 AM/1643 AMS.

Alcatel-Lucent offers Installation Services focused on providing the technical support and resources needed to efficiently and cost-effectively install your network equipment. Alcatel-Lucent Installation Services provide unparalleled network implementation expertise to help install your wireline and wireless networks. We use state-of-the-art tools and technology, and highly skilled technicians to install your equipment and help to ensure the timely and complete implementation of your network solution. By relying on our installation experts, we can rapidly build or expand your network, help manage the complexity of implementing new technologies, reduce operational costs, and help improve your competitive position by enabling your staff to focus on the core aspects of your business rather than focusing on infrastructure details.

Description

Within Alcatel-Lucent' overall Installation Services portfolio, Basic Equipment Installation and Site Supplemental Installation are the two services most closely linked to the initial deployment of Alcatel-Lucent' products into your network.

Basic Equipment Installation

Provides the resources, experience and tools necessary to install the 1643 AM/1643 AMS product into your network. We assemble, cable and wire, and test the 1643 AM/1643 AMS, helping to ensure it is fully functioning as engineered and specified.

Site Supplemental Installation

Enhances the Basic Equipment Installation service by performing supplemental work that is unique to your specific site location, configuration, or working requirements. Includes installation of material other than the main footprint product (such as earthquake bracing); provision of services unique to your site (such as, hauling and hoisting, multi-floor cabling, rental and local purchases) or as may be required by your operations (such as, overtime to meet your compressed schedules, night work requested by you, abnormal travel expenses, abnormal transportation or warehousing); and any other additional effort or charges associated with your environment.

Benefits

When implementing our Installation Services, Alcatel-Lucent becomes a strategic partner in helping you realize your long-term strategies and achieve your business and technological goals. We combine our state-of-the-art technical background, high-quality processes, expertise in the latest technologies, knowledge of revolutionary equipment breakthroughs, and feature-rich project management tools to get your network up and running - quickly, efficiently, and reliably. With Alcatel-Lucent, you can concentrate on your core business, while we apply our years of knowledge and experience to installing your network.

Our Installation Services let you:

- *Rapidly expand your network* — by turning hardware into working systems, with the capability to deploy multiple networks in parallel rollouts

- *Reduce operational expense* — of recruiting, training, and retaining skilled installation personnel

- *Leverage Alcatel-Lucent' resources and expertise* — by utilizing our team of knowledgeable and fully equipped experts that implement projects of any size, anywhere around the world

- *Implement quality assurance* — through our total quality management approach

- *Reduce operational expenses* — by avoiding the purchase of the necessary state-of-the-art tools, test equipment, specialized test software, and spare parts that Alcatel-Lucent Installation Services utilize

- *Ensure high-quality support* — with Alcatel-Lucent' extensive support structure, including proven methods and procedures, mechanized tools, professional training, technical support, and access to Bell Labs.

Reference

For more information about specialized installation services and/or database preparation, please contact your local Account Executive.

Engineering services

This section describes the engineering services available to support 1643 AM/1643 AMS.

Alcatel-Lucent Worldwide Services (LWS) offers Engineering Services focused on providing the technical support and resources needed to efficiently and cost-effectively engineer your network equipment. We provide the best, most economical equipment solution by ensuring your network equipment is configured correctly, works as specified, and is ready for installation upon delivery. With our proven, end-to-end solutions and experienced network engineering staff, Alcatel-Lucent Worldwide Services is the ideal partner to help service providers engineer and implement the technology that supports their business.

Description

Within Alcatel-Lucent' overall Engineering Services portfolio, Site Survey, Basic Equipment Engineering, Site Engineering, and Site Records are the four services most closely linked to the initial deployment of 1643 AM/1643 AMS into your network; each is described below.

Site Survey

A Site Survey may be required to collect your site requirements needed for proper equipment engineering. If adequate site requirements and records are not available up front, a site survey would be performed to collect information required for configuration of the equipment and integration of the equipment into the site.

Basic Equipment Engineering

Ensures that the correct footprint hardware is ordered and that the ordered equipment is configured for optimal performance in the network for the customer. Alcatel-Lucent Engineering configures equipment requirements based on inputs from the customer order, completed questionnaires, and/or site survey data. The decisions as to specific equipment needs are based on each component's functionality and capacity, and the application of engineering rules associated with each component.

Site Engineering

Ensures that the correct site material is ordered and that the optimal equipment layout for the installation of the ordered equipment in the customer's site is determined. Site Engineering will be used in assisting the customer with determining the necessary site conditions, layout and equipment required to properly install/integrate the footprint hardware components into a specific location.

Site Records

Site Records Service provides detailed record keeping which accurately documents the physical placement and configuration of specified customer equipment. Depending on the customer request, this can involve the initial creation of site records, updating of existing records, or ongoing maintenance of the customer's records.

Benefits

When implementing our Engineering Services, Alcatel-Lucent becomes a strategic partner in helping you realize your long-term strategies and achieve your business and technological goals. Our Engineering Services portfolio delivers quick, responsive support, with state-of-the-art tools, top technicians and end-to-end services to help you engineer an optimal network solution. Whether you are looking to outsource your total engineering effort or simply supplement basic coverage gaps, our portfolio of services provides the flexible level of support you need. With Alcatel-Lucent, you can concentrate on your core business while we apply our years of knowledge and experience in engineering your equipment solutions.

Our Engineering Services let you:

- *Rapidly expand your network* — by turning products into working systems, with the capability to deploy multiple networks in parallel rollouts
- *Reduce costs* — by determining the most cost-effective network configuration and optimal use of office space when planning and providing an equipment solution
- *Reduce operational expense* — of recruiting, training, and retaining skilled engineering personnel
- *Leverage Alcatel-Lucent' resources and expertise* — by utilizing our team of knowledgeable and fully equipped experts that can plan, design, and implement projects of any size, anywhere around the world
- *Implement quality assurance* — through our total quality management approach and use of ISO-certified processes
- *Provide one–stop shopping* with a globally deployed engineering workforce, saving the time, delays and coordination challenges of dealing with multiple equipment vendors and service providers
- *Keep pace with rapidly changing technology* — by supporting the latest technologies and equipment breakthroughs, including Alcatel-Lucent' and other vendor's products
- *Ensure high-quality support* — with Alcatel-Lucent' extensive support structure, including proven methods and procedures, mechanized tools, professional training, technical support, and access to Bell Labs
- *Maintain and track vital office records* — keep track of equipment locations and connections.

Reference

For more information about specialized engineering services, engineering consultations, and/or database preparation, please contact your local Account Executive.

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Maintenance services

This section describes the maintenance services available to support 1643 AM/1643 AMS.

Description

Maintenance Services is composed of three primary services to support your maintenance needs. The services are

- Remote Technical Support Service (RTS)
- On-site Technical Support Service (OTS)
- Repair and Exchange Services (RES)

Remote Technical Support Service (RTS)

RTS provides remote technical support and Software Patches and Software Updates, as available, for deployed Alcatel-Lucent network elements to help cost-effectively maximize network availability and performance. With this service, system engineers deliver remote support via phone or modem connection for rapid response, diagnoses, and resolution of system outages and issues.

Support from our expert remote system engineers will:

- enable trouble tracking, resolution, and restoration
- answer technical product-related questions and specific feature and function questions
- help identify and apply available Software Patches and Software Updates on Covered Products.

Single Point of Contact — access to Alcatel-Lucent engineers and information to help identify and resolve technical issues via phone or modem.

Alcatel-Lucent OnLine Customer Support —

- web-based tracking and management of Assistance Requests (AR)
- self-help services i.e., Knowledge Database, Documentation, E-mail.

Service Options —

- Premium RTS: 24 hours a day, 7 days a week (24 × 7)
- Standard RTS: 8 hours a day (8 am – 5 pm Client local time) 5 days per week (8 × 5), Monday - Friday, excluding Alcatel-Lucent holidays.

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On-site Technical Support (OTS)

OTS provides cost-effective support for Alcatel-Lucent products including systems that incorporate select third-party equipment.

- OTS Dispatched Technician — Alcatel-Lucent will dispatch a technician to your location to provide on-site assistance. We offer multiple coverage options to meet your needs from same-day dispatch, with 24 × 7 or 8 × 5 response, to next-business-day dispatch, with 8 × 5 response.

- OTS Dedicated Technician — a Alcatel-Lucent technician works at your location to perform daily maintenance tasks that keep your system running at peak performance.

- OTS Dedicated Engineer — an expert Alcatel-Lucent engineer provides you with customized on-site support and assistance in areas such as maintenance of new equipment, administration of software releases, and support with your administrative processes.

Repair and Exchange Services (RES)

RES provides rapid replacement or repair of your defective hardware, eliminating the need for you to purchase and maintain a costly spares inventory. These services can dramatically reduce investment capital and recurring operating expenses while helping to assure maximum network availability. RES offers

- Same Day Advanced Exchange — delivers a replacement part to Customer equipment site within four hours to enable rapid restoration of service to equipment and the ability to return parts to Alcatel-Lucent later. We have established an infrastructure of multi-point, overlapping-coverage field stocking locations and automated electronic process controls that help us approach a 100% on-time delivery track record.

- Next Day Advanced Exchange — delivers a replacement part on the very next day, 7 days a week, including holidays. Consider what is at risk when you compare this service to a "business day" program.

- Return for Repair — is an economical solution, which allows the Customer to return your field-replaceable parts to Alcatel-Lucent for repair or replacement. Alcatel-Lucent returns them in a very timely manner and without unexpected repair fees.

Contact

For maintenance service contact information please refer to .

Technical support

This section describes the technical support available for 1643 AM/1643 AMS.

Services

1643 AM/1643 AMS are complemented by a full range of services available to support planning, maintaining, and operating your system. Applications testing, network integration, and upgrade/conversion support is also available.

Technical support groups

Technical support is available through

- Local/Regional Customer Support (LCS/RCS)
- Technical Support Service (TSS).

Contacting your LCS/RCS

LCS/RCS personnel troubleshoot field problems 24 hours a day over the phone and on site (if necessary) based on Alcatel-Lucent Service Contracts:

for Europe, Africa, Asia and the pacific region (EMEA and APAC)	International Customer Management Centre (ICMC): +353 1 692 4579 (toll number) 00 800 00Alcatel-Lucent (toll free number in most EMEA countries)

For technical assistance, call your Local/Regional Customer Support Team. If the request cannot be solved by LCS/RCS, it will be escalated to the central Technical Support Service (TSS) team in Hilversum, Netherlands.

Technical support service

Alcatel-Lucent Technical Support Service (TSS) organization is committed to providing customers with quality product support services. Each segment of the TSS organization regards the customer as its highest priority and understands your obligations to maintain quality services for your customers.

The TSS team maintains direct contact with Alcatel-Lucent manufacturing, Bell Laboratories development, and other organizations to assure fast resolution of all assistance requests.

Technical support platform

A global online trouble tracking system is used by all support teams to track customer assistance requests. The system communicates details about product bulletins, troubleshooting procedures, and other critical information to customers. All details of a

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request are entered into this database until closure. For online access to your trouble tickets via the web please contact your local support team or check the following website: (https://support.lucent.com/support)

Reference

For additional information about technical support, please contact your Account Executive for 1643 AM/1643 AMS or your Alcatel-Lucent local Customer Team.

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Product support levels

        The following figure shows the levels of product support for Alcatel-Lucent products.

Customers

Technician

Customer Escalation Procedures

Alcatel-Lucent LCS/RCS

First Alcatel Lucent contact

Supports Alcatel Lucent Installer

Supports customer in Country/Region

Trouble Tracking System

                    (open and close MR)

Alcatel-Lucent TSS
(Technical Support Service)

LCS/RCS Assistance

Problem Diagnosis/Isolation

Provides Solutions/Workarounds

Consultation

Alcatel-Lucent
Bell Laboratories

Highest Level of Support

Product Design Subject Matter Expert

Enhancements

Change control board

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Documentation support

Alcatel-Lucent provides comprehensive product documentation tailored to the needs of the different audiences. An overview of the documentation set can be found at "Related documentation" (p. xv).

Customer comment

As customer satisfaction is extremely important to Alcatel-Lucent, every attempt is made to encourage feedback from customers about our information products. Thank you for your feedback.

To comment on this information product online, go to *http://www.alcatel-lucent-info.com/comments*.

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Training support

To complement your product needs, the Alcatel-Lucent Learning organization offers a formal training package, with the single training courses scheduled regularly at Alcatel-Lucent' corporate training centers or to be arranged as on-site trainings at your facility.

Registering for a course or arranging an on-site training

To enroll in a training course at one of the Alcatel-Lucent corporate training centers or to arrange an on-site training at your facility (suitcasing), please contact:

Asia, Pacific, and China	Training Center Singapore, Singapore voice: +65 6240 8394 fax: +65 6240 8017
Central America and Latin America	Training Center Mexico City, Mexico voice: +52 55 527 87187 fax: +52 55 527 87185
Europe, Middle East, and Africa	Training Center Nuremberg, Germany voice: +49 911 526 3831 fax: +49 911 526 6142
North American Region	Training Center Altamonte Springs, USA voice: +1-888-582-3688 - prompt 2 (+1-888-Alcatel-Lucent8 - prompt 2).

To review the available courses or to enroll in a training course at one of Alcatel-Lucent' corporate training centers you can also visit: *https://www.alcatel-lucent-product-training. com*.

Warranty

Introduction

Warranty, support, and trouble escalation procedures have been established on a per country basis. Contact your Alcatel-Lucent account representative for details.

Discontinued Availability

Alcatel-Lucent ONG reserves the right to notify the customer in advance of the intention to Discontinue the Availability (DA) of a product. Alcatel-Lucent' ONG also reserves the right to offer a Technical Support Contract (TSC) to make repair and technical support services available for an additional period of time after a product has been discontinued. All TSC services will be at a specified price dependent on the terms and conditions of the contract.

The rights and obligations of Alcatel-Lucent ONG and the customer shall neither be assigned nor delegated without prior written consent of the other party, except that Alcatel-Lucent' ONG may assign its obligations to any of its affiliates or non-Alcatel-Lucent contractors without further consent by the customer.

Standard Repair

Introduction

If Alcatel-Lucent' ONG determines that a product is not defective or is in conformance, the customer shall pay Alcatel-Lucent' ONG the costs of handling, inspecting, testing, and transporting the product and, if applicable, travel and related expenses.

Repair interval

Alcatel-Lucent' ONG repair locations set their own standards for return intervals. On average, the minimum time to return repairs to the customer is 14 days from the receipt of the product by the repair location. The maximum time to return repairs to the customer can range from 50 to 180 days.

Out-of-Warranty provisions

For any activity associated with repair or replacement of hardware and/or software systems that is determined by Alcatel-Lucent' ONG to be out of warranty, materials and labor will be billed at Alcatel-Lucent' ONG list price (time-and-materials plus additional incurred expenses), or in accordance with a separate Technical Support Contract.

International repair and service

The customer or the customer's in-country representative should send a description of the material to be returned for repair or service including the quantity, comcodes, and serial numbers (if available).

After the material has been shipped, the following information should be faxed to the Service Center:

- Customer's return address
- Customer contact name, telephone number, and fax number
- Value of material
- Identification of any hazardous equipment or material
- Shipping information including the date of shipment, air waybill, carrier name, flight number, number of cartons, and weight of material.

When the material arrives at the Service Center, it is entered into the Repair, Service, and Return database for tracking purposes.

The repair location will repair the material. If it is determined that an item is not repairable and the item is under factory warranty, a replacement will be sent. If the item is out of factory warranty, the customer will advise their Country Desk Representative if they would like to order a replacement.

The Service Center will prepare the paperwork for exporting the material, and ship the material to the customer. When available, the Service Center will fax the shipping information to the customer or the customer's in-country representative.

Upon receipt of the material, the customer or the customer's in-country representative should send the Service Center the order numbers of the material received and the date the material was received. The Service Center will then close the order on the Repair, Service, and Return database.

Important! Please note that Alcatel-Lucent warranty is contingent upon the use of Alcatel-Lucent specified SFPs for 1643 AMS. Use of other SFPs is not approved by Alcatel-Lucent and is fully at the customer's own risk. Any warranty obligation of Alcatel-Lucent is extinguished when non-Lucent specified SFPs are used.

9 Quality and reliability

Overview

Purpose

This chapter presents the Alcatel-Lucent quality policy and describes the reliability of the 1643 AM/1643 AMS.

Contents

Quality

Overview

Purpose

This section describes Alcatel-Lucent' commitment to quality and reliability and how quality is ensured.

Contents

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Alcatel-Lucent' commitment to quality and reliability

Alcatel-Lucent is extremely committed to providing our customers with products of the highest level of quality and reliability in the industry. 1643 AM/1643 AMS are a prime example of this commitment.

In line with this policy, all major transmission facilities in the USA, Europe and China are ISO-9000 certified. In line with the above, Alcatel-Lucent' policy statement in this respect is as follows.

Quality policy

Alcatel-Lucent is committed to achieving sustained business excellence by integrating quality principles and methods into all we do at every level of our company to

- Anticipate and meet customer needs and exceed their expectations, every time
- Relentlessly improve how we work – to deliver the world's best and most innovative communications solutions – faster and more cost-effectively than our competitors

Reliability in the product life-cycle

Each stage of the life cycle of 1643 AM/1643 AMS relies on people and processes that contribute to the highest product quality and reliability possible. The reliability of a product begins at the earliest planning stage and continues into

- Product architecture
- Design and simulation
- Documentation
- Prototype testing during development
- Design change control
- Manufacturing and product testing (including 100% screening)
- Product quality assurance
- Product field performance
- Product field return management

The R&D community of Alcatel-Lucent is certified by ISO 9001.

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Ensuring quality

This section describes the critical elements that ensure product quality and reliability within

- Product development
- Manufacturing

Critical elements of product development

The product development group's strict adherence to the following critical elements ensures the product's reliability

- Design standards
- Design and test practices
- Comprehensive qualification programs
- System-level reliability integration
- Reliability audits and predictions
- Development of quality assurance standards for manufactured products

Critical elements of manufacturing

Note: Independent Quality Representatives are also present at manufacturing locations to ensure shipped product quality.

The manufacturing and field deployment groups' strict adherence to the following critical elements ensures the product's reliability

- Pre-manufacturing
- Qualification
- Accelerated product testing
- Product screening
- Production quality tracking
- Failure mode analysis
- Feedback and corrective actions

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Conformity statements

CE conformity

Hereby, Alcatel-Lucent declares that the Alcatel-Lucent products

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS, Release 1.0 through 7.2

are in compliance with the essential requirements and other relevant provisions of the following Directive:

Directive 1999/5/EC of 9 March 1999 on Radio and Telecommunication Terminal Equipment of the European Parliament and of the Council

is tested and conforms with the essential requirements for protection of health and the safety of the user and any other person and Electromagnetic Compatibility. Conformity is indicated by the CE mark affixed to the product. For more information regarding CE marking and Declaration of Conformity (DoC), please contact your local Alcatel-Lucent Customer Service Organization.

This product is in conformity with Article 3, Paragraph 3 of the R&TTE Directive and interworks in networks with other equipment connected to the optical telecommunication network.

Conformance with specifications of optical interfaces is granted as stated in the Official Journal of the European Union.

Compliance Statement in other European Languages

English

Hereby, Alcatel-Lucent, declares that this 1643 AM/1643 AMS is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Finnish

Alcatel-Lucent vakuuttaa täten että 1643 AM/1643 AMS tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Dutch

Bij deze verklaart Alcatel-Lucent dat deze 1643 AM/1643 AMS voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.

French

Par la présente, Alcatel-Lucent déclare que ce 1643 AM/1643 AMS est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables.

Swedish

Härmed intygar Alcatel-Lucent att denna 1643 AM/1643 AMS står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

Danish

Undertegnede Alcatel-Lucent erklærer herved, at følgende udstyr 1643 AM/1643 AMS overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF

German

Hiermit erklärt Alcatel-Lucent die Übereinstimmung des Gerätes 1643 AM/1643 AMS mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG.

Greek

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Alcatel-Lucent ΔΗΛΩΝΕΙ ΟΤΙ 1643 AM/1643 AMS ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ

Italian

Con la presente Alcatel-Lucent dichiara che questo 1643 AM/1643 AMS è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Spanish

Por medio de la presente Alcatel-Lucent declara que el 1643 AM/1643 AMS cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE

Portuguese

Alcatel-Lucent declara que este 1643 AM/1643 AMS está conforme com os requisitos essenciais e outras provisões da Directiva 1999/5/CE.

1643 AM CE conformity declaration

EC DECLARATION OF CONFORMITY

We

Lucent Technologies Network System GmbH
Thurn-und-Taxis-Str. 10
90411 Nuremberg
Germany

declare under our sole responsibility that the product:

Metropolis® AM, Release R7.1
Configuration with X5IP option card

to which this declaration relates is in conformity with the following specifications

EN   300 386   V 1.3.3 (2005)
IEC 60950-1   (2001-12)

following the provisions of Council Directive 89/336/EEC, 2004/108/EC and 73/23/EEC, as amended by Directive 93/68/EEC, on the approximation of the laws of the Member States relating to electromagnetic compatibility and electrical equipment designed for use within certain voltage limits.

Nuremberg, Febr. 06, 2007   Nuremberg, Febr. 06, 2007

Dr.Rainer Fechner   *Siegfried Träger*
Vice President & Managing Director   *E&H Manager*

ECL-CE-ONG-07-001-V 01.00

Supplementary Information

Manufacturer
Lucent Technologies Network System GmbH
Thurn-und-Taxis-Str. 10
90411 Nuremberg

Technical Construction File No (if applicable) :
Number

Competent Body (if applicable) :

Test report No: EMC-JHS006090537-001
INTERTEK Testing Services Shanghai Ltd.
Safety, JSH006090536-001
INTERTEK Testing Services Shanghai Ltd.

Technical Certificate No (if applicable) :

Lucent Technologies
Bell Labs Innovations

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1643 AMS CE conformity declaration

EC DECLARATION OF CONFORMITY

We

Lucent Technologies Network System GmbH
Thurn-und-Taxis-Str. 10
90411 Nuremberg
Germany

declare under our sole responsibility that the product:

Metropolis ™ AMS, Release R5.0

to which this declaration relates is in conformity with the following specifications

EN 300 386   V 1.3.2 (2003)
IEC 60950-1   (2001-12)

following the provisions of Council Directive 89/336/EEC, 2004/108/EC and 73/23/EEC, as amended by Directive 93/68/EEC, on the approximation of the laws of the Member States relating to electromagnetic compatibility and electrical equipment designed for use within certain voltage limits.

Nuremberg, July 25, 2006   Nuremberg, July 25, 2006

Dr. Rainer Fechner   Siegfried Träger
Vice President & Managing Director   E&H Manager

ECL-CE-ONG-06-002-V 01.00

Supplementary Information

Manufacturer   Technical Construction File No (if applicable) :
Lucent Technologies Network System GmbH   Number
Thurn-und-Taxis-Str. 10
90411 Nuremberg

Competent Body (if applicable) :   Test report No: EMC-15010648001,
                                                          TÜV Rheinland (Shanghai), LTD.
                                          Safety 12010630001,
                                                          TÜV Rheinland Japan, Ltd.

                                          Technical Certificate No (if applicable) :

Lucent Technologies
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Eco-environmental statements

The statements that follow are the eco-environmental statements that apply to the *Waste from Electrical and Electronic Equipment (WEEE) directive*.

Packaging collection and recovery requirements

Countries, states, localities, or other jurisdictions may require that systems be established for the return and/or collection of packaging waste from the consumer, or other end user, or from the waste stream. Additionally, reuse, recovery, and/or recycling targets for the return and/or collection of the packaging waste may be established.

For more information regarding collection and recovery of packaging and packaging waste within specific jurisdictions, please contact the Alcatel-Lucent Field Services/Installation - Environmental Health and Safety organization.

For installations not performed by Alcatel-Lucent, please contact the Lucent Customer Support Center at::

Technical Support Services, Alcatel-Lucent.

Within the United States: 1 866 Alcatel-Lucent8 (866 582 3688), prompt 1

From all other countries: +1 630 224 4672, prompt 2

Recycling/take-back/disposal of product

Electronic products bearing or referencing the symbol shown below when put on the market within the European Union, shall be collected and treated at the end of their useful life, in compliance with applicable European Union and local legislation. They shall not be disposed of as part of unsorted municipal waste. Due to materials that may be contained in the product, such as heavy metals or batteries, the environment and human health may be negatively impacted as a result of inappropriate disposal.
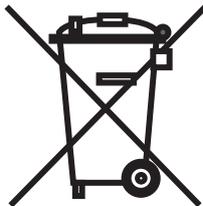
Note: In the European Union, a solid bar under the crossed-out wheeled bin indicates that the product was put on the market after 13 August 2005.

Moreover, in compliance with legal requirements and contractual agreements, where applicable, Alcatel-Lucent will offer to provide for the collection and treatment of Alcatel-Lucent products at the end of their useful life, or products displaced by Alcatel-Lucent equipment offers.

For information regarding take-back of equipment by Alcatel-Lucent, or for more information regarding the requirements for recycling/disposal of product, please contact your Alcatel-Lucent Account Manager or Alcatel-Lucent Takeback Support at *takeback@alcatel-lucent.com*.

Material content compliance

European Union (EU) Directive 2002/95/EC, "Restriction of the use of certain Hazardous Substances" (RoHS), restricts the use of lead, mercury, cadmium, hexavalent chromium, and certain flame retardants in electrical and electronic equipment. This Directive applies to electrical and electronic products placed on the EU market from 1 July 2006, with various exemptions, including an exemption for lead solder in network infrastructure equipment. Alcatel-Lucent products shipped to the EU from 1 July 2006 will comply with the RoHS Directive.

Technical documentation

The technical documentation as required by the Conformity Assessment procedure is kept at Alcatel-Lucent location which is responsible for this product. For more information please contact your local Alcatel-Lucent representative.

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Reliability specifications

Overview

Purpose

      This section describes how reliability is specified.

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General specifications

This section provides general reliability specifications for 1643 AM/1643 AMS.

Mean time between failures

The mean time between failures (MTBF) for the whole 1643 AM/1643 AMS are described in "1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS circuit-pack fit rates and MTBF values" (p. 9-14).

Infant mortality factor

Note: The steady state failure rate is equal to the failure rate of the system.

The number of failures that a product experiences during the first year of service after turn-up may be greater than the number of subsequent annual steady state failures. This is the early life or infant mortality period. The ratio of the first year failure rate to the steady state failure rate is termed the infant mortality factor (IMF).

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Reliability program

Introduction

Reliability is a key ingredient of products life cycle from the earliest planning stage. Major occurrences at the start of the project involve modeling of system reliability. During the design and development stage, reliability predictions, qualification and selection of components, definition of quality assurance standards and prototyping of critical system areas ensured built-in reliability. Manufacturing and field deployment, techniques such as pre-manufacturing, qualification, tracking of production quality, burn-in tests, failure mode analysis and feedback and correction further enhance the ongoing reliability of the 1643 AM/1643 AMS.

Reliability specifications

Introduction

The 1643 AM/1643 AMS provide various protective switching mechanisms where necessary to support a high level of service availability.

Reliability and service availability

Protection mechanisms are supported by the 1643 AM/1643 AMS:

* path protection or SNC/N protection (SubNetwork Connection protection with Non-intrusive monitoring) for higher and lower order VCs
* 1+1 multiplex section protection (MSP) for STM-1 optical interfaces

Ethernet traffic can be protected by:

* spanning tree protocol
* link capacity adjustment scheme (LCAS)

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS circuit-pack fit rates and MTBF values

The following tables gives an overview of the circuit packs fit rates and MTBF values (calculated according to RIN 8.0, confidence level 60 %).

1643 AM Products	FIT (10^{-9}/h)	MTBF (years)
1643 AM TM-S1.1 - 16 x E1 75/120 - B - DC PS (CC: 109164418)	3599	31.72
1643 AM AD-S1.1 - 16 x E1 75/120 - B - DC PS (CC: 109164426)	4550	25.09
1643 AM AD-S4.1 - 16 x E1 75/120 - B - DC PS (CC: 109164434)	5924	19.27
1643 AM AD-L4.2 - 16 x E1 75/120 - B - DC PS (CC: 109164442)	5924	19.27
1643 AM TM-S1.1 - 16 x E1 75/120 - B - AC PS (CC: 109164459)	3865	29.54
1643 AM AD-S1.1 - 16 x E1 75/120 - B - AC PS (CC: 109164467)	4816	23.70
1643 AM AD-S4.1 - 16 x E1 75/120 - B - AC PS (CC: 109164475)	6268	18.21
1643 AM AD-L4.2 - 16 x E1 75/120 - B - AC PS (CC: 109164483)	6268	18.21
1643 AM AD-S1.1 - 16 x E1 75/120 - B - 18dB - DC PS (CC: 109338103)	4550	25.09

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1643 AM Products	FIT (10^{-9}/h)	MTBF (years)
1643 AM AD-S1.1 - 16 x E1 75/120 - B - 18dB - AC PS (CC: 109338095)	4816	23.70
1643 AM AD-L1.2 - 16 x E1 - B - DC (CC: 109199505)	4550	25.09
1643 AM AD-L1.2 - 16 x E1 - B - AC (CC: 109199513)	4816	23.70
1643 AMS E1 16 DC (CC: 109445643)	3369	34
1643 AMS E1 16 AC (CC: 109528018)	2490	46
1643 AMS DS1 16 DC (CC: 109445650)	3176	36

The next table lists the failure rate calculation (FIT) and the MTBF (Mean Time Between Failures) of the different option cards (calculated according to RIN8.0 with confidence level of 60 %). Note that the failure rates of packs in this document may differ from rates of similar packs in previous documents. This is due to differences in parameters that match design specifications and applications such as electrical stress level.

1643 AM Products	FIT (10^{-9}/h)	MTBF (years)
1643 AM - optional STM-1 tributary X2S11TRIB option card (CC: 109018044)	2080	55
1643 AM/1643 AMS - optional 16 E1 75/120 Ω X16E1-V3 option card (CC: 109011528)	647	176
1643 AM/1643 AMS - optional 16 DS1 X16DS1 option card (CC: 108756081)	604	189
1643 AM/1643 AMS - optional 2 E3 X2E3-V2 option card (CC: 108756107)	618	184
1643 AM/1643 AMS - optional 2 DS3 X2DS3-V2 option card (CC: 108756099)	635	180
1643 AM/1643 AMS - optional 4 X.21 X4X.21 option card (CC: 108828328)	502	228
1643 AM/1643 AMS - optional 4 X4IP (*TransLAN*®) option card (CC: 108865064)	808	141
1643 AM - optional STM-1 tributary X2STM1ETRIB option card (CC: 109177196)	276	414

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1643 AM Products	FIT (10⁻⁹/h)	MTBF (years)
1643 AM/1643 AMS - optional 12 SHDSL tributary X12SHDSL-V1/V2/V3 option card (CC: 109177204, 109579912 or 109782565)	3955	29
1643 AM/1643 AMS X8PL - optional 8 Ethernet PL option card (CC: 109480707)	601	190
1643 AM/1643 AMS X5IP - optional 5 Ethernet LAN interface option card (CC: 109599845)	2736	42

The next table lists the failure rate calculation (FIT) and the MTBF (Mean Time Between Failures) of the different SFPs (calculated according to SR-332 RPP with confidence level of 90% therefore it may not be comparable to other Alcatel-Lucent Products):

1643 AMS Products	FIT (10⁻⁹/h)	MTBF (years)
Gigabit Ethernet SFP, ZX 1550nm (CC: 109534347)	780	104
Gigabit Ethernet SFP, LX 1300nm (CC: 109526491)	653	104
Gigabit Ethernet SFP, SX 850nm (CC: 109526483)	402	284
STM-1 S1.1 SFP short range (CC: 109469809)	544	210
STM-1 L1.1 SFP middle range (CC: 109469825)	552	207
STM-1 L1.2 SFP long range (CC: 109469817)	538	212
STM-1 electrical SFP (CC: 109543561)	350	326
STM-1/STM-4 SH 1490, single fiber bidirectional SFP long haul (CC: 109559492)	294	388
STM-1/STM-4 SH 1310, single fiber bidirectional SFP short haul (CC: 109559500)	294	388

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10   Technical Specifications

Overview

Purpose

This chapter contains the technical specifications for the 1643 AM/1643 AMS.

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System specifications

Optical Interfaces/SFPs

STM-1

The table below lists some parameters and the end of life power budgets for the fixed STM-1 optical interfaces that are supported by the 1643 AM and STM-1 SFP cages that are supported by the 1643 AMS:

Application	S-1.1	L-1.1	L-1.2
Operating wavelength range	1260-1360 nm	1270-1360 nm	1480-1580 nm
Transmitter at reference point S			
Source type	MLM	SLM/MLM	SLM
Spectral width at -20 dB (max)	NA	1 nm (SLM)	1 nm
RMS spectral width (max)	7.7 nm	3 nm (MLM)	NA
Side mode suppression ratio (min)	NA	30 dB/NA	30 dB
Mean launched power (max)	-8 dB	0 dB	0 dB
Mean launched power (min)	-15 dB	-5 dB	-5 dB
Extinction ratio (min)	8.2 dB	10 dB	10 dB
Mask of the eye diagram of the optical transmit signal	see G.957	see G.957	see G.957
Optical path between points S and R			
Maximum dispersion	96 ps/nm	NA/246 ps/nm	NA
Attenuation range	0 - 12 dB	10 - 28 dB	10 - 28 dB
Minimum optical return loss of the cable plant at point S including the optical connector	NA	NA	20 dB
Receiver at reference point R			
Sensitivity (min) at BER = 1×10^{-10}	-28 dBm -34 dBm (aggregate only)	-34 dBm	-34 dBm
Overload (min)	-8 dBm	-10 dBm	-10 dBm
Optical path penalty	< 1 dB	< 1 dB	< 1 dB
Optical return loss of the receiver (min)	NA	NA	25 dB

Note: 1643 AM STM-1 (Aggregate and tributary) or STM-4 optical access is via an SC-type connector. Adaptors FC and ST are also supplied.

1643 AMS: All optical interfaces are available as SFPs (Small Form-Factor Pluggable Optics) for STM-1 transmission only.

Note that the 1643 AM supports S1.1 and L1.2 interfaces for STM-1 transmission, whereas, the 1643 AMS only supports S1.1, L1.1, and L1.2 SFPs. The 1643 AMS does not support STM-4 transmission.

STM-4 interfaces

The table below lists some parameters and the end of life power budgets for the fixed STM-4 interfaces that are only supported by the 1643 AM:

Application	S-4.1	L-4.2
Operating wavelength range	1274-1356 nm	1480-1580 nm
Source type	MLM	SLM
Spectral width at -20 dB (max)	NA	1 nm
RMS spectral width (max)	2.5 nm	NA
Mean launched power (max)	-8 dBm	+2 dBm
Mean launched power (min)	-15 dBm	-3 dBm
Side mode suppression ratio (min)	NA	30 dB
Extinction ratio (min)	8.2 dB	10 dB
Mask of the eye diagram of the optical transmit signal	see G.957	see G.957
Optical path between points S and R		
Maximum dispersion	74 ps/nm	NA
Optical attenuation range	0 - 12 dB	10 - 24 dB
Optical return loss of the cable plant at point S including the optical connector	NA	24 dB
Receiver at reference point R		
Sensitivity (min) at BER = 1×10^{-10}	-28 dBm	-28 dBm
Overload (min)	-8 dBm	-8 dBm
Optical path penalty	< 1 dB	< 1 dB
Optical return loss of the receiver (min)	NA	27 dB

Single-fiber Bidirectional SFPs

The table below lists some parameters and the end of life power budgets for the single fiber bidirectional STM-1 optical modules (SFPs).

	Unit	Downstream	Upstream
Application		S-1.2	S-1.1
Data rate	Mbit/s	155	155
Target distance	km	15	15
Transmitter at reference point S/TP2			
Source type		SLM	SLM
Wavelength	nm	1480 - 1500	1260 - 1360
Max. spectral width at -20 dB	nm	1	1
Mean launched power (max)	dBm	0	0
Mean launched power (min)	dBm	-6	-6

	Unit	Downstream	Upstream
Application		**S-1.2**	**S-1.1**
Data rate	**Mbit/s**	**155**	**155**
Target distance	**km**	**15**	**15**
Maximum mean launched power in case Tx_Disable = high	dBm	-45	-45
Minimum extinction ratio	dB	6	6
Transmitter eye mask definition		see G.957	see G.957
Maximum reflectance of transmitter, measured at S/TP2	dB	NA	NA
Maximum optical path penalty/Maximum transmitter and dispersion penalty	dB	1	1
Optical path between S/TP2 and R/TP3			
Available power budget (BER = 1 × 10^{-12})	dB	12.5	12.5
Minimum attenuation	dB	0	0
Maximum dispersion	ps/nm	275	132
Receiver at reference point R/TP3			
Operating wavelength range	nm	1260 - 1360	1480 - 1500
Sensitivity (min) at BER = 1 x 10^{-12}	dBm	-19.5	-19.5
Minimum overload	dBm	0	0
Maximum reflectance of receiver, measured at R/TP3	dB	-12	-12

1000BASE-SX SFP

The characteristics of the 1000BASE-SX SFP are summarized in the table below.

The 1000BASE-SX pluggable optic (850 nm short haul, multi-mode) uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040/IEC 60825). The 1000BASE-SX pluggable optic complies with IEEE 802.3-2000 Clause 38. The following table describes the various operating ranges for the 1000BASE-SX pluggable optic over each optical fiber type.

Fiber Type	Modal Bandwidth @ 850 nm (min. overfilled launch) (MHz x km)	Minimum range (m)
62.5 µm MMF	160	2 ... 220
62.5 µm MMF	200	2 ... 275
50 µm MMF	400	2 ... 500
50 µm MMF	500	2 ... 550

The following table lists the specific optical characteristics for a 1000BASE-SX pluggable optic.

Application	1000BASE-SX
Bit rate	1.25Gb/s +/-100ppm
Operating wavelength range [Non Peltier cooled]	770 - 860 nm
Transmitter characteristics	
Transmitter type	Shortwave Laser
T^{rise}/T^{fall} (max, 20–80%, $\lambda > 830$ nm)	0.26 ns
T^{rise}/T^{fall} (max, 20–80%, $\lambda \leq 830$ nm)	0.21 ns
RMS spectral width (max)	0.85 nm
Average launch power (max)	-1.1 dBm (Class 1M safety limit as defined by IEEE 802.3–2000 Clause 38.7.2)
Average launch power (min)	–9.5 dBm
Average launch power of OFF transmitter (max)	–30 dBm
Extinction ratio (min)	9 dB
RIN (max)	–117 dB/Hz
Mask of the eye diagram of the optical transmit signal	see IEEE802.3
Receive Characteristics	
Average receive power (max)	0 dBm
Receive sensitivity (min) at BER = 1 x 10 $^{-12}$	–17 dBm
Return loss (min)	12 dB
Stressed receive sensitivity (measured with conformance test signal at TP3 for BER = 10–12 at the eye center)	–12.5 dBm (62.5 µm MMF) –13.5 dBm (50 µm MMF)

The following table lists the worst-case power budget and link penalties for a 1000BASE-SX pluggable optic. Link penalties are used for link budget calculations.

Description	Unit	62.5 µm MMF		50 µm MMF	
Modal bandwidth as measured at 850 nm (minimum, overfilled launch)	MHz × km	160	200	400	500
Link power budget	dB	7.5	7.5	7.5	7.5
Operating distance	m	220	275	500	550
Channel insertion loss (a wavelength of 830 nm is used to calculate the values)	dB	2.38	2.60	3.37	3.56
Link power penalties (a wavelength of 830 nm is used to calculate the values)	dB	4.27	4.29	4.07	3.57

Description	Unit	62.5 μm MMF		50 μm MMF	
Unallocated margin in link power budget (a wavelength of 830 nm is used to calculate the values)	dB	0.84	0.60	0.05	0.37

1000BASE-LX SFP

The following table lists the specific optical characteristics for a 1000BASE-LX pluggable optic.

The 1000BASE-LX pluggable optic uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040/IEC 60825). The 1000BASE-LX pluggable optic complies with IEEE 802.3-2000 Clause 38. The table below describes the various operating ranges for the 1000BASE-LX pluggable optic over each optical fiber type.

Fiber Type	Modal Bandwidth @ 1300 nm (min. overfilled launch) (MHz × km)	Minimum range (meters)
10 μm SSMF	N/A	2 to 5000

The following table lists the specific optical characteristics for a 1000BASE-LX pluggable optic.

Application	1000BASE-SX
Bit rate	1.25Gb/s +/-100ppm
Operating wavelength range [Non Peltier cooled]	1270 - 1355 nm
Transmitter Characteristics	
Transmitter type	Longwave Laser
T^{rise}/T^{fall} (max, 20–80%)	0.26 ns
RMS spectral width (max)	4 nm
Average launch power (max)	-3 dBm
Average launch power (min)	-11 dBm
Average launch power of OFF transmitter (max)	-30 dBm
Extinction ratio (min)	9 dB
Mask of the eye diagram of the optical transmit signal	see IEEE802.3
RIN (max)	-117 dB/Hz
Receive Characteristics	
Average receive power (max)	-3 dBm
Receive sensitivity	-19 dBm
Return loss (min)	12 dB
Stressed receive sensitivity (measured with conformance test signal at TP3 for BER = 10–12 at the eye center)	-14.4 dBm

The following table lists the worst-case power budget and link penalties for a 1000BASE-LX pluggable optic. Link penalties are used for link budget calculations.

Description	Unit	10 μm SMF
Link power budget	dB	8
Operating distance	m	5000
Channel insertion loss (a wavelength of 1270 nm is used to calculate the values)	dB	4.57
Link power penalties (a wavelength of 1270 nm is used to calculate the values)	dB	3.27
Unallocated margin in link power budget (a wavelength of 1270 nm is used to calculate the values)	dB	0.16

1000BASE-ZX SFP

The following table lists the specific optical characteristics for a 1000BASE-ZX pluggable optic.

The 1000BASE-ZX pluggable optic uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040/IEC 60825). The 1000BASE-ZX pluggable optic complies with IEEE 802.3-2002 Clause 38. The following table lists the specific optical characteristics for a 1000BASE-ZX pluggable optic.

Application	1000BASE-ZX
Bit rate	1.25Gb/s +/-100ppm
Operating wavelength range [Non Peltier cooled]	1500-1580 nm
Transmitter at reference point TP2	
Source type	SLM
Spectral width at -20 dB	1.0 nm
Side mode suppression ratio (min)	30dB
Mean launched power (max)	+5 dBm
Mean launched power (min)	0 dBm
Extinction ratio (min)	9.0 dB
Mask of the eye diagram of the optical transmit signal	see IEEE802.3
RIN (max)	-120 dB/Hz
Optical path between points TP2 and TP3	
Optical return loss of the cable plant at point TP2 including the optical connector	20 dB
Maximum dispersion	1600 ps/nm
Attenuation range	5 - 21 dB
Optical path penalty (max)	1.5 dB
Receiver at reference point TP3	

Application	1000BASE-ZX
Sensitivity (min) at BER = 1 x 10^{-12}	-22.5 dBm
Overload (min)	0 dBm
Optical return loss of the receiver (min)	12 dB

Electrical STM-1 interface

The following table lists some parameters and the End of Life power budget of the STM-1 electrical interface unit for the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS:

	Unit	Value
Application		**intra-office**
SDH Level	type	STM-1
Transmission rate	kbit/s	155,520 ± 20 ppm
Line coding	type	Coded Mark Inversion (CMI, G.703-12.1)
Impedance	Ω	75
Return Loss (8 ... 240 MHz.)	dB	15
Maximum cable attenuation (78 MHz)	dB	12.7

Tributary interfaces and ISDN interfaces

- STM-1 tributary interface at 155 Mbit/s according to G.957. The 155 Mbit/s optical access is done with a universal connector type allowing SC, FC/PC, ST connector types without external optical cable conversion 1643 AM only.

  Note: The STM-1 aggregate interface of 1643 AMS *according to G.957 utilizes SFP's with LC connector. SFP usage is only available for* 1643 AMS *STM-1 interface.*

- STM-1 tributary interface at 155 Mbit/s according to the ITU G703-15. The physical interface for the STM-1 signals is a coaxial female DIN 1.6/5.6 type connector with an impedance of 75 Ω or a DIN 1.0/2.3 type connector if an SFP is used.

- Interface at 1.544 Mbit/s ± 130 ppm, AMI or B8ZS encoded (programmable in groups of 8) and conforming to G.703-2 standard 1991, asynchronously mapped via VC-11 to a TU-12. The 1.5 Mbit/s electrical (DS1) interface access is via a RJ45 connector suitable for symmetrical twisted pair cables with an impedance of 100 Ω.

- Interface at 2.048 Mbit/s ± 50 ppm, HDB3 coded and conforming to G.703 standard 1991, asynchronously mapped via a VC-12 in TU-12. The 2 Mbit/s electrical (E1) interface access is via RJ45 connector suitable for symmetrical twisted pair cables either with an impedance of 120 Ω or coaxial cables with an impedance of 75 Ω.

  Each 2 Mbit/s tributary interface (main card or optional card) can be operated in ISDN PRI (Primary Rate Interface) or Leased-Line mode. It allows to transmit "30 B+D" according to G.962 and I.431. This feature requires the processing of the overhead contained in timeslot 0 (TS0) of the 2 Mbit/s signal.

- Interface at 34.368 Mbit/s ± 20 ppm, HDB3 encoded and conforming to G.703-8 October 1998, asynchronously mapped into LO-VC3. The 34 Mbit/ s electrical clear channel (E3) interface access is via a coaxial female DIN 1.6/5.6 type connector with an impedance of 75 Ω.

- Interface at 44.736 Mbit/s ± 20 ppm, B3ZS encoded and conforming to G.703-6 October 1998, directly mapped in a LO-VC3. The 45 Mbit/s electrical tributary (DS-3) interface access is via a coaxial female DIN 1.6/5.6 type connector with an impedance of 75 Ω.

- A 10/100BaseT Ethernet Interface (LAN interface) with auto-negotiation supporting Ethernet and IEEE 802.3, 1998 access protocols. Auto-negotiation of the data rate (10 Mbit/s or 100 Mbit/s) and of the mode (half-duplex and full duplex). The 10/100BaseT Ethernet Interface access is via a RJ45 connector.

- Interface at 2.048 Mbit/s ± 50 ppm asynchronously mapped via VC-12 in TU-12 with physical characteristics and DCE control signalling according X.21 for leased circuit service (point to point). The X.21 Interface access is via a 15 pin female sub-D connector (ISO 4903 recommendation).

  The jitter and shift levels comply with G.823 and G.783.

X12SHDSL-V2/V3 option board

An SHDSL interface over a single copper pair (two wires) that allows for the transport of either an E1 or an TU-12 over SHDSL in compliance with ITU-T standards.

Interfaces:

- 12 standard SHDSL physical interfaces compliant ITU-T G.991.2 and ETSI TS 101 524 on single (twisted) copper pair

- TC-16-PAM modulation/coding

- RJ-45 connector suitable for symmetrical 135 Ω twisted pair cable.

Possible operation in TU-12 or E1 mode.

Selection made per option board by software:

TU-12 mapping in SHDSL:

- TU-12 to SHDSL synchronous mapping according HDSL: ETSI TS 101 135 clause 7.6

- Interface SHDSL rate of 2320 kbit/s

E1 mapping in SHDSL:

- ITU G.991.2 Appendix E.5 (= ETSI TS 101 524 D2048U) Clear channel TPS-TC framing for unstructured E1 (plesiochronous SHDSL transport).

- Interface SHDSL rate of 2056 kbit/s.

Flexible TU-12 slot/SHDSL port mapping assignment.

SHDSL span fault management Incoming & Outgoing loopbacks at SHDSL interface for installation or fault localization-

Surge protection K.20 and K.21.

SDH Element Management (Alcatel-Lucent OMS, ITM-CIT):

- Remote NTUs management via in-band SHDSL EOC channel (~3.3kbit/s). All provisioning of NTU device made via it's associated LTU.
- Support of standard EOC protocol + extensions
- Managed Remote SHDSL Power Supply (RPS) module support
- Enhanced PM support

Mapping

- The 1643 AM/1643 AMS support an AU-4 <-> VC-4 <-> TUG-3 <-> TUG-2 <-> TU-12 <->VC-12 <->E1 mapping scheme for each VC-12 created and terminated in the system
- The 1643 AM/1643 AMS support an AU-4 <-> VC-4 <-> TUG-3 <-> TUG-2 <-> TU-12 <-> VC-11 <->DS1 mapping scheme for each VC-11 created and terminated in the system
- The 1643 AM/1643 AMS support an AU-4 <-> VC-4 <-> TUG-3 <-> TU-3 <-> VC-3 <->E3 mapping scheme for each VC-3 created and terminated in the system
- The1643 AM/1643 AMS support an AU-4 <-> VC-4 <-> TUG-3 <-> TU-3 <-> VC-3 <-> DS3 mapping scheme for each VC-3 created and terminated in the system.

Connectivity

- The equipment supports VC-4 connectivity
- The equipment supports bi-directional, non-blocking cross-connection switching at the VC-3 level and at the VC-12 level within one selected VC-4 from each line interface.

Protection schemes

- The equipment provides 1 + 1 MSP protection for STM-1 optical aggregate or STM-1 optical or electrical tributary interfaces
- The equipment provides VC-11/VC-12, VC-3 or VC-4 SNC/N (1643 AM for STM-4 version only) protection.

Synchronization and timing

- Synchronization can be derived from the incoming STM-1 or STM-4 (1643 AM only) aggregate signals
- Synchronization can be derived from the incoming STM-1 tributary signals (1643 AM STM-4 version only)
- The 1643 AMS supports synchronization derived from an incoming 2 Mbit/s (E1 or DS1) data input from the main board and option card
- Re-synchronization of the 2 Mbit/s ports is supported
- Support of SSM byte according to ETSI ETS 300 417-6

- External synchronization output at 2.048 MHz is according to G.703-10 (SYNC-OUT, SYNC-I/O) via RJ45 connector with an impedance of 120 Ω symmetrical or with an impedance of 75 Ω

- Internal Clock in accordance with ITU-T G.813 option 1.

Overhead bytes processing

The next table shows the processing of SOH (Section OverHead):

Overhead bytes	Function	Processing
A1-A2	Framing A1=11110110 (HF6) Framing A2=00101000 (H28)	Yes
J0	Regenerator section trace identifier	Yes
C1	Regenerator section trace Trace/frame identifier	Fixed to 00000001
B1	RS Bit error monitoring (BIP-8)	Yes
B2	MS Bit error monitoring (BIP-8)	Yes
D1 to D12	Data communication channel (DCC) D1 to D3 or D4 to D12 can be selected	D1-D3 fixed to 01010101 D4 to D12 used as DCC
E2	Codirectional interfaces at 64 kbit/s (J64), in accordance with G.703 (Service channel)	Yes
F1	64 kbit/s user channel	Fixed to 11111111
K1, K2 (bit 1 to 5)	Automatic Protection Switching (APS) channel for MSP	Yes
K2 (bit 6 to 8)	Remote alarm MS (MS-FERF)	Yes
S1	Synchronization state	Yes
M1	Remote error indication MS (MS-REI)	Yes
Z1, Z2	Reserved	Fixed to 11111111
NU	National use	11111111

The next table shows the processing of the POH (Path Overhead) of VC-12:

Overhead bytes	Function	Processing
V5 (bit 1 to 2)	VC-12 BIP-2 error checking	Yes
V5 (bit 3)	REI path (FEBE)	Yes
V5 (bit 4)	RFI path	Fixed to 0
V5 (bit 5 to 7)	Label of VC-12 path	Yes

Overhead bytes	Function	Processing
V5 (bit 8)	RDI path (FERF)	Yes
J2	VC-12 Trace identifier	Yes
Z6	Connection/monitoring	Fixed to 0
K4 (bit 1 to 4)	VC-12 APS path	Fixed to 0
K4 (bit 5 to 6)	Reserved	Fixed to 0

The next table shows the processing of the POH of VC-3:

Overhead bytes	Function	Processing
J1	VC3 trace identifier	Yes
B3	Path bit error monitoring (BIP-8)	Yes
C2	Path signal label	Yes
G1	REI/RDI path	Yes
F2	User channel	Fixed to 0
F3	User channel	Fixed to 0
H4	Multiframe indicator	Fixed to 11111111
K3 (bit 1 to 4)	VC-4 APS path	Fixed to 0
K3 (bit 5 to 6)	Reserved	Fixed to 0
Z5	Network control	Fixed to 0

The next table shows the processing of the POH of VC-4

Overhead bytes	Function	Processing
J1	VC4 trace identifier	Yes
B3	BIP-8 path	Yes
C2	Path signal label	Yes
G1	REI/RDI path	Yes
F2	User channel	Fixed to 0
F3	User channel	Fixed to 0
H4	Multiframe indicator	Yes
K3 (bit 1 to 4)	VC-4 APS path	Fixed to 0
K3 (bit 5 to 6)	Reserved	Fixed to 0
Z5	Network control	Fixed to 0

Note: The ISDN feature requires the processing of the overhead contained in timeslot 0 (TS0) of the 2 Mbit/s signal.

Power supply specifications

Two possibilities of Power supply: DC power supply or AC power supply to choose when ordering the equipment (it is not possible to modify only the type of the Power supply of an equipment).

- Power Consumption, in STM-1 configuration is of 13 watts for the basic unit or of 25 watts with any option card
- Power Consumption, in STM-4 configuration is of 25 watts for the basic unit or of 40 watts with any option card
- The system optionally supports the grounding philosophy according to ETSI Requirements 300 253, January 1995 (battery return connected to ground).

Power supply 1643 AM:

The following possibilities are available:

- Voltage range DC: –24 VDC, –48 VDC and –60 VDC (–18 VDC minimum, –72 VDC maximum).
- Voltage range AC: 120 VAC to 240 VAC (90 VAC minimum, 264 VAC maximum).
- An external AC/DC converter is also available.

Supervision interface

- F-interface for Craft Interface Terminal via RJ45 connector with metal shell for grounding (ITM-CIT)

  The interface conforms to V.10/RS-232C standards.

- Q-LAN Interface via RJ45 connector with metal shell for grounding (Ethernet-10BASE-T)

  This interface conforms to IEEE 802.3 Ethernet standards.

Miscellaneous Discrete Inputs/Outputs

- The user can assign, through the EMS or local workstation, an alarm message and alarm severity to each of the four miscellaneous discrete inputs (MDIs). They are equivalent with other system alarms.
- When receiving power, all four miscellaneous discrete outputs (MDOs) are normally open. If power is lost, MDO 1's contacts close (assigned to indicate power failure). MDO 2-4 are respectively assigned to Prompt alarm, Deferred alarm and Information alarm.
- The MDI inputs and MDO outputs are available from a 25 pin SUB-D male connector.

Performance monitoring

- Performance monitoring is in accordance with ITU-T G.826 and G.784
- The following four parameters are available to estimate the error performance of a path:
  - SES: number of Severely Errored Seconds in the received signal
  - ES: number of Errored Seconds in the received signal

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- BBE: number of Background Block Errors in the received signal

- UAS: number of UnAvailable Seconds in the received signal

- Monitoring can be done on the incoming MS4, MS1, VC-4, VC-3, VC-12, VC-11 signals of the 1643 AM/1643 AMS unit

- Performance monitoring data is stored in one current and sixteen recent 15 minutes registers, and one current and one recent 24 hours registers. Note that these counters are only applicable to Lucent OMS users. However, ITM-CIT users will only have access to currently available PM bins.

- Threshold reports are generated when user-settable performance parameters are exceeded during 15 minutes and 24 hours periods

- During reset, for several types of PM counters on CC, TS1, LS1, TS2 show the UAS values to be counted. Only after TS2 enters configured status, the software components can start to count the PM counters, for the seconds in which TS2 is not configured. Software will mark these seconds to UAS whether there is traffic or not. During an upgrade all PM points like MS, VC3 and VC4 are affected with UAS.

- Ethernet performance monitoring information can be derived from packets sent, bytes received and bytes dropped. This information is available in 15 minutes or 24 hours registers.

- ISDN Performance monitoring information can be derived for 2 Mbit/s signal from pN_EBC (Near-end Errored Block Count).

- For transparent, it is possible to do near-end performance monitoring on each 2 Mbit/s signal in both directions (PDH to SDH and SDH to PDH) at the 2 Mbit/s system interface. Near-end information is obtained from CRC-4 violations and defects (E1 non-intrusive monitoring).

Equipment dimensions

1643 AM:

- Dimensions (H x W x D) 83 x 439 x 295 mm (without the wall or rack mounting system)

- Weight of 5 kg with an option card.

1643 AMS:

- Dimensions (H x W x D) 70 x 448 x 204 mm (without the wall or rack mounting system)

- Weight of 5 kg with an option card.

Environmental conditions

The environmental conditions applicable for the 1643 AM/1643 AMS:

- Storage compliant with ETSI 300 019-1-1 Class 1-2, February 1992:

  - Temperature range -5°C to +45°C

  - Humidity of 5 to 95% without condensation.

- Transport compliant with ETSI 300 019-1-2 Class 2-3, February 1992:

  - Temperature range -5°C to +45°C

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- Humidity of 5 to 95% without condensation.

- The system operates with convection cooling.

- CE marking compliant with 73/23/EEC and 89/336/EEC

- ETSI EMC - The system meets the requirements of EN 300 386-2 V.1.1.3 (december 1997) for equipment installed in locations other than telecom centers.

- IEC 60950 -Ed3, 1994-04

- Optical safety compliant with IEC 60825-1 Ed 1.1 (1998/01) and IEC 60825-2 Ed 2 (2000/05).

The following table shows the environmental conditions for the 1643 AM/1643 AMS. The data refers to applications with and without X4IP option cards:

Power Type	X4IP installed Note: The X8PL and X5IP option cards do not have temperature limitations.	Min Temp.	Max Temp	Min Hum.	Max Hum	Compliant to ETS 300 019-1-3 of February. 1992 & Amendment A1 June 1997
DC	No	-5	+45	5%	95%	Class 3.2
	Yes	+5	+40	5%	85%	Class 3.1
AC	No	-5	+45	5%	90%	Class 3.1E
	Yes	+5	+40	5%	85%	Class 3.1

It is assumed that the X4IP option board is used in climate controlled environments. Additionally, a fan unit is available for improving the air flow.

Installation in street cabinets supported (1643 AM only), when street cabinets provides required environment conditions.

Important! Ensure that the 1643 AM/1643 AMS units have reached room temperature and are dry before taking them into operation.

For further information, please refer to the 1643 AM/1643 AMS *Installation Guide*.

11   Ethernet Overview

Overview

Purpose

This chapter describes the Ethernet principles used for 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS

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Ethernet concepts

Overview

Purpose

This section describes the 1643 AM Ethernet feature.

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Ethernet over SDH

Introduction

To connect remote PC LAN network sites via an SDH network without the need for intermediate bridges or routers, the 1643 AM or 1643 AMS network element is equipped with the Ethernet Interface extension card.

The following figure visualizes the basic design of a *TransLAN®* card:
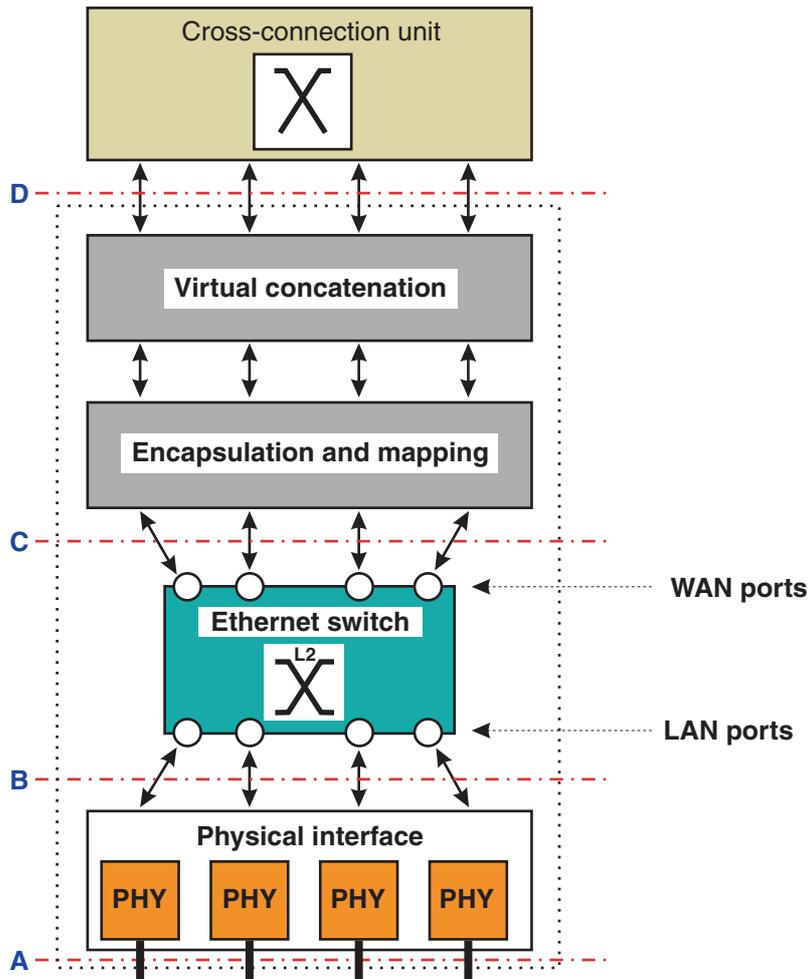
Legend:

A	The external interfaces, to which the end-customer's Ethernet LANs are physically connected.
B	The interface between the Ethernet physical interface port and the Ethernet switch. The internal interfaces of the Ethernet switch towards the Ethernet physical interface port are referred to as "LAN ports". Note that two types of LAN ports can be differentiated according to their port role: "customer LAN ports" and "network LAN ports" (cf. "Port provisioning" (p. 11-45)).

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C   The internal interface between the Ethernet switch and the
        encapsulation and mapping function. The internal interfaces of the
        Ethernet switch towards the encapsulation and mapping function are
        referred to as "WAN ports". Note that two types of WAN ports can
        be differentiated according to their port role: "network WAN ports"
        and "customer WAN ports" (cf.).

D   The interface between the encapsulation and mapping function and
        the cross-connect function of the network element. This is were the
        virtually concatenated payload is cross-connected to be transported
        over the SDH network.

The *TransLAN®* implementations use standardized protocols to transport Ethernet frames
over the SDH network. The Ethernet over SDH (EoS) method and the generic framing
procedure (GFP) are used to encapsulate the Ethernet frames into the SDH transmission
payload. Virtual concatenation and LCAS are used to allocate a flexible amount of WAN
bandwidth for the transport of Ethernet frames as needed for the end-user's application.

The Ethernet Interface extension card contains four 10/100BaseT Ethernet ports (LAN
ports). The LAN ports automatically determine the speed of the network, whether it is
10BaseT or 100BaseT.

The physical L2 switch that is present on a Ethernet Interface extension card can be split
into several logical or virtual switches. A Virtual Switch is a set of LAN/WAN ports on a
Ethernet Interface extension card that are used by different VLAN's which can share the
common WAN bandwidth. Each of the virtual switches can operate in a specific Virtual
Switch mode depending on the VLAN tagging scheme.

First the VLAN tagging mode has to be specified on Ethernet Interface extension card
level, this can be either IEEE 802.1Q VLAN tagging,VPN-tagging (Transparent) or
802.1ad provider bridge mode. In VPN tagging (Transparent) mode, the end-user 802.1Q
VLAN tags that optionally may appear in the end user traffic are ignored in the
forwarding process. These VLAN tags are carried transparently through the SDH
network. In IEEE 802.1Q VLAN-tagging mode, the VLAN tags are also carried
transparently, but the VLAN ID in the VLAN tags is used in the forwarding decision.
Therefore end user VLAN IDs must be unique per physical switch.

Physical interfaces

The physical interface function provides the connection to the Ethernet network of the
end-customer. It performs auto-negotiation, and carries out flow control.

The following physical interfaces are enabled on Alcatel-Lucent *TransLAN®* cards:

• 10BASE-T

• 100BASE-TX

  Important! It is recommended not to use flow control for 1000BASE-LX and
  1000BASE-ZX interfaces located on the LKA12 unit.

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The supported LAN interfaces for Ethernet and Fast Ethernet applications are 10BASE-T and 100BASE-TX. The numbers "10" and "100" indicate the bitrate of the LAN, 10 Mbit/s (Ethernet) and 100 Mbit/s (Fast Ethernet) respectively. The "T" or "TX" indicates the wiring and the connector type: Twisted pair wiring with RJ-45 connectors.

Ethernet switch

The Ethernet switch connects the LAN ports with the WAN ports. It performs learning, filtering and forwarding according to the IEEE 802.1D standard.

The physical Ethernet switch can be logically split in multiple, independent switches or port groups, called "virtual switch". In the transparent tagging modes (LAN interconnect, LAN-VPN or LAN-VPN with QoS), also the name "LAN group" is used instead of "virtual switch".

The following applies to port groups or virtual switches, respectively:

- A virtual switch defines a spanning tree domain, and can be assigned a mode of operation (LAN interconnect, LAN-VPN or LAN-VPN with QoS).
- A virtual switch includes any number (at least 2) of external Ethernet LAN ports and/or internal WAN ports associated with a VC-n-Xv payload.
- Traffic *between* virtual switches is *not* possible.
- Each port can be a member of only one virtual switch at a time.
- A VLAN must have all its port members inside a single virtual switch.

In the following example, a virtual switch is provisioned that connects 2 LAN ports with 1 WAN port:
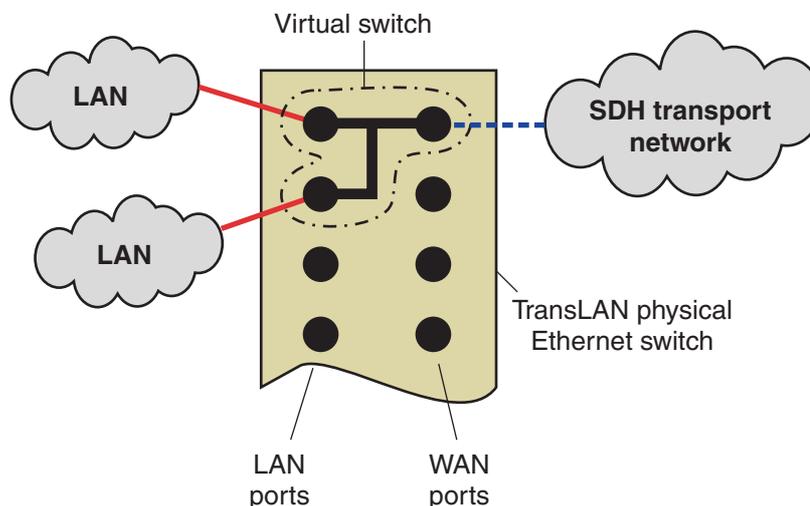
Ethernet encapsulation with GFP

The generic framing procedure (GFP) is used to adapt the asynchronous Ethernet payload to the synchronous SDH server layer.

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A GFP-header (8 octets) is prepended to each Ethernet frame to indicate frame length and payload type. Gaps between Ethernet frames are filled with "IDLE" frames (4 octets each).
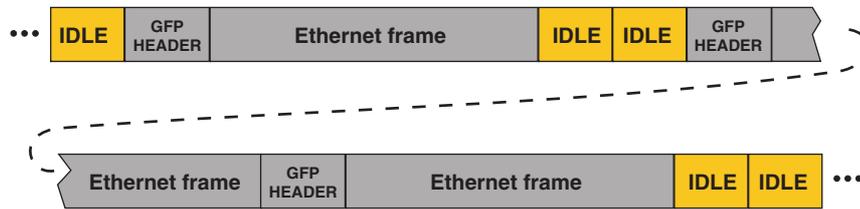
GFP, standardized by the ITU-T in the recommendations G.7041 and Y.1303, is a very efficient encapsulation protocol because it has a fixed and small overhead per packet.

In earlier versions (prior to the Garnet network release of June 2002) of the *TransLAN*® equipment, the Ethernet over SDH (EoS) encapsulation and mapping method is used for VC-12 and/or VC-3 based designs (10/100BASE-T Ethernet/Fast Ethernet cards). EoS is a proprietary encapsulation protocol, based on the ANSI T1X1.5/99-268r1 standard, and can be regarded as a precursor of GFP. EoS and GFP are both length-based encapsulation methods. EoS is similar to GFP in terms of frame delineation and mapping (incl. scrambling); differences between the two encapsulation methods lie in the size and interpretation of the EoS/GFP encapsulation core headers, as well as the length of the Idle frames.

The generic framing procedure, framed mode (GFP-F) compliant to the ITU-T Rec. G.7041 is available on all *TransLAN*® products since the Garnet Maintenance/Mercury network release of January 2003.

The following GFP encapsulation are possible:

- Mapping of Ethernet MAC frames into Lower Order SDH VC12–Xv
- Mapping of Ethernet MAC frames into Lower Order SDH VC3–Xv

VC12-Xv GFP encapsulation

The 1643 AM supports virtual concatenation of Lower Order SDH VC-12 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC12-Xv, where X = 1...5. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000).

This feature implies specific processing of some overhead bytes:

- Source direction: Each individual VC-12 (from the VC12-Xv group) K4-byte (bit 1-2 multiframed) will be written to indicate the values of the multiframe indicator (timestamping), as well as the sequence indicator (individual VC-12 position inside a VC12-Xv)
- Sink direction: Each individual VC-12 (from the VC12-Xv group) K4-byte (bit 1-2 multiframed) multi-framing indicator and sequence indicator is used to check that the differential delay between the individual VC-12s of the VC12-Xv remains within implementation limits.

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Additionally, the use of G.707 Extended Signal Label is supported using V5(bits 5-7) field, in which the "101" value is written, which points to the appropriate bits of K4(bit 1) multiframe for writing in the Extended Signal Label value.

VC3-Xv GFP encapsulation

The 1643 AM supports virtual concatenation of Lower Order SDH VC-3 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC3–Xv, where X = 1,2 (SDH). Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000) and T1X1 T1.105 Clause 7.3.2 (2001 Edition).

This feature implies specific processing of some overhead bytes:

- Source direction; each individual VC-3 (from the VC3–Xv group) H4-byte will be written to indicate the values of the two-stage- multiframe indicator (timestamping), as well as the sequence indicator (individual VC-3 position inside a VC3–Xv)

- Sink direction; each individual VC-3 (from the VC3–Xv group) H4-byte two-stage-multi-framing indicator and sequence indicator is used to check that the differential delay between the individual VC-3 of the VC3–Xv remains within implementation limits.

Virtual concatenation

The virtual concatenation function arranges the Ethernet frames into the right SDH virtual container. It is possible to map the client's data signal over a number of grouped virtual containers.

Related information

Please refer to for more detailed information.

LAN interfaces

1643 AM and 1643 AMS support up to four 10/100BASE-T LAN interfaces, as part of the *TransLAN*® Ethernet SDH Transport Solution, when the X4IP option card is used.

1643 AM and 1643 AMS support up to eight Ethernet interfaces in Private Line mode, when the X8PL option card is used. The X8PL board is a point-to-point Ethernet solution without any switching capabilities. The Ethernet ports are directly connected to the virtual concatenation groups (VCGs o flexible SDH Channel TTPs).

### Main features of the X4IP and X8PL options cards

The following table lists the main features and differences of the two option cards X4IP and X8PL which can be used for Ethernet applications:

X4IP	X8PL
4 ports	8 ports
provides a Layer 2 switch	no switch

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X4IP	X8PL
supports advanced networking applications like ring connections or point-to-multi-point connections	cost optimized option card for point-to-point applications
no LCAS (Link capacity adjustment scheme) support	supports the LCAS (Link Capacity Adjustment Scheme) protocol (please refer to "Link Capacity Adjustment Scheme (LCAS)" (p. 11-12))
EoS (Ethernet over SDH) mapping or GFP (Generic Framing Procedure)	GFP or LAPS (Link Access Procedure SDH) (please refer to "Ethernet mapping schemes" (p. 11-42))

LAN and WAN ports and VLAN

A VLAN can contain multiple LAN ports and multiple WAN ports.
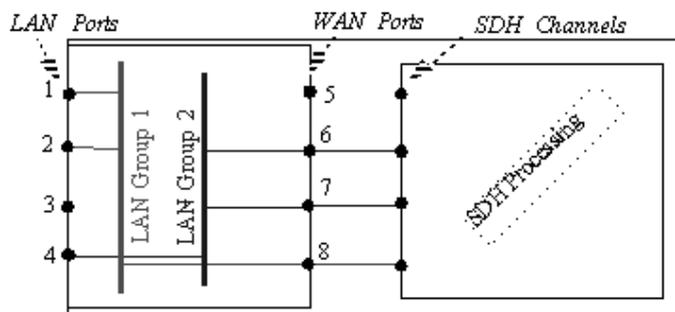
Multiple LAN ports can be assigned to different VLANs, also mentioned as Virtual LAN's. This keeps the traffic on each VLAN totally separate. VLAN groups are used to connect LAN ports and WAN ports. The LAN ports are the physical 10BaseT or 100BaseT on the NE. All valid Ethernet packets are accepted (both Ethernet 2 and IEEE 802.3). The WAN ports are the logical connection points to the SDH channels. The LAN port is the interface between the customers Ethernet LAN and the Ethernet switch on the LAN unit. The WAN port is the internal port between the Ethernet switch and the part of the LAN unit where the Ethernet frame is mapped into or de-mapped from SDH payloads.

VLAN trunking

VLAN trunks carry the traffic of multiple VLANs over one single Ethernet link and allow handling off aggregated LAN traffic from multiple end users via one single high capacity Ethernet link (Fast Ethernet or Giga Ethernet) to data equipment in a Central Office or an IP Edge Router, IP Service Switch or an ATM Switch. The main benefit of VLAN trunking is that TransLAN cards can hand off end user LAN traffic via one high capacity LAN port instead of multiple low speed LAN ports.

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Advantages of VLAN trunking are:

- it does not require the assignment of CID tags
- it permits different 802.1 tagged frames to share the same physical LAN port
- it gives additional flexibility for egress logical WAN port assignment
- it permits successfully routing via an aggregation function.

Learning bridges

To increases the efficiency of the network, it can be separated into segments. A bridge, which may have several parts, passes packets between multiple network segments. By noting at which port an Ethernet packet with a certain source address arrives, the bridge learns to which ports a packet with a certain destination address must be sent. If the port does not know the destination address, then it will send it to all the ports except the port where it comes from. The tables which the learning bridge uses to pass the Ethernet packets to its ports are not shown to the user by the management systems.

MAC-Bridges perform automatic address learning based on the source MAC-address present in each frame.

- In this process an unknown SA of a frame is stored together with the port number over which the frame entered the Bridge to be used when frames with that DA need to be forwarded
- Addresses that are not refreshed (relearned) within the so-called MAC address ageing time, are removed.

In case more different source address than there is memory space are passing in an specific interval, the MAC address ageing time, addresses are prematurely flushed and possibly need to be re-learned

This causes some excess traffic as unlearned traffic is broadcasted. Too much unlearned traffic can also affect the learned traffic (because of the broadcasting).

Example

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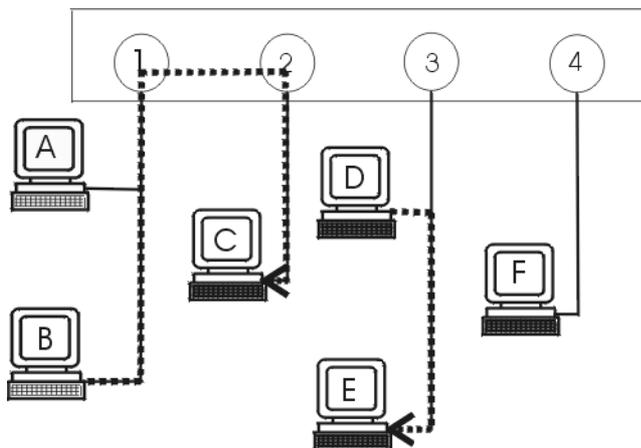
After the bridge has received a packet from station C it knows that station C is attached to port 2. When the bridge knows to which ports a station is attached, it will send packets with destination addresses of these stations only to the port the station is attached to (e.g. a packet from station B to station C is only forwarded to port 2). When a destination address of a packet is of a station in its own segment, the packet is not forwarded by the bridge (e.g. a packet from station D to station E).

Quality of service

Refer to "Quality of Service (QoS) overview" (p. 11-51).

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Virtual concatenation

The SDH granularity problem

The virtual containers of the SDH have fixed sizes. These virtual containers are important for the transport of Ethernet frames over the SDH network:

- VC-12: 2 Mbit/s
- VC-3: 50 Mbit/s
- VC-4: 150 Mbit/s

It is difficult to fit the Ethernet traffic into one of these virtual containers. For many applications the containers, or contiguously concatenated virtual containers, such as VC-4-4c (600 Mbit/s) for example, are either too small or too big. This is known as the granularity problem.

Virtual concatenation is a mechanism by which a number of independent VCs can be used to carry a single payload. This way, the granularity problem is solved.

The following table shows the possible payload sizes, and the virtual containers that are used for the transport.

Payload	Virtual containers	Concatenation
2 Mbit/s	1 × VC-12	VC-12
4 Mbit/s	2 × VC-12	VC-12-2v
6 Mbit/s	3 × VC-12	VC-12-3v
8 Mbit/s	4 × VC-12	VC-12-4v
10 Mbit/s	5 × VC-12	VC-12-5v
50 Mbit/s	1 × VC-3	VC-3
100 Mbit/s	2 × VC-3	VC-3-2v

Virtual concatenation

Virtual concatenation can be used for the transport of payloads that do not fit efficiently into the standard set of virtual containers (VCs).

Virtual concatenation splits the contiguous bandwidth into individual VCs, transports these VCs separately over the SDH network, and recombines them to a contiguous signal at the path termination. An important aspect of virtual concatenation is that it *only needs to be supported at the end nodes* (i.e. at the *TransLAN*® cards that interface with the end-customer's LAN). The rest of the network simply transports the separate channels.

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Example 1

As an example, the following figure shows the virtual concatenation of 5 × VC-12:
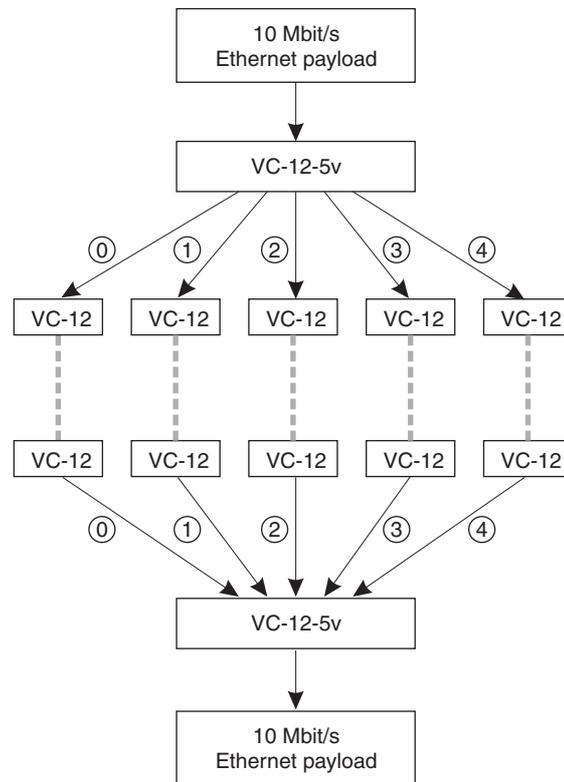
The 10 Mbit/s payload is put into a VC-12–5v, i.e. into a virtual concatenation group (VCG) consisting of 5 virtually concatenated VC-12s. These VC-12s can travel the network independently, and do not have to follow the same route. At the endpoint, the VC-12–5v is reassembled, and the payload is extracted.

Differential delay

Due to the different propagation delay of the VCs a differential delay occurs between the individual VCs. This differential delay has to be compensated and the individual VCs have to be re-aligned for access to the contiguous payload area.

The *TransLAN*® re-alignment process covers at least a differential delay of 32 ms.

Link Capacity Adjustment Scheme (LCAS)

LCAS is an extension of virtual concatenation that allows dynamic changes in the number of channels in a connection. In case channels are added or removed by management actions this will happen without loosing any customer traffic.

LCAS allows a bandwidth service with scalable throughput in normal operation mode. In case of failure the connection will not be dropped completely but only the affected channel(s). The remaining channels will continue carrying traffic. LCAS provides automatic decrease of bandwidth in case of link failure and re-establishment after link recovery.

In case only one end supports (or has turned on) the LCAS protocol, the side that does support LCAS adapts automatically to the restrictions that are dictated by the non-supporting end, i.e. the entire link behaves as a link that does not support in-service bandwidth adaptations.

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Spanning tree protocol (STP)

Overview

The spanning tree protocol (STP) is a standard Ethernet method for eliminating loops and providing alternate routes for service protection. Standard STP depends on information sharing among Ethernet switches/bridges to reconfigure the spanning tree in the event of a failure. The STP algorithm calculates the best loop-free path throughout the network.

STP defines a tree that spans all switches in the network; it e.g. uses the capacity of available bandwidth on a link (path cost) to find the optimum tree. It forces redundant links into a standby (blocked) state. If a link fails or if a STP path cost changes the STP algorithm reconfigures the spanning tree topology and may reestablish previously blocked links. The STP also determines one switch that will be the root switch; all leaves in the spanning tree extend from the root switch.

Maximum bridge diameter

The maximum bridge diameter is the maximum number of bridges between any two hosts on the bridged LAN for any spanning tree configuration.

For *TransLAN®* applications the maximum bridge diameter is 25 nodes.

Spanning tree example

The following example network serves to illustrate the principle how a spanning tree is constructed.

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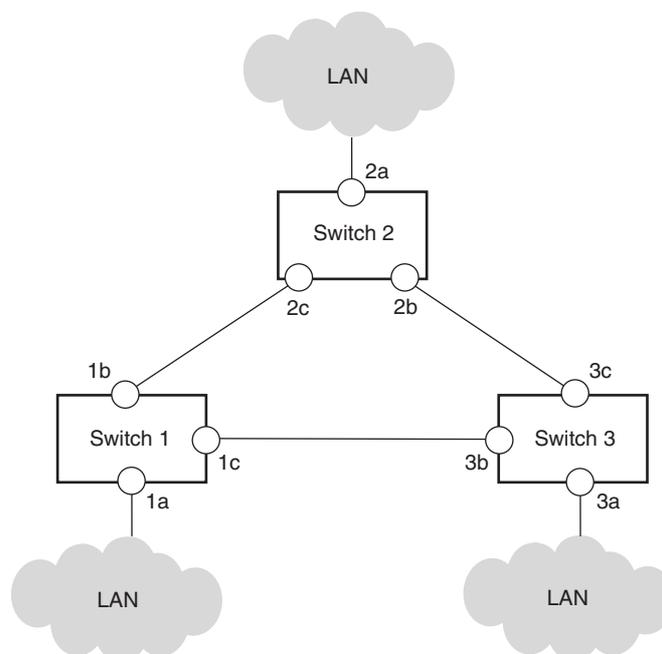
Determination of the root

For every switch a priority can be configured. The switch priority is a number between 0 (highest priority) and 61440 (lowest priority) in steps of 4096. The switch with the highest priority will become root.

If there are two or more switches with the same highest priority, then the switch with the lowest number for the MAC address will become root. This rule ensures that there is always exactly one root, as MAC addresses are unique.
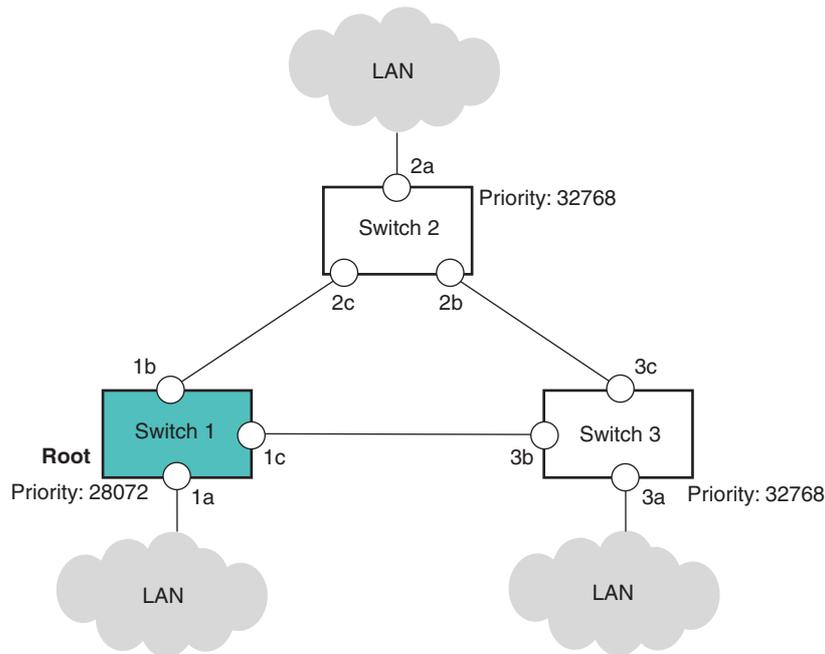
Determination of the root ports

Root ports are those ports that will be used to reach the root. For each switch the port with the lowest root path cost is chosen, where the root path cost is determined by adding the path costs to the root. In the example port 2b and 3b are root ports.
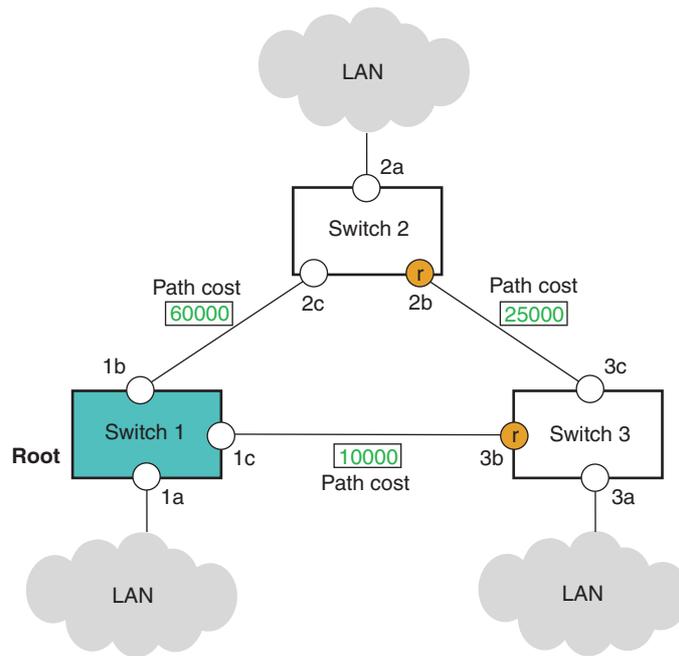
For every port a path cost value can be configured. For E/FE *TransLAN*® cards, the default value of the path cost is determined by dividing 20,000,000,000 by the bandwidth in kbit/s. For GbE *TransLAN*® cards, the path cost is a means to influence the active network topology.

Determination of the designated and blocked ports

The designated port is the one port that is going to be used for a certain LAN. In the example, there are 6 LANs.

The designated ports for LAN 1, LAN 2 and LAN 3 are the ports 1a, 2a and 3a respectively, because these LANs have only one connection to a switch. If there are more connections to a switch, then the port with the lowest root path cost is chosen. Thus the designated ports for LAN 4, LAN 5 and LAN 6 are the ports 1b, 1c and 3c respectively.
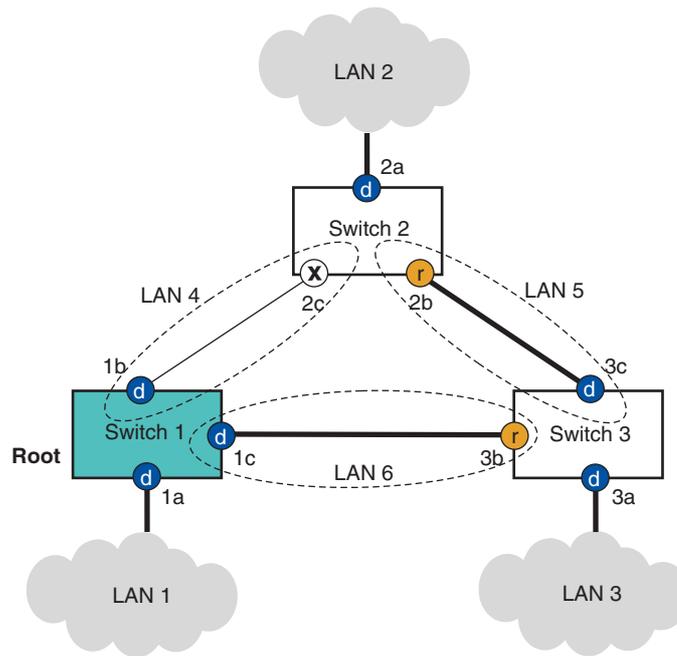
Ports that are neither root ports nor designated ports are blocked. In the example port 2c is a blocked port.

Thus the loop free spanning tree is constructed.

Rapid spanning tree protocol (rSTP)

The rapid spanning tree protocol reduces the time that the standard spanning tree protocol needs to reconfigure after network failures. Instead of several tens of seconds, rSTP can reconfigure in less than a second. The actual reconfiguration time depends on several parameters, the two most prominent are the network size and complexity. IEEE802.1w describes the standard implementation for rSTP.

Specific attributes for *TransLAN®* STP enhancements:

- Failure Detection - Use SDH-layer failure detection to trigger STP reconfiguration.

- Convergence Time - Key aspects of the message-based IEEE 802.1w/D10 (rSTP) protocol instead of timer-based 802.1D (STP) protocol.

- Support larger network diameter by adjusting the "Maximum Age Timer" parameter and enhanced STP configuration controls and reports.

- Automatic mode detection - The rSTP is supported as an enhancement to STP, it cannot be enabled explicitly. It rather will operate by default and will fall back to STP as soon as it finds peer nodes that do not support rSTP. The STP mode that the bridge elected can be retrieved per port.

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GARP VLAN Registration Protocol (GVRP)

Automatic configuration of VLANs

The GARP VLAN Registration Protocol (GVRP) is a protocol that simplifies VLAN assignment on network-role ports and ensures consistency among switches in a network.

GVRP is supported only in the IEEE 802.1Q/IEEE 802.1ad VLAN tagging modes. In the transparent tagging modes (VPN tagging modes), a similar protocol, the proprietary spanning tree with VPN registration protocol (STVRP) is supported. STVRP is enabled per default and cannot be disabled.

By using GVRP, VLAN identifiers (VLAN IDs) only need to be provisioned on customer-role ports of access nodes. VLAN IDs on network-role ports of intermediate and access nodes are automatically configured by means of GVRP. The provisioned VLAN IDs on customer-role ports are called static VLAN entries; the VLANs assigned by GVRP are called dynamic VLAN entries. In addition, GVRP prevents unnecessary broadcasting of Ethernet frames by forwarding VLAN frames only to those parts of the network that have customer-role ports with that VLAN ID. Thus, the traffic of a VLAN is limited to the STP branches that are actually connecting the VLAN members.
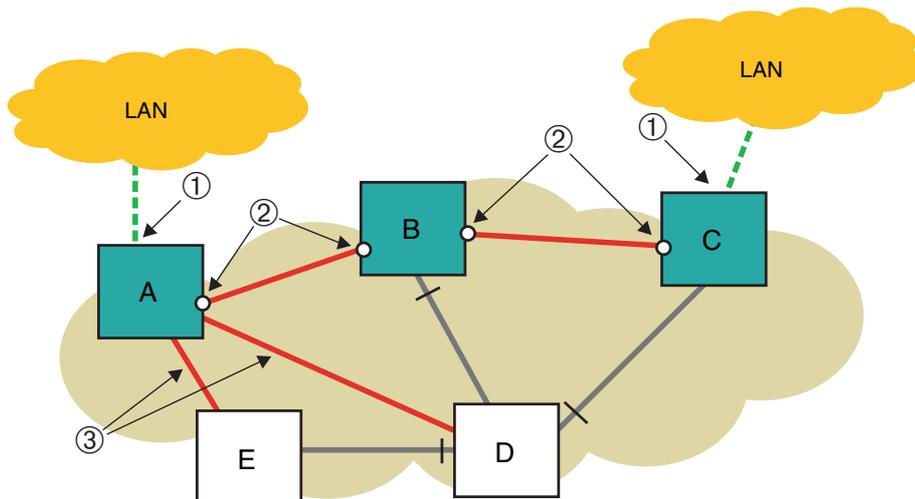
Legend:

1	Static VLAN IDs need to be entered manually at customer-role ports.
2	Dynamic VLAN IDs of intermediate and access nodes are automatically configured.
3	No automatic configuration of VLAN IDs on ports towards those access nodes where the respective VLAN ID is *not* provisioned, i.e. no unnecessary broadcasting of Ethernet frames by forwarding VLAN frames only to those parts of the network that have customer-role ports with that VLAN ID.

Note that GVRP and the spanning tree protocol (STP) interact with each other. After a stable spanning tree is determined (at initialization or after a reconfiguration due to a failure) the GVRP protocol recomputes the best VLAN assignments on all network-role ports, given the new spanning tree topology.

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GVRP can be enabled (default setting) or disabled per virtual switch. However, all virtual switches on an Ethernet network need to be in the same GVRP mode. For interworking flexibility one can optionally disable STP per network-role port; implicitly GVRP is then disabled as well on that port. GVRP must be disabled in order to interwork with nodes that do not support GVRP.

Max. number of VLANs

The maximum supported number of active VLANs (VLAN identifiers) is limited for reasons of controller performance, and varies depending on product, tagging mode and GVRP activation status. The following table shows the applicable values. Note that even if the maximum number of active VLANs is limited to 64, 247, or 1024, VLAN identifiers out of the full range of VLAN identifiers (1…4093) can be used for tagging purposes.

Max. number of active VLANs			
Product	Transparent tagging (VPN tagging) mode[1]	IEEE 802.1Q/IEEE 802.1ad tagging mode	
		GVRP enabled	GVRP disabled
1643 AM/1643 AMS[2]	64 VLANs per card	64 VLANs per card	64 VLANs per NE

Notes:

1. No distinction is made with respect to the STVRP activation status, because STVRP is enabled per default and cannot be disabled.

2. An alarm (`MACcVLANOVFW — Maximum number of VLAN instances exceeded`) will be reported when the max. number of active VLANs per *TransLAN*® card is exceeded.

3. The *LambdaUnite*® MSS transparent tagging mode rather compares to the provider bridge tagging mode (see "IEEE 802.1ad VLAN tagging" (p. 11-38)) than to this transparent tagging (VPN tagging) mode.

A maximum of 5000 VLAN/port associations is supported per network element, except for the 1643 AM/1643 AMS, where the maximum number of VLAN/port associations is 2000. An alarm (`MIBcVLANOVFW — Maximum number of VLAN instances exceeded in MIB`) will be reported when the max. number of VLAN/port associations per network element is exceeded.

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Ethernet over SDH applications

Purpose

This section gives an introduction to the possible *TransLAN®* Ethernet over SDH applications.

Types of applications

Layer-2 switching allows different types of applications, including:

- Ethernet point-to-point transport
- Ethernet point-to-point transport in buffered repeater mode
- Ethernet multipoint transport (dedicated bandwidth)
- Ethernet multipoint transport (shared bandwidth)
- Ethernet multiplexing (VLAN trunking)

TransLAN® supports all Ethernet transport solutions. Specific system configuration is required for each network application.

Direct interconnection of two LANs - Ethernet point-to-point transport

The most straight-forward Ethernet application on the *TransLAN®* equipment is a leased line type of service with dedicated bandwidth to interconnect two LAN segments which are at a distance that cannot be bridged by using a simple Ethernet repeater, because the collision domain size rules would be violated.

The two interconnected LANs need not be of the same speed; it is possible to interconnect a 10BASE-T and a 100BASE-T LAN this way for example.

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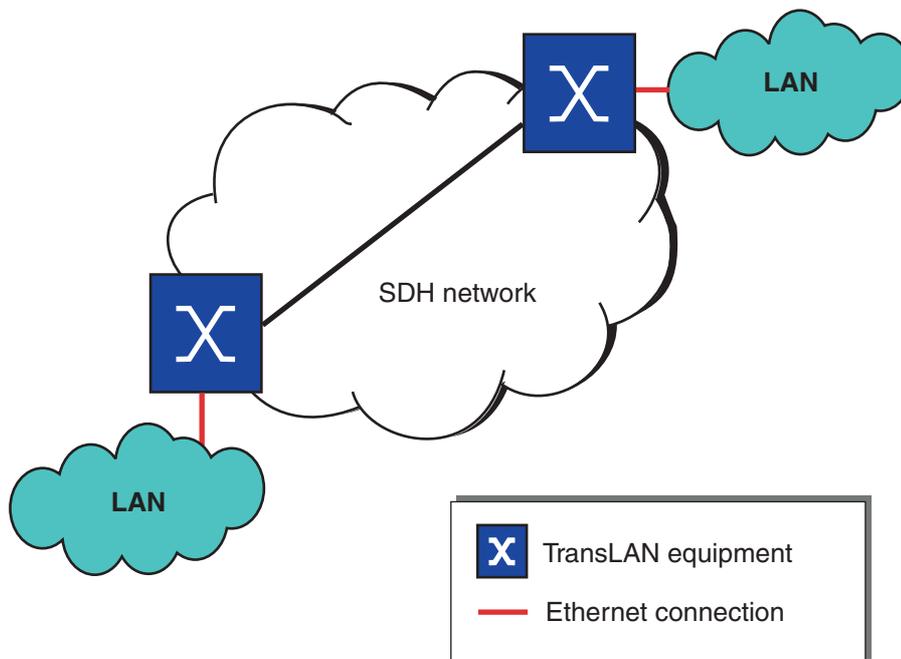
Mode of operation

Ethernet point-to-point transport can be realized by using any of the *TransLAN®* operational modes. However, the preferred mode of operation for the direct interconnection of two LANs is the repeater mode.

Related information

Please also refer to "Repeater mode" (p. 11-28).

Ethernet multipoint transport with dedicated bandwidth

The following figure shows a network example of a multipoint Ethernet over SDH network with dedicated bandwidth:
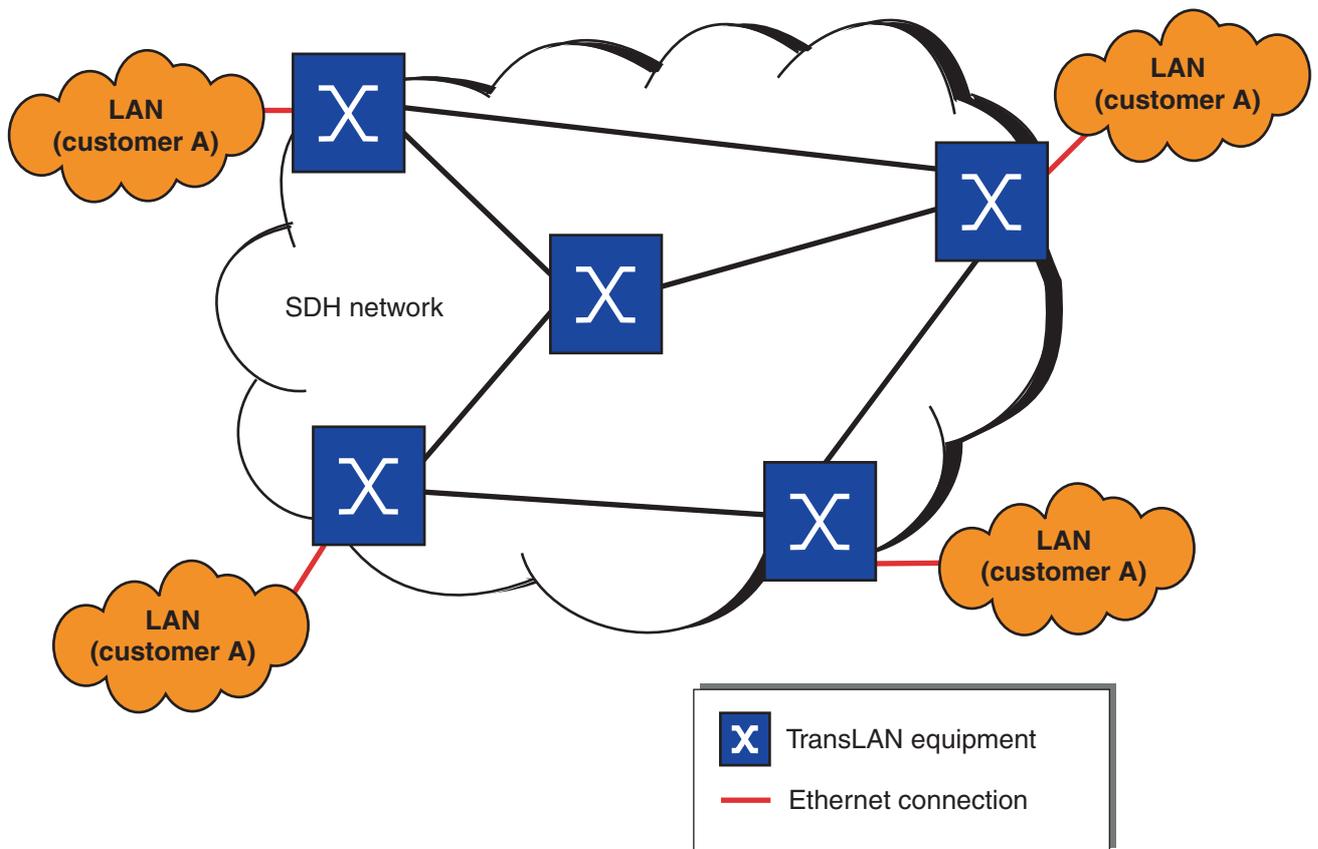
This multipoint network is dedicated to a single user.

Mode of operation

Ethernet multi-point transport with dedicated bandwidth can be realized by using any of the following *TransLAN®* operational modes:

- LAN-VPN mode
- STP virtual switch mode compliant with IEEE 802.1Q
- STP virtual switch mode compliant with IEEE 802.1ad (provider bridge mode)

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Related information

Please also refer to:

- "LAN-VPN (M-LAN) mode" (p. 11-32)
- "IEEE 802.1Q STP virtual switch mode" (p. 11-34)
- "Provider bridge mode" (p. 11-36)

Ethernet multipoint transport with shared bandwidth

The following figure shows a network example of a multipoint Ethernet over SDH network with shared bandwidth:
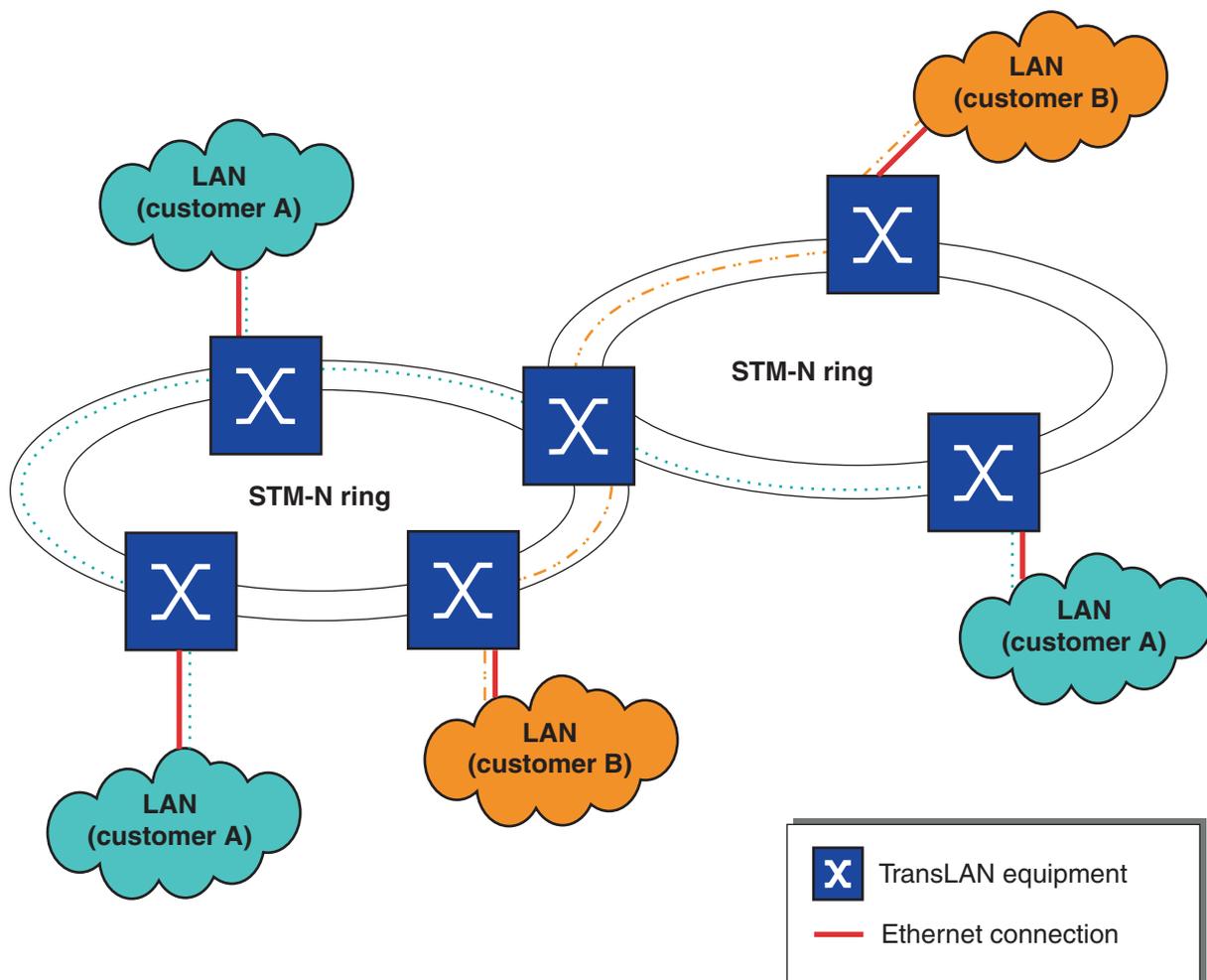
The SDH capacity is shared among more than one customer in this multipoint network. This allows customer A to use the complete SDH bandwidth at the moment that customer B is inactive, and vice versa. As Ethernet traffic is inherently bursty, sharing bandwidth can increase the efficiency of the network usage.

Isolation of the traffic of different end-users can be accomplished by using transparent tagging or VLAN tagging (see "Tagging modes" (p. 11-37)), depending on the desired mode of operation.

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Mode of operation

Ethernet multi-point transport with shared bandwidth can be realized by using any of the following *TransLAN®* operational modes:

- LAN-VPN mode
- STP virtual switch mode compliant with IEEE 802.1Q
- STP virtual switch mode compliant with IEEE 802.1ad (provider bridge mode)

Related information

Please also refer to:

- "LAN-VPN (M-LAN) mode" (p. 11-32)
- "IEEE 802.1Q STP virtual switch mode" (p. 11-34)
- "Provider bridge mode" (p. 11-36)

VLAN trunking

Trunking applications are a special case of Ethernet multipoint transport, either with dedicated or shared bandwidth.

Trunking applications are those applications where traffic of multiple end-users is handed-off via a single physical Ethernet interface to a router or switch for further processing. This scenario is also called "back-hauling", since all traffic is transported to a central location, e.g. a point-of-presence (PoP) of a service provider.

Trunking applications can be classified into two topology types:

- Trunking in the hub-node
- Distributed aggregation in the access network

Common to both topology types is that the Ethernet traffic of multiple LANs is aggregated on one or a few well filled Ethernet interfaces, the trunking LAN interface(s). Thus, the Ethernet traffic of multiple end-users can be made available to a service provider at a central location via a limited number of physical connections. Without VLAN trunking, each end-user would need to be connected to the service provider equipment via his own Ethernet interface.

Trunking applications include the aggregation of Ethernet traffic of a single end-user as well as the aggregation of Ethernet traffic of multiple different end-users. Isolation of the traffic of different end-users can be accomplished by using transparent tagging or VLAN tagging (see "Tagging modes" (p. 11-37)), depending on the desired mode of operation.

A typical *TransLAN®* trunking application would be a configuration where many E/FE access nodes are combined with a trunking GbE hub node (cf. "Distributed aggregation in the access network" (p. 11-25)).

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Trunking in the hub node

This figure shows an example of VLAN trunking in the hub node:
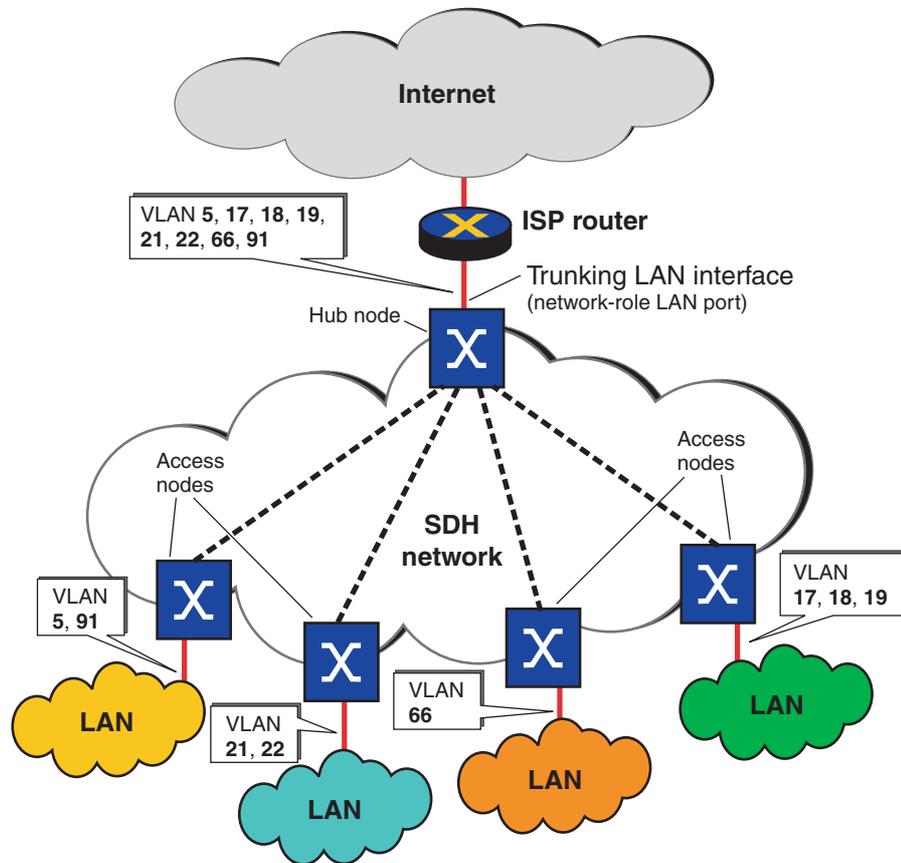
Each access node is individually connected to the hub node over a single SDH connection (or even one SDH connection per LAN port). The trunking LAN interface is a network-role LAN port. The VLAN tags in the Ethernet frames are preserved, i.e. made available to the service provider, and can thus be used for further processing.

A high WAN port density is required in the hub-node.

Averaging of the peak traffic loads of each access node (or LAN port) is not used. Each SDH link bandwidth has to be engineered for the corresponding amount of peak traffic.

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Distributed aggregation in the access network

This figure shows an example of distributed aggregation in the access network:
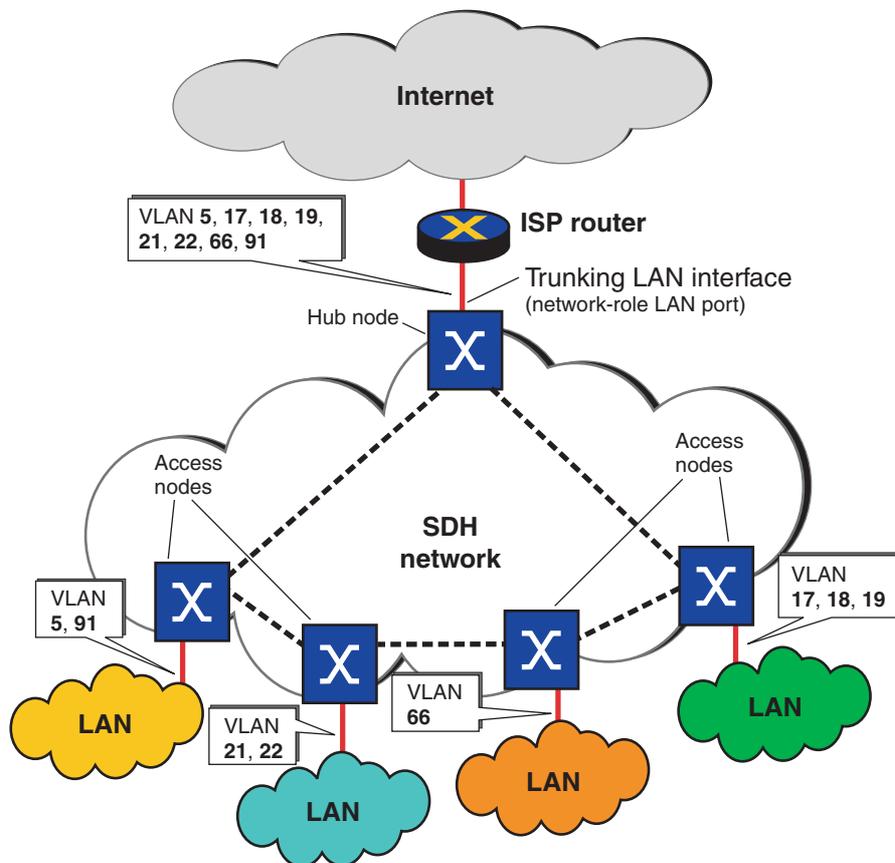
The SDH bandwidth can be shared by many end-users, which allows to gain from the statistical effects in the traffic offered by each end-user ("statistical multiplexing"). Thus, the distributed aggregation in the access network configuration is more bandwidth efficient than the trunking in the hub node topology.

Another difference is that in the trunking in the hub-node topology, the hub node has to support many WAN ports, which is not the case in the distributed aggregation in the access network configuration.

A certain bandwidth allocation fairness can be guaranteed by applying ingress rate control in the access nodes. Please note that ingress rate control is *not* supported on GbE *TransLAN*® cards but only on E/FE *TransLAN*® cards.

Mode of operation

Trunking applications can be realized by using any of the following *TransLAN*® operational modes:

- LAN-VPN mode
- STP virtual switch mode compliant with IEEE 802.1Q
- STP virtual switch mode compliant with IEEE 802.1ad (provider bridge mode)

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Related information

Please also refer to:

- "LAN-VPN (M-LAN) mode" (p. 11-32)
- "IEEE 802.1Q STP virtual switch mode" (p. 11-34)
- "Provider bridge mode" (p. 11-36)

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Operational modes

Overview of operational modes

These *TransLAN*® operational modes exist:

- Proprietary VPN modes:
    - Multipoint LAN bridging mode ("LAN-VPN mode", "MLAN mode")
- Standard compliant IEEE modes:
    - STP virtual switch mode compliant with IEEE 802.1Q
    - STP virtual switch mode compliant with IEEE 802.1ad ("Provider bridge mode")

Virtual Switch operation mode

When the transparent tagging mode has been selected on the Ethernet Interface extension card (LAN unit) level, a different Virtual Switch operational mode must be chosen per Virtual Switch. The Virtual Switch can be configured in the following operation modes:

- Repeater
- LAN-interconnect
- LAN-VPN (MLAN)

When the IEE802.1Q/IEEE 802.1ad tagging mode has been selected, the operation mode of the Virtual Switch is always Spanning Tree.

The physical Layer 2 (L2) switch that is present on an Ethernet LAN tributary board can be split into several logical or virtual switches. A Virtual Switch is a set of LAN/WAN ports on a Ethernet LAN tributary board that are used by different VLAN's which can share the common WAN bandwidth. Each of the virtual switches can operate in a specific Virtual Switch mode depending on the VLAN tagging scheme, and each Virtual Switch mode allows specific LAN-WAN port associations as explained in the following paragraphs.

First the VLAN tagging mode has to be specified on LAN unit level, this can be either IEEE 802.1Q/IEEE 802.1adVLAN tagging or VPN tagging. In VPN tagging mode, end-user VLAN tags that optionally may appear in the end user traffic are ignored in the forwarding process. These VLAN tags are carried transparently through the "TransLAN Network". In VLAN-tagging mode, the VLAN tags are also carried transparently, but the VLAN ID in the VLAN tags is used in the forwarding decision. Therefore customers' VLAN IDs may not overlap on a physical Ethernet switch, the VLAN IDs must be unique per switch pack. (FEP 1_188_14221)

After having provisioned the tagging mode, per virtual switch a different Virtual Switch operational mode may be chosen. The Ethernet LAN tributary board supports either the Repeater mode, LAN-Interconnect, LAN-VPN, and Spanning Tree Protocol Virtual Switch mode of operation. IEEE 802.1D MAC forwarding and address filtering, multi-point bridging and spanning tree protocol (STP) are supported under all modes of operation, except the Repeater mode.

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The following table gives an overview of the different modes and a list of the corresponding supported functionality:

VLAN Tagging Mode	Virtual Switch Mode	Ethertype/TPID	QoS_CQS (Quality of Service - Classification Queueing Scheduling)	Dynamic VLAN Registration Protocol	Spanning Tree Implementation
valid per pack	valid perunit				
VPN Tagging	Repeater	N/A	N/A	N/A	No STP
	LAN Interconnect (Dedicated Bandwidth)	N/A	N/A	STVRP	Multiple STP
	LAN-VPN (Shared Bandwidth)	N/A	N/A		
	LAN-VPN with QoS	This mode of operation is supported in previous releases. However, it is no longer supported from the 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS Release 4.0 onwards.			
IEEE 802.1Q/IEEE 802.1ad VLAN tagging	Spanning Tree Switched Network	600 ... FFFF, except for 8100	disabled	GVRP	Single STP
			enabled		
		8100	enabled		
	Repeater	600 ... FFFF, except for 8100	disabled	N/A	No STP

Interoperability of operational modes

Virtual Switches that are configured in the same operational mode can interwork. Virtual Switches not configured in the same operational mode do not interwork in all cases. If a Virtual Switch is configured in the "Repeater" mode or the "STP Switch" mode, it can only interwork with Virtual Switches that are configured in the same mode.

Interworking between a remote LAN-interconnect virtual switch and a VPN virtual switch is not prohibited, because the LAN-interconnect mode can be seen as a special case of the VPN mode.

Repeater mode

A virtual switch in repeater mode consists of exactly *one LAN port* and *one WAN port* in a fix 1:1 relationship. All Ethernet frames entering the virtual switch at a LAN port are transparently forwarded to the corresponding WAN port and transported over the network with specific limitation for X4IP described in chapter *Provisioning a virtual switch in repeater (promiscuous) mode* of *User Operations Guide*. None of the standard IEEE Std 802.1D/Q processes (MAC address learning, MAC frames forwarding and filtering, VLAN classification and filtering) applies. Received frames are relayed to the other port of the virtual switch, irrespective of their format or contents.

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The WAN port that supports the Repeater mode requires the provisioning of the following parameters:

- WAN port capacity (require manual provisioning) at 2, 4, 6, 8, 10, 50 or 100 Mbit/s
- association of the WAN port to a LAN port
- create cross-connections between VC-X and TU-X (where X=12 or 3).

The following figure shows the network element configured in the Repeater operation mode.
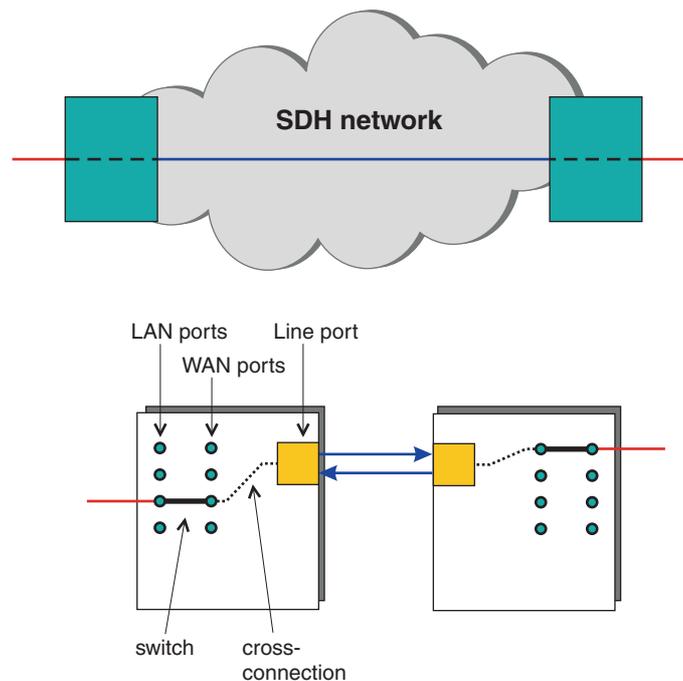
A virtual switch in repeater mode emulates an Ethernet repeater except that it

- breaks-up the collision domains,
- removes the length limitation of CSMA/CD LANs, and
- also works in full-duplex mode.

Synonyms

The *TransLAN*® repeater mode of operation is often also referred to as "promiscuous mode" or "buffered repeater mode".

Intended use

The repeater mode is only intended to be used in point-to-point configurations to offer a leased-lines type of service. The repeater mode is supported by E/FE as well as GbE *TransLAN*® cards.

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Configuration rules and guidelines

Please observe these configuration rules and guidelines:

● The use of the repeater mode is limited to virtual switches consisting of exactly *one customer LAN port* and *one network WAN port*. Only point-to-point connections are supported.

● *No* customer identifier (CID) can be configured.

● It is *not* possible to provision QoS functions.

● Flow control can be enabled or disabled per LAN port.

● *No* WAN port configurations are possible.

● When a virtual switch is switched from any of the other operational modes into repeater mode, then all VLAN and QoS configuration information will be reset. When the virtual switch is switched back again into the previous mode, then these configuration settings will *not* become operational again but must be provisioned again.

The Ethernet packets are carried across the SDH network in a channel. Each channel comprises up to 63 VC12 or up to 2 VC3 concatenated. These VC12s and VC3s behave in the same way as normal SDH VC12s from an E1 port or SDH VC3s from an E3 port. There is some buffering in the NE, but it is still possible to lose packets because the channel bandwidth can be less than the Ethernet traffic rate.

LAN-interconnect mode

The LAN-interconnect mode of operation offers dedicated WAN bandwidth to a single end-user. Under the LAN-interconnect mode of operation, a Virtual Switch must only contain LAN ports with the same CID (Customer ID) to ensure the entire WAN port bandwidth allocated for the group is dedicated to a single end-user. Any combination of LAN- and WAN-ports is allowed, but with a minimum of two ports to be meaningful.

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The following figure shows the network element configured in the LAN-interconnect operation mode.
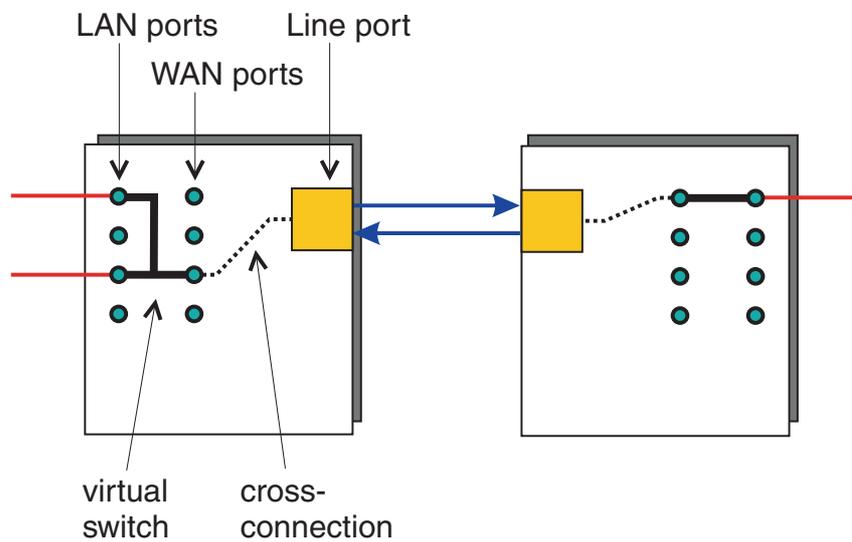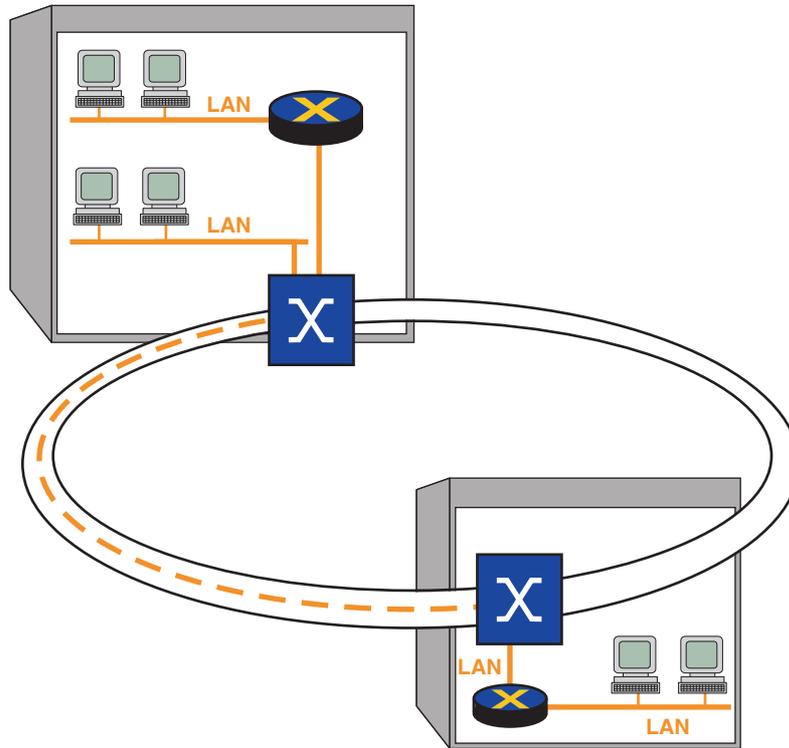
The Ethernet packets are carried across the SDH network in a channel. Each channel comprises up to 63 VC12 or up to 2 VC3 concatenated. These VC12s or VC3s behave in the same way as normal SDH VC12s from an E1 port respectively normal SDH VC3s from an E3 port.

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This operation mode support the following features:

- Learning bridges
- Spanning tree
- Additional SDH bandwidth
- Virtual Switch and
- CID (Customer Identifier).

Special case of the LAN-VPN mode

The LAN interconnect mode of operation is a special case of the LAN-VPN operation. In the LAN interconnect mode a virtual switch may contain LAN and WAN ports of a single user only.

The *TransLAN*® cards can support both modes of operation simultaneously as long as the corresponding virtual switches do *not* include the same WAN ports.

Configuration rules and guidelines

Please observe these configuration rules and guidelines:

- On LAN ports the CID needs to be provisioned manually.

  The permitted CID value range is [0 … 4094]. However, note that only values out of the value range [1 … 4094] can be used to identify a user while the value "0" cannot. The corresponding LAN port is disabled if the CID is set to "0".

- In the LAN interconnect mode, the virtual switch is dedicated to a single customer. Therefore, all LAN ports of a virtual switch must have the *same* customer identifier (CID).

- In the LAN interconnect mode, LAN ports are always customer-role ports, and WAN ports are always network-role ports (see "Port provisioning" (p. 11-45)).

LAN-VPN (M-LAN) mode

Under the LAN-VPN (Virtual Private Network) operation mode, a number of LAN- and WAN ports are grouped together to form one virtual switch. The Virtual Switch contains LAN ports of multiple end-users sharing the same WAN port(s) bandwidth. To safeguard each individual end-user's data flow and to identify an end-user's VPN from the shared WAN, the Ethernet Interface card assigns a CID to each LAN port within a Virtual Switch. The CID of each end-user (or LAN port) must be unique within a shared WAN port to create a fully independent VPN. The VPN provisioning on the WAN ports on the access and intermediate nodes is done automatically by the proprietary protocol STVRP (Spanning Tree with VPN Registration Protocol) that runs without operator intervention.

The end-users are assigned bandwidth by the operator. It allows multiple end-users to share the same SDH WAN bandwidth with each end-user being allocated a sub-VC-12-Xv (X= 1, 2, 3, 4, 5) or sub-VC-3-Xv (X=1, 2) rate of bandwidth when using the Fast Ethernet card. The combined end-user bandwidth is then mapped to the SDH time-slots and transported in the SDH network as a single data load. The minimum rate that can be configured per end-user at a LAN port is 150 kbit/s. The operator also specifies a traffic policy for each end-user.

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The LAN-VPN operation mode controls the shared bandwidth by making use of the following features:

- Learning bridges

- Spanning tree

- V-LAN (Virtual-LAN)

- CID (Customer Identifier)

- Assigned bandwidth policy (CIR = Committed Information Rate and PIR = Peak Information Rate)

- Additional SDH bandwidth and SDH WAN bandwidth sharing

- Traffic policy (Strict policing/Oversubscription).

The following figure shows the network element configures in the LAN-VPN operation mode
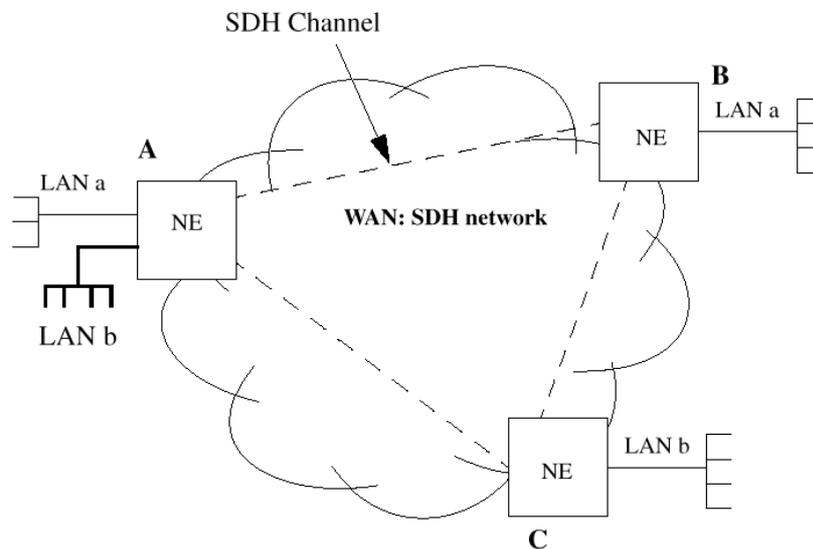
LAN-VPN with QoS mode

Starting with release 4.0, the LAN-VPN with QoS mode, which was supported in releases prior to release 4.0, is no longer supported.

The QoS features which were supported by the LAN-VPN with QoS mode in previous releases are different to the new QoS features supported in the 1643 AM release 4.0.

VPN tagging mode

VPN tagging is used to identify user frames in the LAN-VPN mode of operation. VPN tagging is often also referred to as "transparent tagging".

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VPN tagging is characterized as follows:

- VPN tagging is a double tagging mode. This means that a customer identifier (CID tag) is inserted into each frame at each network ingress LAN port. User frames that are already tagged become double tagged. The CID tag is removed from the frame at each network egress LAN port.

- Ports forward only those frames that have a CID tag which "belongs" to that port (i.e. which has previously been provisioned on that port).

In the VPN tagging mode, the term "LAN group" is synonymously used to the term "virtual switch".

Configuration rules and guidelines

Please observe these configuration rules and guidelines:

- Be aware that the port role of the LAN and WAN ports is fixed (see above):
  - LAN ports are always customer role ports.
  - WAN ports are always network role ports.
- On LAN ports the CID needs to be provisioned *manually*.
- The CID provisioned on each LAN port must be *unique* within a shared WAN to create a fully independent VPN.

  The VPN provisioning on the WAN ports is done automatically by means of the proprietary spanning tree with VPN registration protocol (STVRP).

IEEE 802.1Q STP virtual switch mode

The IEE802.1Q/IEEE 802.1ad VLAN tagging scheme can be seen as an extension of the LAN-VPN mode, providing more flexibility in defining the VPN's and in general leading to a more efficient use of bandwidth. In IEEE 802.1Q VLAN tagging mode, a virtual switch is formed by a combination of LAN- and WAN ports on a physical switch that is used by different VLAN's which can share the common WAN bandwidth. Each port can be part of only one virtual switch, but a certain port may be associated with more than one VLAN. The ports that are associated with a certain VLAN ID form the VLAN Port Member Set.

On ingress, each packet is filtered on its VLAN ID. If the receiving port is a member of the VLAN to which a received MAC frame is classified, then the frame is forwarded. The user can provision whether untagged packets are dropped, or tagged with a PVID (Port VLAN ID), via the acceptable frame type parameter.

Example VLAN trunking

The VLAN trunking example shown in the next figure is one of the possible applications in this operation mode.
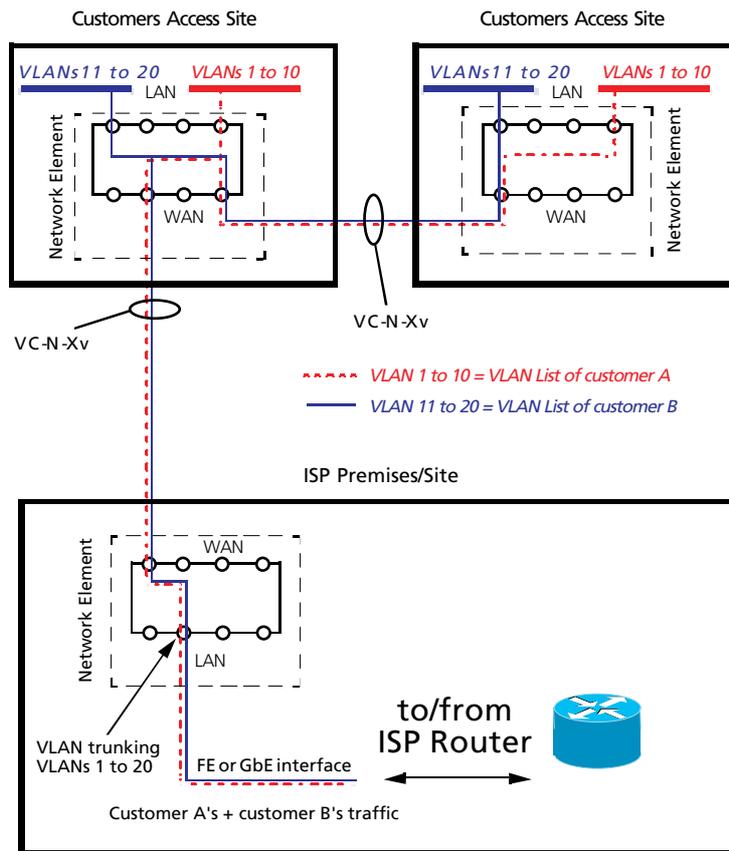
VLAN IDs assigned to LAN Ports should not overlap in case the operator wants to ensure Layer-2 security between those LAN Ports (in many applications, LAN Ports are likely to be dedicated to one customer). It is the responsibility of the operator to define appropriately non-overlapping VLAN IDs on all the created virtual switches.

Also the provisioned PVID, with which untagged incoming frames are tagged, should not overlap with any VLAN ID on the virtual switch of which the customers' port is part (again, this is the responsibility of the operator). Manual provisioning of intermediate nodes can be cumbersome and difficult. Therefore it is recommended to use the auto-provisioning mode for VLAN ID's on the intermediate nodes. A protocol named GVRP (GARP VLAN Registration Protocol) provides this functionality. GVRP is an application of the Generic Attribute Registration Protocol (GARP) application, which runs on top of the active spanning tree topology.

IEEE 802.1Q defines two kinds of VLAN registration entries in the Bridge Filtering Database: static and dynamic entries. In the *TransLAN*® implementation, static entries need to be provisioned on access node LAN ports only. GVRP will take care of configuring dynamic entries on the WAN ports of intermediate and access nodes.

A spanning tree per virtual switch is implemented. If the user wants the traffic to be protected by the spanning tree protocol and uses the manual-provisioning mode, he must make sure that the WAN ports in the alternative path also will have the corresponding VLAN IDs assigned. E.g. in a ring topology, all NE's in the ring must be provisioned with

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this VLAN ID. In automatic mode, the GVRP protocol will take care of the dynamic VLAN ID provisioning. The user has the possibility to flush dynamic VLAN's, thus remove dynamic VLAN's that are no longer used.

Only independent VLAN learning is supported. This means, if a given MAC address is learned in a VLAN, the learned information is used in forwarding decisions taken for that address only relative to that VLAN.

For the IEEE 802.1Q VLAN tagging mode, the oversubscription mode is not supported (cf. "Quality of Service (QoS) overview" (p. 11-51)).

Configurable spanning tree parameters

Even though the management system is an SDH network element manager, the data networking problems still need to be addressed when managing network elements carrying Ethernet traffic. As such the following parameters are visible/provisionable per virtual switch.

- bridge address
- bridge priority
- root cost
- root port
- port priority
- bridge priority

Provider bridge mode

The provider bridge mode, a double tagging mode with provisionable TPID ("Ethertype"), is - from a functional point of view - comparable to the LAN-VPN with the chief difference that the provider bridge mode is compliant to the IEEE 802.1ad standard while the VPN modes are Alcatel-Lucent proprietary modes, and that the provider bridge mode supports Quality of Service features while the LAN-VPN does not.

Traffic is forwarded based on the destination MAC address and the outer VLAN tag (S-tag).

As in the IEEE 802.1Q STP virtual switch mode, a virtual switch in the provider bridge mode is a set of LAN/WAN ports on a physical switch that are used by different VLANs which can share the common WAN bandwidth. VLANs in the same virtual switch are defined by their VLAN port member set. An instance of the spanning tree protocol runs on the WAN ports for each virtual switch.

The LAN ports and WAN ports can be configured to be customer-role or network-role ports (see "Flexible port role assignment" (p. 11-46)).

In the provider bridge mode, the IEEE 802.1ad VLAN tagging mode is used (see "IEEE 802.1ad VLAN tagging" (p. 11-38)).

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Tagging modes

Overview

Sharing transport channels between multiple users requires the identification of MAC frames. Tagging is the process of attaching an identifier, a "tag", to a MAC frame in order to identify the user to which the frame pertains.

These tagging modes are supported:

- *Transparent* tagging ("VPN tagging")
- *IEEE 802.1Q/IEEE 802.1ad* VLAN tagging
  - VLAN tagging compliant with IEEE 802.1Q-1998 ("IEEE 802.1Q VLAN tagging")
  - VLAN tagging compliant with IEEE 802.1ad ("IEEE 802.1ad VLAN tagging", "Provider bridge tagging mode")

The different tagging modes are explained later-on in this section.

Important! Note that it is *not* possible to use different tagging modes at the same time on the same *TransLAN®* card.

However, within the transparent tagging mode there can be virtual switches in the repeater mode, LAN interconnect mode, or LAN-VPN mode (with or without IEEE 802.1p QoS) at the same time on the same physical switch.

Transparent tagging

Transparent tagging (or "VPN tagging") is a double tagging mode used to identify end-user frames in the LAN-VPN mode of operation.

To enable bandwidth sharing, a customer identification (CID) is associated with every LAN port. This CID is inserted into incoming Ethernet frames, in an extra tag. MAC address filtering and learning is done independently for every CID.

Ethernet frames that are already tagged become double tagged. Already present end-user VLAN tags remain unused in the transparent tagging mode, i.e. every VLAN tag is transmitted transparently through the SDH network.

Outgoing frames are only transmitted on LAN ports which have the respective CID associated. The extra tag is removed before the Ethernet frames are forwarded to an external LAN.

Note that in the VPN tagging mode the term "LAN group" is synonymously used to the term "virtual switch".

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Configuration rules and guidelines

Please observe these configuration rules and guidelines:

- The port role of the LAN and WAN ports is fixed in the operational modes that make use of the VPN tagging mode (see above):
  - LAN ports are always customer role ports.
  - WAN ports are always network role ports.

- On LAN ports the CID needs to be provisioned *manually*.

- The CID provisioned on each LAN port must be *unique* within a shared WAN to create a fully independent VPN.

The VPN provisioning on the WAN ports is done automatically by means of the proprietary spanning tree with VPN registration protocol (STVRP).

> **Important!** Changing the tagging mode from transparent tagging to IEEE 802.1Q/IEEE 802.1ad VLAN tagging or vice versa is *traffic affecting*! Furthermore, most objects provisioned in one mode will be deleted or reset to default - except the LAN group/virtual switch infrastructure - when switching to the other mode.

IEEE 802.1Q VLAN tagging

IEEE 802.1Q VLAN tagging is used to identify end-user frames in the STP virtual switch mode compliant with IEEE 802.1Q.

These are the IEEE 802.1Q VLAN tagging rules:

- On end-user LAN interfaces:
  - At each network ingress port, untagged user frames are tagged with a default identifier, the port VLAN identifier (PVID) which is removed from the frame at the network egress port.

    Already tagged frames are forwarded if their VLAN identifier is in the port's static or dynamic list of VLAN IDs, i.e. if the port belongs to the configured port member set for that VLAN ID. The static VLAN ID list is configurable. The dynamic VLAN ID list is automatically generated by making use of the GARP VLAN Registration Protocol (GVRP).

  - At each network egress port, the port VLAN identifier (PVID) is removed from previously untagged frames that were tagged with the PVID at the ingress port. VLAN tagged frames are forwarded if the port belongs to the configured port member set for the respective VLAN ID.

- On trunking LAN interfaces, *all* tagged frames are forwarded in both directions. Untagged frames are discarded (dropped).

- The end-customer VLAN tag sets have to be disjunct.

IEEE 802.1ad VLAN tagging

The IEEE 802.1ad VLAN tagging mode ("provider bridge tagging mode") is a double tagging mode with provisionable Ethertype (TPID), used to identify end-user frames in the STP virtual switch mode compliant with IEEE 802.1ad ("provider bridge mode").

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At each customer role port, a provider bridge tag carrying a customer identifier (CID) is inserted into each Ethernet frame in the ingress direction, and removed from the frame in the reverse direction. Frames that are already tagged become double tagged. The IEEE 802.1ad VLAN tagging mechanism is transparent to the end-customer. VPNs on transit nodes (no customer LAN port) are automatically instantiated by means of the standard GVRP protocol which optionally can be disabled.

The value of the Ethertype (TPID) can be flexibly chosen. However, some values are reserved for specific purposes, for example:

- 0x0800 for IP

- 0x0806 for ARP

- 0x8847 for MPLS

- 0x8100 is not selectable because this is the default value for the STP virtual switch mode compliant with IEEE 802.1Q.

Configuration rules and guidelines

Please observe these configuration rules and guidelines:

- The provider bridge mode can be configured by selecting the IEEE 802.1Q/IEEE 802.1ad tagging mode in combination with provisioning an Ethertype *in the range 0x0601 … 0xFFFF, but unequal to 0x8100*. Provisioning the value 0x8100 for the Ethertype results in the selection of the STP virtual switch mode compliant with IEEE 802.1Q.

  The recommended value for the Ethertype in the provider bridge tagging mode is 0x9100. Please also observe the reserved values as given above.

- The customer identification (CID) can be configured in the range [0 … 4094].

  Important! *Changing the tagging mode is traffic affecting!*

  Furthermore, most objects provisioned in one mode will be deleted or reset to default - except the LAN group/virtual switch infrastructure - when switching to a different mode.

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Tagged MAC frame

The following figure illustrates the structure of the MAC frame in different tagging modes as well as the structure of the respective tags.
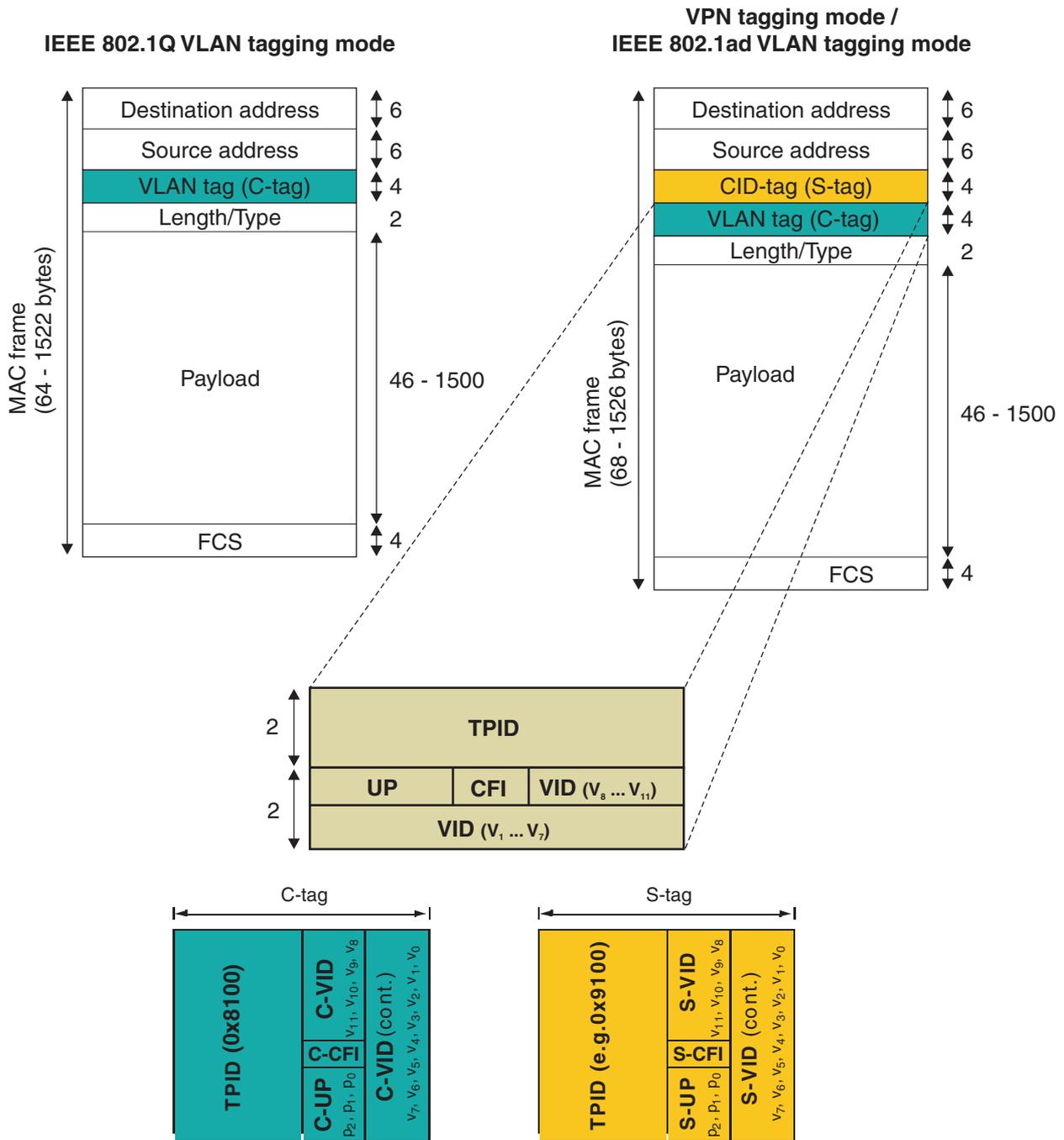
Legend:

TPID	Tag protocol identifier ("Ethertype") - indicates the presence of a VLAN tag (or CID tag, respectively). Furthermore, it indicates that the length/type field can be found at a different position in the frame (moved by 4 bytes).

UP (3 bits)	User priority - "0" (low priority) … "7" (high priority).
CFI (1 bit)	Canonical Format Identifier - indicates the presence or absence of routing information.
ID (12 bits)	Identification - customer identification which can be configured in the range [0 … 4094].

Concerning their structure there is no difference between a VLAN tag (C-tag) and a CID tag (S-tag). A distinction between both types of tags can be made by means of the value in the TPID field, the "Ethertype". In the IEEE 802.1ad VLAN tagging mode (provider bridge tagging mode), the Ethertype can be provisioned per virtual switch.

The value of the Ethertype depends on the mode of operation:

- In the transparent tagging modes (VPN tagging modes), the value of the Ethertype is 0xFFFF, and cannot be changed.
- In the IEEE 802.1Q VLAN tagging mode, the value of the Ethertype is 0x8100, and cannot be changed.
- In the IEEE 802.1ad VLAN tagging mode (provider bridge tagging mode), the value of the Ethertype can be flexibly chosen in the range 0x0601 … 0xFFFF, but unequal to 0x8100. The recommended value for the Ethertype in the provider bridge tagging mode is 0x9100.

Comparison of different tagging schemes

The next figure summarizes the possible tagging schemes:

- No tagging
- Single tagging (IEEE 802.1Q VLAN tagging)
- Double tagging (VPN tagging, IEEE 802.1ad VLAN tagging)
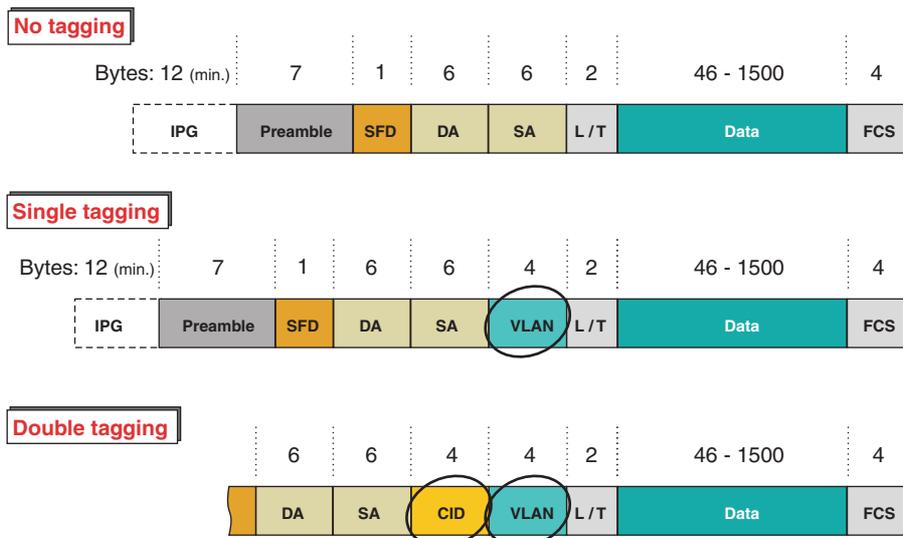
Ethernet mapping schemes

Introduction

1643 AM and 1643 AMS support the following schemes for the mapping of Ethernet packets into SDH frames:

- Link Access Procedure SDH (LAPS encapsulation)
- Ethernet over SDH (EoS encapsulation)
- Generic Framing Procedure (GFP encapsulation)

LAPS encapsulation

LAPS encapsulation is implemented according to ITU-T X.86. It is supported when using the option card X8PL.

EoS encapsulation

EoS encapsulation is implemented according to T1X1.5/99-268. It is supported when using the option card X4IP.

GFP encapsulation

GFP encapsulation is implemented according to T1X1.5/2000-147. It is supported when using the option cards X8PL or X4IP.

GFP provides a generic mechanism to adapt traffic from higher-layer client signals over a transport network.

The following GFP encapsulation are possible:

- Mapping of Ethernet MAC frames into Lower Order SDH VC12–Xv
- Mapping of Ethernet MAC frames into Lower Order SDH VC3–Xv

TUG structure

For X8PL, it is possible to set the TUG structure of the VC4 that runs to the option board. The TUG structure determines what VC12s/VC3s are available for assignment to a VCG. The method of setting the bandwidth of a VCG has also been modified. For X8PL it is not possible to modify the bandwidth parameter of a VCG. Instead VC12s/VC3 have to be allocated to a certain VCG, the total combined bandwidth of the allocated VCs is reflected in the bandwidth parameter of the VCG.

The TUG structure of the VC4 running to the option board also determines the possible cross-connections to the X8PL unit.

VC12-Xv GFP encapsulation

The 1643 AM and 1643 AMS support virtual concatenation of Lower Order SDH VC-12 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET

network. This is noted VC12-Xv, where X = 1...5 when using the X4IP option card and X = 1...63 when using the X8PL option card.. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000).

Additionally, the use of G.707 Extended Signal Label is supported using V5 (bits 5-7) field.

VC3-Xv GFP encapsulation

The 1643 AM and 1643 AMS support virtual concatenation of Lower Order SDH VC-3 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC3–Xv, where X = 1,2 (SDH). *For X8PL also VC3-3v is supported.* Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000) and T1X1 T1.105 Clause 7.3.2 (2001 Edition).

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Ethernet engineering rules and guidelines

Overview

Purpose

This chapter contains provisioning information as well as specific engineering rules and guidelines.

Contents

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Port provisioning

Customer-role and network-role ports

The user can assign a so-called "port role" to WAN ports as well as to LAN ports. In this way it is possible to forward VLAN tags , especially in double-tagging mode, also via LAN ports. Additionally it is possible to run the STP and GVRP protocols on physical LAN ports, too.

Each LAN port or WAN port can have one of the following port roles:

Customer role	Customer-role ports are usually located at the edge of the switched *TransLAN®* network boundary, providing the Ethernet interface to the end-customer. Ethernet frames may be but need not necessarily to be tagged.
	In the majority of cases, LAN ports are customer-role ports. However, two LAN ports connected via an Ethernet LAN link would be an example of network-role LAN ports. Another example would be a trunking LAN port connected via an Ethernet LAN link to an ISP router (where VLAN tags are needed for further processing).
Network role	Network-role ports usually interconnect the nodes that make up the *TransLAN®* network. Ethernet frames need to be tagged.
	In the majority of cases, WAN ports are network-role ports. However, a WAN port which is connected to an Ethernet private line unit (EPL unit), thus extending the switched *TransLAN®* network boundary, would be an example of a customer-role WAN port.

The following figure serves to visualize the concept of customer-role and network-role ports.

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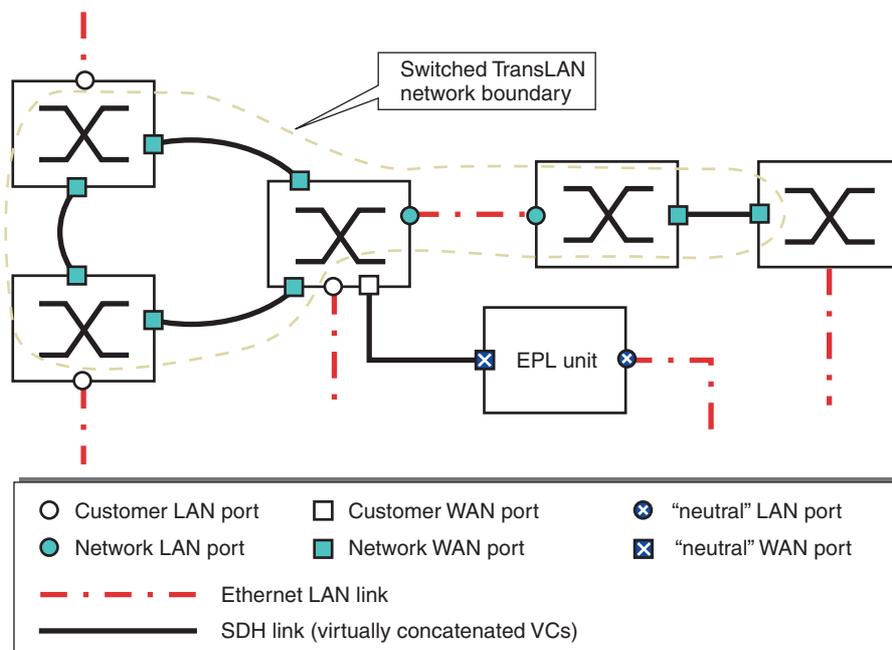
Flexible port role assignment

In most cases physical LAN ports have the customer role and physical WAN ports have the network role, but there may be exceptions in some applications. In the following figure the WAN port connects an EPL link and is therefore at the edge of the *TransLAN®* network. Thus it has the customer role in this case.
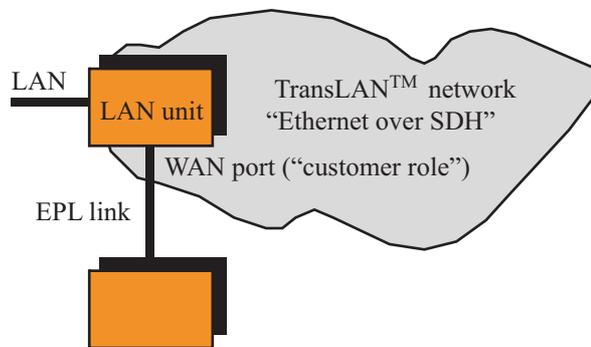
In the example in the figure below the VLAN tags have to be forwarded to a router. The router uses the tagging information for its switch decisions. Additionally the LAN port must fulfil a network role. In this case it behaves like a node of the *TransLAN®* network. It could also participate in the STP in order to avoid loops, if there was another link from a Router LAN interface to a second node within the *TransLAN®* network.
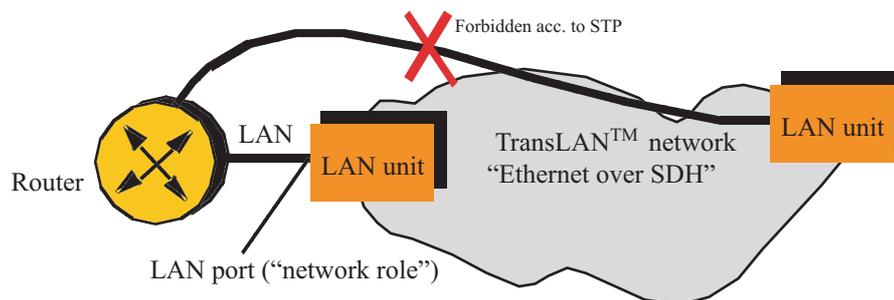
A LAN port which operates in the "network role" behaves like a WAN port in terms of VLAN tagging, STP and GVRP.

The default settings are shown in the following table

	Physical ports	
Port role	**LAN port**	**WAN port**
Customer role	default	
Network role		default

In the IEEE 802.1Q STP virtual switch mode and in the provider bridge mode, the port role of each LAN and WAN port can be flexibly assigned. Each LAN or WAN port can be configured to be either a customer-role or network-role port.

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Ethernet engineering rules and guidelines

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These are the characteristics of customer-role and network-role ports:

Customer-role port	Network-role port
In the *IEEE 802.1Q STP virtual switch mode*: In the ingress direction, untagged Ethernet frames are tagged with a default identifier, the port VLAN identifier (PVID). The PVID is removed from each frame at each network egress port. See also: "IEEE 802.1Q VLAN tagging" (p. 11-38) In the *provider bridge mode*: A provider bridge tag carrying a customer identifier (CID) is inserted into each Ethernet frame in the ingress direction, and removed from the frame in the reverse direction. Frames that are already tagged become double tagged. See also: "IEEE 802.1ad VLAN tagging" (p. 11-38)	No tagging or untagging operations are performed.
The spanning tree protocol (STP) is *not* supported.	The spanning tree protocol (STP) can be enabled (default setting) or disabled.
GVRP is *not* supported. VLAN IDs or CIDs need to be configured manually.	GVRP can be enabled (default setting) or disabled. Dynamic VLAN IDs or CIDs of intermediate and access nodes are automatically configured if GVRP is enabled.
Ingress rate control exists at customer-role ports only (see "Quality of Service (QoS) overview" (p. 11-51)).	There is no rate control on network-role ports. The traffic class encoded in the p1 and p2 bits of the incoming frames is evaluated and transparently passed through.

Fix port-role assignment in the VPN tagging modes

In all the operational modes relying on the VPN tagging mode (see "Transparent tagging" (p. 11-37)) the port role is fixed:

- LAN ports are *always* customer role ports.
- WAN ports are *always* network role ports.

This port-role assignment in the VPN tagging modes cannot be changed. Corresponding provisioning options that might be available on the graphical user interfaces of the management systems do not apply to the VPN tagging modes and are blocked.

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Repeater mode

In the repeater mode, there is no necessity to distinguish between customer-role and network-role ports, because the repeater mode can only be used in point-to-point configurations, and there is:

*   no tagging mechanism,
*   no spanning tree, and
*   no GVRP or STVRP.

In the repeater mode, there is simply a LAN port and a WAN port. The LAN port provides the connection to the end-customer LAN, and the WAN port provides the connection to the SDH transport network (see).

Example

As an example, the following figure shows a possible network application:
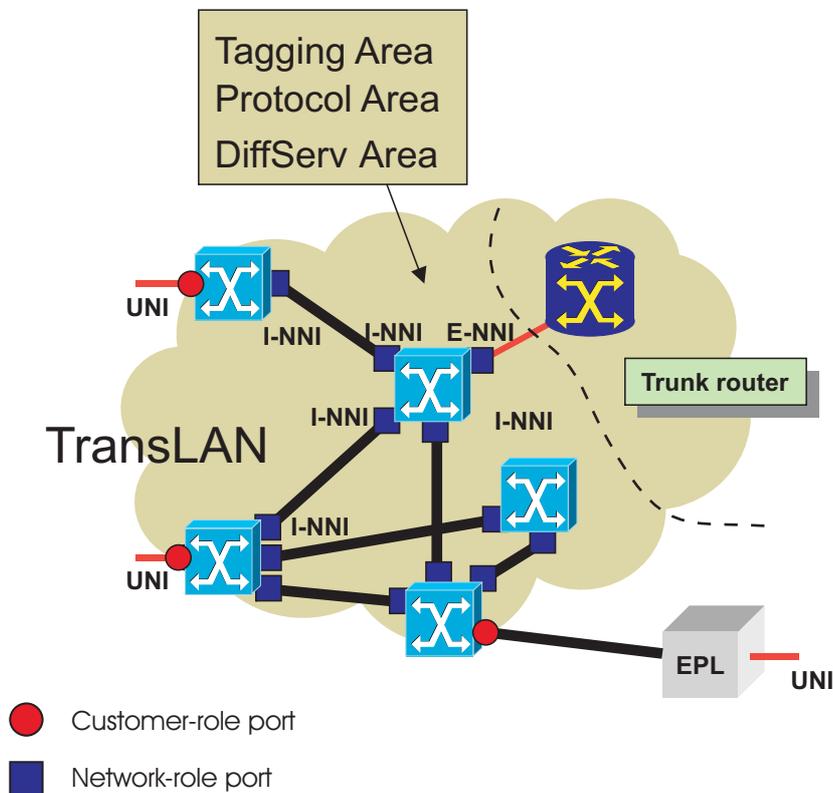
Legend:

UNI port	User-Network-Interface (always a customer-role port)
I-NNI port	Internal Network-Network Interface (always a network-role port)
E-NNI port	External Network-Network Interface (here a trunking network-role port)

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Ethernet WAN port mapping

The following table shows the mapping of WAN ports to termination points (TP) for X4IP and LKA4 port units. The LKA4 port unit belongs to the former *Metropolis*® products. With this mapping, interworking between these products is possible. The mapping is fixed and cannot be altered. X4IP are 4-port units, whereas LKA4 is an 8-port unit. WAN ports 5 through 8 at LKA4 utilize identical mapping as respective WAN ports 1 trough 4. In case the units in service do not use the same termination points adaptation via the LO cross connect is required.

Capacity	WAN port 1 / WAN port 5		WAN port 2/ WAN port 6		WAN port 3/ WAN port 7		WAN port 4/ WAN port 8	
	LKA4 LJB459	X4IP	LKA4 LJB459	X4IP	LKA4 LJB459	X4IP	LKA4	X4IP
100 Mbit/s	TP100	TP100	-	-	-	-	-	-
	TP200	TP200	-	-	-	-	-	-
50 Mbit/s	TP100	TP100	TP200	TP200	-	-	-	-
10 Mbit/s	TP311	TP311	TP323	TP361	TP342	TP342	TP361	TP323
	TP312	TP321	TP331	TP371	TP343	TP352	TP362	TP333
	TP313	TP331	TP332	TP312	TP351	TP362	TP363	TP343
	TP321	TP341	TP333	TP322	TP352	TP372	TP371	TP353
	TP322	TP351	TP341	TP332	TP353	TP313	TP372	TP363
8 Mbit/s	TP311	TP311	TP323	TP361	TP342	TP342	TP361	TP323
	TP312	TP321	TP331	TP371	TP343	TP352	TP362	TP333
	TP313	TP331	TP332	TP312	TP351	TP362	TP363	TP343
	TP321	TP341	TP333	TP322	TP352	TP372	TP371	TP353
6 Mbit/s	TP311	TP311	TP323	TP361	TP342	TP342	TP361	TP323
	TP312	TP321	TP331	TP371	TP343	TP352	TP362	TP333
	TP313	TP331	TP332	TP312	TP351	TP362	TP363	TP343
4 Mbit/s	TP311	TP311	TP323	TP361	TP342	TP342	TP361	TP323
	TP312	TP321	TP331	TP371	TP343	TP352	TP362	TP333
2 Mbit/s	TP311	TP311	TP323	TP361	TP342	TP342	TP361	TP323

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....

In accordance with the SDH multiplexing scheme, the termination point (TP) assignment of the VC-12 and VC-3 tributaries is as follows: [TPabc]

....
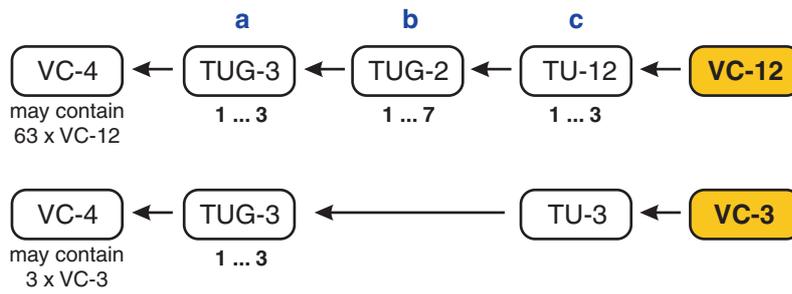
Quality of Service (QoS) overview

Introduction

Quality of service (QoS) control allows to differentiate between Ethernet frames with different priorities. If traffic with a high priority and traffic with a low priority compete for SDH capacity, the traffic with the high priority should be served first. This can be realized through quality of service control.

QoS control is supported on the E/FE and Gigabit Ethernet cards, in the IEEE 802.1Q VLAN tagging mode and the IEEE 802.1ad VLAN tagging mode (provider bridge mode). QoS control is implemented as a DiffServ architecture applied to layer 2 (in accordance with IETF recommendations on Differentiated Services, cf. *www.ietf.org*).

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Flow classification, queueing and scheduling

The following figure provides an overview of the QoS control:
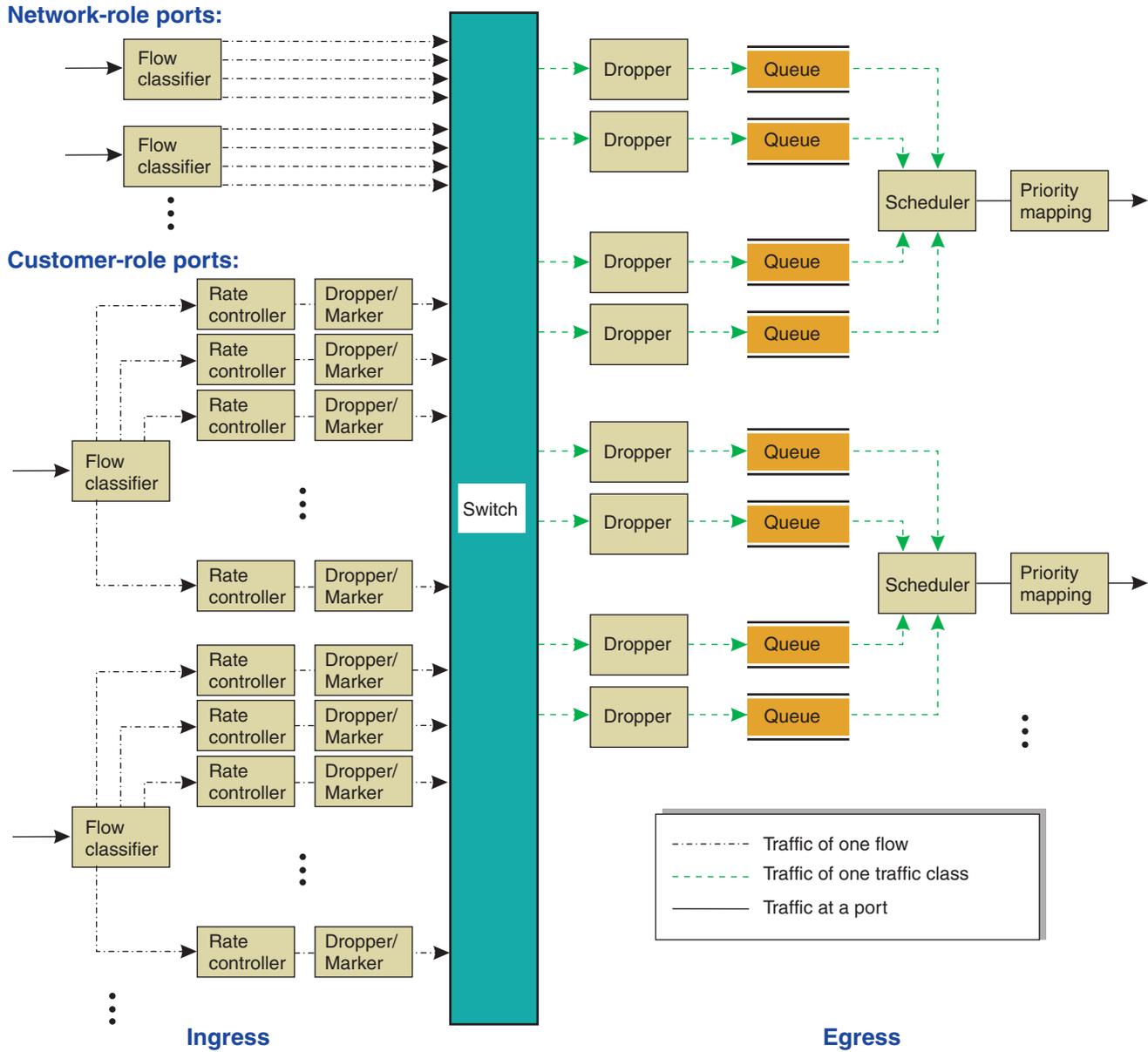
Quality of Service configuration options

The following table gives on overview of the QoS provisioning options depending on the configured mode of operation.

Mode of operation	Ethertype (hex. value)	QoS CQS	QoS_osub	Ingress rate control	HoL blocking prevention
Repeater mode	–	[disabled]	[disabled]	[none]	[disabled]

Mode of operation		Ethertype (hex. value)	QoS CQS	QoS_osub	Ingress rate control	HoL blocking prevention
VPN mode	LAN interconnect	[0xFFFF]	[disabled]	[disabled]	[none]	[disabled]
	LAN-VPN	[0xFFFF]	[disabled]	[enabled]	strict policing	[enabled]
					oversubscription	
	LAN-VPN with QoS	This mode of operation was supported in previous releases. However, it is no longer supported in the 1643 AM release 4.0.				
IEEE mode	STP virtual switch mode compliant with *IEEE 802.1Q*	0x8100	[enabled]	disabled	strict policing	[enabled]
				enabled	strict policing, oversubscription	
	STP virtual switch mode compliant with *IEEE 802.1ad* (Provider bridge mode)	0x0601 … 0xFFFF ($\neq$ 0x8100)	[enabled]	enabled	strict policing, oversubscription	[enabled]

Notes:

1. QoS CQS: Quality of Service - Classification, Queueing and Scheduling

2. "QoS_osub" represents a configuration parameter which determines if the encoding and evaluation of the dropping precedence is supported (supported if QoS_osub is enabled).

3. Entries in square brackets indicate an implicit selection. If in the "QoS CQS" column for example the entry is "[disabled]", then the preceding selection of tagging and operation mode implies that Quality of Service - Classification, Queueing and Scheduling (QoS CQS) is not available. It is implicitly disabled, and cannot be enabled.

4. The Ethertype can be set per virtual switch. However, as all virtual switches of a *TransLAN*® card are switched in common, it is effectively set per *TransLAN*® card.

5. The distinction between the STP virtual switch mode compliant with IEEE 802.1Q and the STP virtual switch mode compliant with IEEE 802.1ad (provider bridge mode) can be realized by provisioning the Ethertype. In the STP virtual switch mode compliant with IEEE 802.1Q, the Ethertype is fix preset to 0x8100. In the provider bridge mode, the Ethertype can be provisioned in the range 0x0600 … 0xFFFF, but unequal to 0x8100.

6. If "HoL blocking prevention" is enabled then frames that are destined for an uncongested port will not be discarded as a result of head-of-line blocking.

Ingress rate control provisioning method

If Quality of Service - Classification, Queueing and Scheduling (QoS CQS) is enabled, then ingress rate control can be provisioned per flow by using QoS profiles (see "Quality of Service provisioning" (p. 11-63)). Otherwise, ingress rate control can only be provisioned per port.

Service level agreements

On the 1643 AM the responsibility for admission control is left to the operator. This means there is no check that the Service Level Agreements on already existing connections can be fulfilled, when a new user starts sending data from node A to B.

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In this respect the notion of over-subscription factor is important. This is the factor by which the calculated bandwidth, based on e.g. the traffic matrices of the operators sharing a link, exceeds the physically available bandwidth. Although theoretically the bandwidth can only be guaranteed for an over-subscription factor ≤ 1, in practice an over-subscription factor of 5-10 can be used without giving problems. Due to the effects of statistical multiplexing it is safe to "sell the bandwidth more than once". The burstiness of the traffic from individual customers that share a common link makes this possible. The Service Level Agreements give a quantification for the "statistics" of the multiplexing.

Provisioning LAN and WAN ports details

The provisioning of the classifier and rate controller per flow is done only on the ingress customer-role port (LAN port). On the network ports (WAN port), only the scheduler for the egress queues is provisionable.

It is important that some of the QoS settings are provisioned consistently on all ports throughout the whole customer's VPN domain. In the LAN-VPN (M-LAN) operation mode, the rate controller mode (none, strict policing, oversubscription) must be provisioned consistently (per virtual switch). The latter applies to the only. For the scheduler, for each egress queue the mode = strict_priority/weighted_bandwidth and corresponding weights (per virtual switch) must be provisioned consistently. This is ensured by a background aging function of the system. The parameter will be enforced to be set equally.

Classification, queueing and scheduling

Flow classification

The flow classifier determines into which flow each incoming packet is mapped. On customer-role ingress ports, a number of flows can be defined, based on port, user priority, VLAN ID, IP-ToS field and destination MAC address. For each flow a rate controller can be specified (CIR/PIR value).

Apart from these flows based on input criteria, a default flow is defined for packets that do not fulfil any of the specified criteria for the flows, e.g. untagged packets that have no user priority field. Thus, untagged traffic is classified per port. All traffic on a certain port is treated equally and attached a configurable default port user priority value to map the traffic on the appropriate queues.

A default user priority can be specified on port level to be added to each packet in the default flow (see "Default user priority" (p. 11-58)). Furthermore, the rate controller behaviour for the default flow can be specified. The same fixed mapping table from user priority to traffic class to egress queue is applied to packets in the default flow as to packets in the specified flows.

Provided that Quality of Service - Classification, Queueing and Scheduling (QoS CQS, cf. "Quality of Service configuration options" (p. 11-52)) is enabled, each flow can be assigned a traffic class by using QoS profiles (see "Quality of Service provisioning" (p. 11-63)).

Each traffic class is associated with a certain egress queue (see "Traffic class to queue assignment" (p. 11-60)).

Ingress direction for network-role ports

For network-role ports, two cases need to be differentiated:

- On *I-NNI ports*, explicit provisioning of the flow identification (flow configuration) is not provisionable. I-NNI ports always have the default QoS profile assigned. On an I-NNI port, the only purpose of the flow classifier is to evaluate the traffic class. The traffic class determines the egress queue.

- *E-NNI trunk ports* may be split in so-called virtual ports which can be provisioned by means of virtual port descriptors (VPDs). Explicit provisioning of the flow identification (flow configuration) enables the DiffServEdge function for this fraction of the network-role port. Ingress rate control of these virtual ports is the same as for customer-role ports.

Ingress rate control

Ingress rate control is a means to limit the users access to the network, in case the available bandwidth is too small to handle all offered ingress packets.

A rate controller has two parameters, a provisionable committed information rate CIR (or PIR, if CIR = 0, see below), and a committed burst size (CBS). The committed burst size is the committed information rate multiplied by 0.11 seconds.(CBS = 0.11 seconds × CIR).

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Rate control is supported for every ingress flow on every customer-role port. There is one rate controller per flow. A "color unaware one-rate two-color marker" is supported, which can be seen as a degenerate case of the two-rate three-color marker. "Color unaware" means that the rate controller ignores and overwrites any dropping precedence given by an upstream network element (network-role ports with DiffServEdge function (E-NNI) only).

The rate controller is accurate within 5% of the rates specified for the CIR and PIR. The rate metering comprises the whole Ethernet MAC frame. Products may deviate from this and count only the IP package size. The rate controller measurement accuracy is optimized for long frame traffic. Shorter frames are underestimated. Thus, it is recommended to dimension the transporting network to have always a headroom of at least 10% bandwidth compared to the committed information rate (CIR) provisioned.

A two-rate three-color marker is defined by three colors, specifying the dropping precedence, and two rates as delimiter between the colors. The marker will mark each packet with a certain color, depending on the rate of arriving packets, and the amount of credits in the token bucket. The size of the token bucket will determine how long and far a data burst may be surpassed before the packets are marked with a higher dropping precedence.

The three colors indicate:

- *Green:* Low dropping precedence.
- *Yellow:* Higher dropping precedence.
- *Red:* The packet will be dropped.

The two rates mean:

Committed Information Rate (CIR)	The committed information rate is the delimiter between green and yellow packets.
	If the information rate is less than the committed information rate, all frames will be admitted to the egress queues. These frames will be marked "green", and have a low probability to be dropped at the egress queues.
Peak Information Rate (PIR)	The peak information rate is the delimiter between yellow and red packets.
	If the information rate is greater than the committed information rate (CIR), but less than the peak information rate (PIR), the frames will be admitted to the egress queues. They will be marked "yellow" and have a high probability to be dropped ("high dropping precedence").
	If the information rate is greater than the PIR, the frames will be marked "red" and dropped immediately.
	For the LAN-VPN (M-LAN) operation mode the relationship between CIR and PIR is determined by the rate control mode.
	For the IEEE 802.1Q STP virtual switch mode and the provider bridge mode the relationship is as specified in the assigned QoS profile. Note that on the LKA4 unit, any PIR is interpreted as infinite (if not: CIR=0, or CIR=PIR).

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Important! Provisioning of rate controllers does not apply to network-role ports (see "Quality of Service (QoS) overview" (p. 11-51)).

In general, the behavior of the rate controller is characterized as follows:

- All packets below CIR are marked green.
- All packets above CIR are marked yellow.
- All packets above PIR are marked red and dropped.

In case oversubscription support is disabled (QoS_osub = disabled), then the provisioning of the PIR is ignored and system-internally the value of the CIR is taken instead. This leads to a strict policing of all flows entering at a customer-role port of this VS.

Rate control modes

The rate controller can operate in two different modes:

1. Strict policing mode (CIR = PIR)

The strict policing mode allows each user to subscribe to a minimum committed SDH WAN bandwidth, or CIR (committed information rate). This mode will guarantee the bandwidth up to CIR but will drop any additional incoming frames at the ingress LAN port that would exceed the CIR.

All packets below CIR are marked green; all packets above PIR (= CIR) are marked red and dropped.

$$CIR = PIR \le MAX$$

0 kbit/s   CIR=PIR

green   red   Information rate
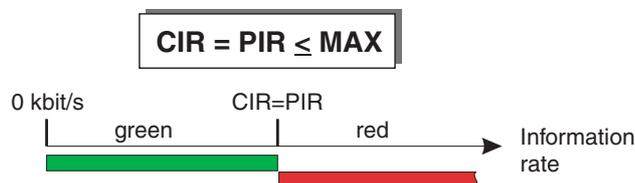
2. Oversubscription mode (CIR < PIR)

The oversubscription mode allows users to burst their data flow to a maximum available WAN bandwidth at a given instance. When PIR is set equal to the maximum of the physical network port bandwidth, then a user is allowed to send more data than the specified CIR. The additional data flow above CIR has a higher dropping probability.

The following two cases can be differentiated in oversubscription mode.

$$0 < CIR < PIR = MAX$$

0 kbit/s   CIR

green   yellow   Information rate

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$$0 = CIR < PIR < MAX$$

(CIR)
0 kbit/s   PIR

|___ yellow ___|___ red ___|→ Information
                                rate
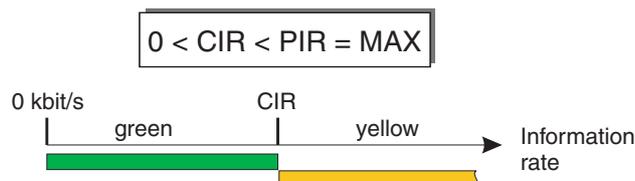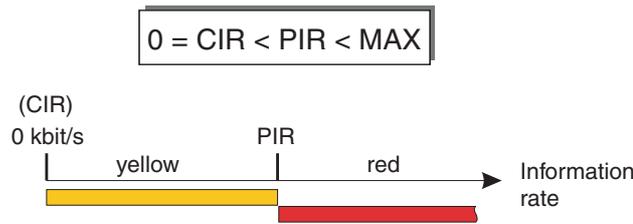
Provisioning the rate control mode

The desired rate control mode can be chosen by enabling/disabling oversubscription support (QoS_osub = enabled/disabled), and by setting the CIR and PIR values. CIR and PIR values can be set by means of QoS profiles (see "Quality of Service provisioning" (p. 11-63)).

The setting of the QoS_osub configuration parameter in combination with the relationship between CIR and PIR determines which rate control mode becomes effective. If, for example, oversubscription support is enabled, and the relationship between CIR and PIR is CIR = PIR ≤ MAX, then the rate controller is operated in strict policing mode.

Important!

1. Which of the rate control modes can actually be configured depends on the mode of operation (see "Quality of Service configuration options" (p. 11-52)).

2. As a general rule it is recommended to use the oversubscription mode for TCP/IP applications, especially in case of meshed or ring network topologies where multiple end-users share the available bandwidth.

Dropper/Marker

Based on the indication of the rate controller, and the rate control mode for the flow, the dropper/marker will do the following:

	No rate control	Oversubscription mode	Strict policing mode
Incoming rate < CIR	mark "green"	mark "green"	mark "green"
Incoming rate > CIR	mark "green"	mark "yellow"	drop

In the dropper function a decision is made whether to drop or forward a packet. On a *TransLAN*® card a deterministic dropping from tail when the queue is full is implemented. Packets that are marked red are always dropped. If WAN Ethernet link congestion occurs, frames are dropped. Yellow packets are always dropped before any of the green packets are dropped. This is the only dependency on queue occupation and packet color that is currently present in the dropper function. No provisioning is needed.

Default user priority

A default user priority can be configured for each customer-role port. Possible values are 0 (lowest priority) … 7 (highest priority) in steps of 1. The default setting is 0.

Provisioning of the default user priority does *not* apply to network-role ports.

The default user priority is treated differently depending on the taggging mode:

- LAN-VPN (M-LAN) mode

   Incoming frames without a user priority encoding (untagged frames) are treated as if they had the default user priority.

- IEEE 802.1Q VLAN tagging mode and provider bridge mode

   Incoming frames without a user priority encoding (untagged frames) get a default user priority assigned. This C-UP may be equal to a user priority given by one of the provisioned flow descriptors. The subsequent traffic class assignment for this flow, however, will overwrite this C-UP bits again.

Traffic classes

At each ingress port, the traffic class (TC) for each frame is determined. At customer-role ports, this is done via the flow identification and the related provisioned traffic class. At network-role ports, the traffic class is directly derived from the p-bits of the outermost VLAN tag.

Depending on the operation mode, these traffic classes exist:

Provider bridge mode and IEEE 802.1Q VLAN tagging mode *with* encoding of the dropping precedence	The traffic class is encoded in the user priority bits using p2 and p1. Thus, 4 traffic classes are defined: 0, 1, 2, 3.
IEEE 802.1Q VLAN tagging mode *without* encoding of the dropping precedence	The traffic class is encoded in the user priority bits using p2, p1, and p0. Thus, 8 traffic classes are defined: 0, 0-, 1, 1-, 2, 2-, 3, 3-. The "n" traffic classes differ from the "n-" traffic classes in the value of the p0 bit.

Notes:

1. The support of dropping precedence encoding and evaluation can be enabled or disabled per virtual switch by means of the QoS_osub configuration parameter (QoS_osub = enabled/disabled). All virtual switches belonging to the same *TransLAN*® network must be provisioned equally for their TPID and this QoS_osub configuration parameter. These tables show the traffic class encoding in the user priority bits:

With oversubscription:

Traffic class	p2	p1
0	0	0
1	0	1
2	1	0
3	1	1

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Without oversubscription:

Traffic class	p2	p1	p0
0	0	0	1
1	0	1	1
2	1	0	1
3	1	1	1
0-	0	0	0
1-	0	1	0
2-	1	0	0
3-	1	1	0

For the IEEE 802.1Q VLAN tagging mode with oversubscription support (QoS_osub = enabled) it is recommended not to use the n- classes, otherwise all frames will always be marked yellow (i.e. they will have a higher dropping precedence; p0 = 0). In the provider bridge mode, any assignment of an n- class will be recognized as the related n class (tolerant system behavior for inconsistent provisioning).

Traffic class to queue assignment

The assignment of the traffic classes to the egress queues is as follows:

Transparent tagging		IEEE 802.1Q VLAN tagging and IEEE 802.1ad VLAN tagging (provider bridge mode)	
Traffic class	**Queue**	**Traffic class**	**Queue**
3, and Internal use	4	Internal use	3
2	3	3 (and 3 -)	4
1	2	2 (and 2-)	2
0	1	1 (and 1-) and 0 (and 0-)	1

Notes:

1. "Internal use" means that the queue is used for network management traffic (spanning tree BPDU's or GVRP PDU's, for example).

Queueing

The egress treatment is the same for customer-role and network-role ports.

Every port has four associated egress queues. The queues 1 and 2 are to be used for delay-insensitive traffic (for instance file transfer); the queues 3 and 4 are to be used for delay-sensitive traffic (for instance voice or video).

Please refer to "Traffic class to queue assignment" (p. 11-60) for the assignment of the traffic classes to the egress queues.

Repeater mode

In the repeater mode, there is no queueing process as described above. All frames go through the same queue.

Scheduler

The preceding functional blocks assure that all packets are mapped into one of the egress queues, and that no further packets need to be dropped.

The scheduler determines the order, in which packets from the four queues are forwarded. The scheduler on each of the four queues can be in one of two operational modes, strict priority or weighted bandwidth. Any combination of queues in either of the two modes is allowed. When exactly one queue is in weighted bandwidth mode, it is interpreted as a strict priority queue with the lowest priority.

Provided that Quality of Service - Classification, Queueing and Scheduling (QoS CQS, cf. "Quality of Service configuration options" (p. 11-52)) is enabled, the queue scheduling method can be configured as follows:

Queue scheduling method	
Strict priority	The packets in strict priority queues are forwarded strictly according to the queue ranking. The queue with the highest ranking will be served first. A queue with a certain ranking will only be served when the queues with a higher ranking are empty.
	The strict priority queues are always served before the weighted bandwidth queues.
Weighted bandwidth	The weights of the weighted bandwidth queues will be summed up; each queue gets a portion relative to its weight divided by this summed weight, the so-called normalized weight. The packets in the weighted bandwidth queues are handled in a Round-Robin order according to their normalized weight.

Each of the two modes has his well-known advantages and drawbacks. Strict priority queues will always be served before weighted bandwidth queues. So with strict priority, starvation of the lower priority queues cannot be excluded. Starvation should be avoided by assuring that upstream policing is configured such that the queue is only allowed to occupy some fraction of the output link's capacity. This can be done by setting the strict policing rate control mode for the flows that map into this queue, and specifying an appropriate value for the CIR. The strict priority scheme can be used for low-latency traffic such as Voice over IP and internal protocol data such as spanning tree BPDU's or GVRP PDU's.

Weighted bandwidth queues are useful to assign a guaranteed bandwidth to each of the queues. The bandwidth can of course only be guaranteed if concurrent strict priority queues are appropriately rate-limited.

Usually the queue with the lowest number also has the lowest ranking order, but the ranking order of the strict priority queues can be redefined.

Important! It is recommended *not* to change the mode and ranking of the queue which is used by protocol packets like spanning tree BPDU's and GVRP PDU's (queue 3 or queue 4, respectively; cf. "Traffic class to queue assignment" (p. 11-60)).

Weight

A weight can be assigned to each port's egress queue in order to define the ranking of the queue.

The weight of a strict priority queue has a significance compared to the weight of other strict priority queues only.

The weight of a weighted bandwidth queue has a significance compared to the weight of other weighted bandwidth queues only.

The weights of the weighted bandwidth queues are normalized to 100%, whereas the normalized weights of the strict priority queues indicate just ordering.

Example

The following table shows an example of a scheduler table:

Queue	Queue scheduling method	Weight	Normalized weight
1	Weighted bandwidth	5	50%
2	Strict priority	9	1
3	Weighted bandwidth	5	50%
4	Strict priority	15	2

The strict priority queues are served before the weighted bandwidth queues. The strict priority queue with the highest weight is served first, queue 4 in this example.

In this example, after serving the strict priority queues 4 and 2, the remaining bandwidth is evenly divided over queues 1 and 3.

Depending on the mode of operation, queue 3 or queue 4 is used for network management traffic, for instance for the spanning tree protocol (see "Traffic class to queue assignment" (p. 11-60)). Hindering this traffic can influence Ethernet network stability.

Default settings

These are the default settings of the queue scheduling method and weight:

Queue	Queue scheduling method	Weight
1	Strict priority	1
2	Strict priority	2
3	Strict priority	3
4	Strict priority	239

Note: To ensure network stability (internal (r)STP BPDUs must arrive), queue 4 is served with strict priority scheduling with a fixed priority of 239.

Quality of Service provisioning

QoS provisioning concept

A 3-stage provisioning concept is used for QoS provisioning. This concept can easily be adapted to different provisioning needs in different network applications.
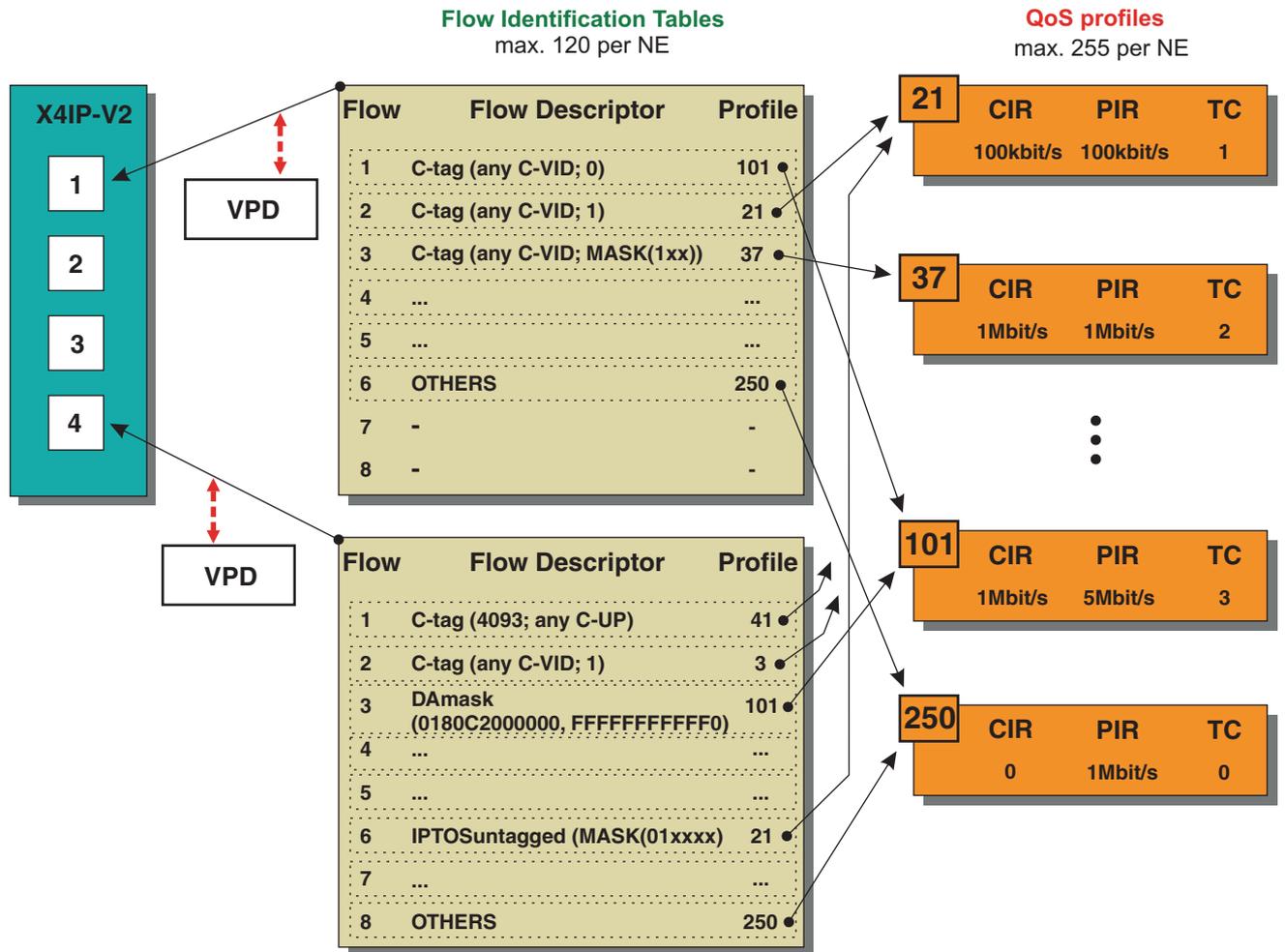
The basic QoS provisioning concept consists of the following stages:

1. For each *port* one or more customized flow identification tables (FIT) can be assigned.

   A flow identification table can be assigned either to an entire physical port, or to a fraction of a physical port, i.e. to a so-called "*virtual port*". Only E-NNI trunk ports can be split into virtual ports each having a flow identification table assigned. A virtual port can be defined by means of a virtual port descriptor (VPD).

   In case more than one flow identification table is assigned, each flow identification table is related to one virtual port. A flow identification table may also be related to several virtual ports, provided they are identified by the same virtual port descriptor (VPD).

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Up to 120 flow identification tables are supported per network element.

2. The *flow identification tables* contain the identification criteria for the flows ("flow descriptors").

Possible flow identification criteria (flow descriptors) are:

- The content of the C-tag, i.e. the values of the C-VID and/or C-UP: C-tag (C-VID; C-UP)
- The value of the IP-TOS (IP type of service) byte
- The MAC destination address (DA)

The possible values of the flow identification criteria are described with the provisioning procedure for the flow identification tables in the *1643 AM and 1643 AMS User Operations Guide*.

Furthermore, the flow identification tables contain a reference identifying the assigned QoS profile.

3. The *QoS profiles* contain the provisioning parameters:

- Committed information rate (CIR)
- Peak information rate (PIR)
- Traffic class (TC)

Using this method of QoS provisioning via QoS profiles can be enabled or disabled on a per-NE basis.

On a per-port basis you can decide to only use default QoS profiles, or to define your own QoS profiles in order to accomplish flow configuration.

Provisioning defaults

The parameter settings in the default QoS profiles for customer-role and network-role ports are:

Port role	CIR	PIR	TC
Customer-role	MAX	MAX	0
Network-role	MAX	MAX	T

The traffic class "T" is the so-called "transparent traffic class". The p-bits of the outermost tag (S-UP of the S-tag, or UP of the VLAN tag) remain unchanged, i.e. keep their value which has been assigned by a data unit anywhere upstream.

Explicit provisioning of the flow identification at network-role ports is only intended in the case of so called external network-network interfaces (E-NNIs) connecting to the network of other operators, or to trunking routers, respectively.

Performance monitoring

Performance counters

On the VC-12, VC-3 or VC-4 termination points connected to a WAN port, standard SDH performance monitoring can be activated. The same counters that apply for VC-12, VC-3 or VC-4 termination points on any other port also apply to the VC-12, VC-3 or VC-4 termination points on a WAN port.

Apart from this standard SDH performance monitoring, a limited amount of counters that are dedicated to LAN/WAN ports are defined. Activation of these counters can be established by setting:

- the LAN/WAN port mode to monitored
- selecting a LAN port or WAN port as active PM point
- setting the PM point type to LAN or WAN.

The supported counters are:

- *CbS (total number of bytes sent)*
- *CbR (total number of bytes received)*
- *pDe (total number of errored packets dropped)*

Note that CbS and CbR are rather traffic monitoring counters than performance monitoring counters, as they give insight in the traffic load in all places in the network. pDe is a real performance monitoring counter as it gives an indication about the performance of the network. Only unidirectional PM is supported for these parameters. See the following figure for the location of the measurements. Note that because of the difference in units, bytes versus packets, the counters cannot be correlated with each other. Also the counter for dropped packets considers only packets dropped due to errors, and does not include packets dropped due to congestion.
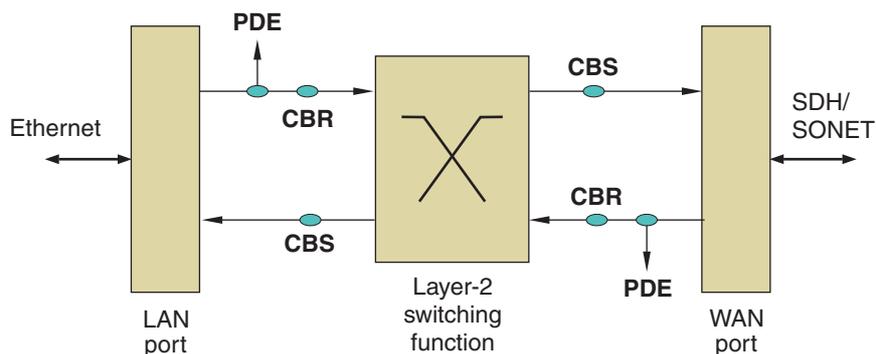
Ethernet PM History Bin

The 1643 AM/1643 AMS supports the Ethernet performance monitoring history bin and can be set to monitor sixteen performance monitoring criteria for 15 minute bins and one for 24 hour bins.

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The 1643 AM/1643 AMS supports the ITM-CIT to retrieve all SDH and Ethernet PM History bins including the 16 x 15 minute bins and 1 x 24 hour bins.

The following sections describe the Ethernet performance monitoring counters.

Enhanced Basic Ethernet PM Counters

The 1643 AM/1643 AMS supports byte and frame related performance monitoring per port. Users can select any individual LAN or WAN port that is terminated in the 1643 AM/1643 AMS for performance monitoring (including binning and thresholding). The following features are applicable to the X8PL, X4IP, and X5IP option cards.

The 1643 AM/1643 AMS supports the following PM counters for the X8PL, X4IP, and X5IP option cards:

- pCbR: Ethernet Incoming Number of Bytes
- pCbS: Ethernet Outgoing Number of Bytes
- eINF: Ethernet Incoming Frames
- eONF: Ethernet Outgoing Frames
- eINCP: Ethernet Incoming Bytes trapped by CPU (X4IP, X5IP option cards only)
- eONCP: Ethernet Outgoing Bytes trapped by CPU (X4IP, X5IP option cards only)
- ppDe: Ethernet Dropped Frames due to Error. Note that this counter also supports 'threshold' notification.
- eUPR: Ethernet Incoming Number of Unicast Frames (X8PL LAN ports only)
- eUPS: Ethernet Outgoing Number of Unicast Frames (X8PL LAN ports only)
- eMPR: Ethernet Incoming Number of Multicast Frames (X8PL LAN ports only)
- eMPS: Ethernet Outgoing Number of Multicast Frames (X8PL LAN ports only)
- eBPR: Ethernet Incoming Number of Broadcast Frames (X8PL LAN ports only)
- eBPS: Ethernet Outgoing Number of Broadcast Frames (X8PL LAN ports only)
- ePPR: Ethernet Incoming Number of Pause Frames received (X5IP and X8PL LAN ports only)
- ePPS: Ethernet Outgoing Number of Pause Frames transmitted (X5IP and X8PL LAN ports only)
- ePCR: Ethernet Incoming Number of Frame with CRC Error (X8PL LAN ports only)

The above features are only applicable to the X4IP, X5IP, and X8PL and option cards. However, the 'ePPR' and 'ePPS' parameters are not supported for the X4IP option card. Note that 'PAUSE' counters are only supported by LAN ports.

PM counters for high quality traffic load (per TC/port)

The 1643 AM/1643 AMS supports performance monitoring parameters for traffic management in 'bytes per traffic class' on ingress and egress ports. Users can select any individual TC per port that is terminated in the 1643 AM/1643 AMS for performance monitoring (including binning and thresholding).

The following PM counters are only applicable to the X4IP and X5IP option cards.

- g2EINB: incoming bytes of green frames with traffic class 2

- y2EINB: incoming bytes of yellow frames with traffic class 2

- g3EINB: incoming bytes of green frames with traffic class 3

- y3EINB: incoming bytes of yellow frames with traffic class 3

- g2EINF: number of incoming green frames with traffic class 2 (X4IP only)

- y2EINF: number of incoming yellow frames with traffic class 2 (X4IP only)

- g3EINF: number of incoming green frames with traffic class 3 (X4IP only)

- y3EINF: number of incoming yellow frames with traffic class 3 (X4IP only)

- c3EIN: incoming layer 1 payload bytes of green frames with traffic class 3 or internal (trapped) frames

- c2EIN: incoming layer 1 payload bytes of green frames with traffic class 3 or traffic class 2 or internal (trapped) frames

- i3gEILS: Loaded Second for incoming traffic with class 3 or internal traffic (supports threshold notification)

- i32gEILS: Loaded Second for incoming traffic with class 3 or class 2 or internal traffic (supports threshold notification)

- i3gEISLS: Severely Loaded Second for incoming traffic with class 3 or internal traffic (supports threshold notification)

- i32gEISLS: Severely Loaded Second for incoming traffic with class 3 or class 2 or internal traffic (supports threshold notification)

PM counters for low quality traffic load (per TC/port)

The 1643 AM/1643 AMS supports performance monitoring parameters for traffic management in 'bytes per traffic class' on ingress and egress ports. Users can select any individual TC per port that is terminated in the 1643 AM/1643 AMS for performance monitoring (including binning and thresholding).

The following PM counters are only applicable to the X4IP and X5IP option cards.

- g0EINB: incoming bytes of green frames with traffic class 0

- y0EINB: incoming bytes of yellow frames with traffic class 0

- g1EINB: incoming bytes of green frames with traffic class 1

- y1EINB: incoming bytes of yellow frames with traffic class 1

- g0EINF: number of incoming green frames with traffic class 0 (X4IP only)

- y0EINF: number of incoming yellow frames with traffic class 0 (X4IP only)

- g1EINF: number of incoming green frames with traffic class 1 (X4IP only)

- y1EINF: number of incoming yellow frames with traffic class 1 (X4IP only)

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PM counters for Ethernet service flow (per flow)

The 1643 AM/1643 AMS supports Ethernet service flow PM counters which provide performance monitoring for service flows. The flows are defined for QoS and CQS functions. These functions can be identified by the C/S-VID, C/S-UP, DMAC address or the IP-TOS byte. Users can select any individual flow that is terminated in the 1643 AM/1643 AMS for performance monitoring (including binning and thresholding).

The following PM counters display the Ethernet service flow on the X4IP and X5IP option cards unless indicated otherwise.

- aQIB: All incoming bytes for one service flow
- gQIB: Incoming bytes of all green marked frames for one service flow (X5IP only)

Note that this feature is only applicable to the X4IP and X5IP option cards.

End-to-end Ethernet PM - Round Trip Delay (RTD) measurement

The 1643 AM/1643 AMS supports end-to-end CPU in-band Round Trip Delay measurement using a retrieval function for the MAC-DA of the VS. Users can enable a repeated latency measurement to another network element in the TransLAN network using the MAC-DA, TC, the color (dropping precedence), and the V-LAN tag to identify the VS. The measured path follows the currently valid STP-topology. The RTD measurement accuracy is 4 ms.

Note that this feature is only available on the X4IP and X5IP option cards.

RTD PM Counters

The 1643 AM/1643 AMS supports Ethernet PM counters to display Ethernet RTD measurements.

The following counters are only supported on the X4IP and X5IP option cards.

- mRTD: Minimum round trip delay
- aRTD: Average round trip delay
- xRTD: Maximum round trip delay
- p900RTD: 90.0 percentile of round trip delay
- p990RTD: 99.0 percentile of round trip delay
- p999RTD: 99.9 percentile of round trip delay
- sRTDM: Number of successful round trip delay measurements
- uRTDM: Number of unsuccessful (timed out) round trip delay measurements.

The Ethernet PM counters should be counted in bits or frames. The accuracy of these counters is 1 ppm (10xE-6). This is applicable to all Ethernet counters on X4IP and X5IP option cards.

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12 SHDSL Overview

Overview

Purpose

This chapter describes the SHDSL principles and features realized for 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS

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SHDSL concepts

Overview

Purpose

This section describes the SHDSL principles which are supported by 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS.

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SHDSL configurations

Applications

There are two application possibilities for the SHDSL feature:

- End-user access for E1 via a E1 NTU (NT2M modem)

- End-user access for Ethernet using a 10Base-T or a 100-Base-TX interface via an Ethernet NTU (NT10ETH modem). There can be one to four parallel SHDSL links to each NTU providing 2.2 Mbit/s to 8.7 Mbit/s throughput. Each NT10ETH modem has 1 or 2 Ethernet ports towards the end-user

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS has to be equipped with an X12SHDSL-V2/V3 option card and is then operating as LTU (Line Termination unit). All ports of the X12SHDSL-V2/V3 option card operate either in the E1/SHDSL mode or in the TU12/SHDSL mode.

An E1 modem provides one E1 user interface and one single SHDSL link. This means a one-to-one correspondence between an LTU SHDSL port, the NT2M and the E1 end-user interface.

An NT10ETH modem has two 10/100BASE-T(X) interfaces and can have one to four parallel SHDSL links, that are all connected to the same X12SHDSL-V2/V3 option card.

Each SHDSL link can have up to two SHDSL Regenerator Units (SRUs) depending on the span connected to the LTU port. Each SRU supports one SHDSL link.

The following figure shows a network example with a 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS configured as LTU with 12 SHDSL links connected.
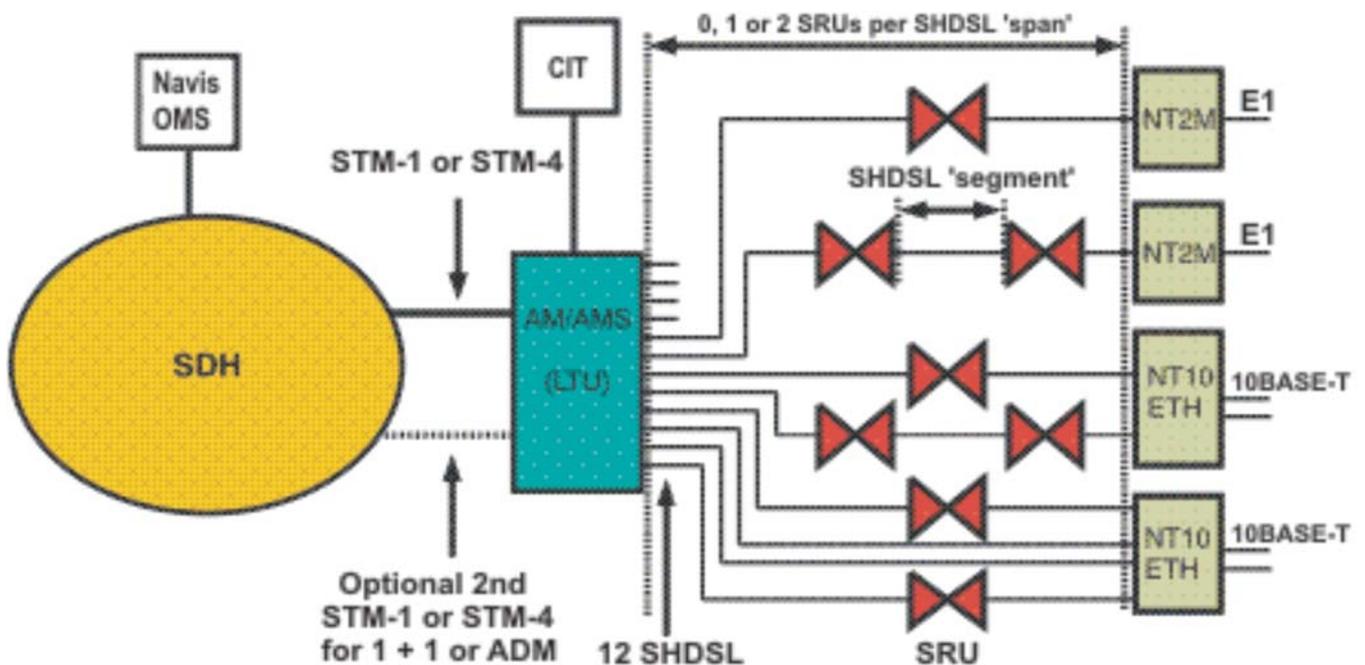
Interworking with third party equipment

1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS supports the following types of third party SHDSL equipment:

- E1 Network Termination Units (NTUs) for E1 over SHDSL
- E1 NTUs for TU-12 over SHDSL
- Ethernet NTUs
- SHDSL Regenerator Units (SRUs) (up to two per LTU port)

The following table gives an overview of the features support in dependence of the release and the SHDSL option card:

Releases 1.0 to 5.0/X12SHDSL option card (CC109177204)	Release 6.1/X12SHDSL-V2 option card (CC109579912) or X12SHDSLoption card (CC109177204) Release 7.2.11/X12SHDSL-V3 option card (CC109782565)	Release 6.1/X12SHDSL-V2 option card (CC109579912) Release 7.2.11/X12SHDSL-V3 option card (CC109782565)
support of TU-12 mode and E1 NTUs for TU-12 over SHDSL (NT2M)	support of TU-12 mode and E1 NTUs for TU-12 over SHDSL (NT2M)	SW download to NTU possible
support of E1 mode and E1 NTUs for E1 over SHDSL (NT2M)	support of E1 mode and E1 NTUs for E1 over SHDSL (NT2M)	
	support of Ethernet NTUs (NT10ETH)	SW download to NTU possible
	support of SRUs	SW download to SRU possible
support of a certain set of third party SHDSL equipment (for detailed information, please contact the local sales organisation of Alcatel-Lucent.)	support of a certain set of third party SHDSL equipment which is different from the one offered in previous releases (for detailed information, please contact the local sales organisation of Alcatel-Lucent.)	

Important! Please note that an in-service upgrade of the SHDSL option card from an older release to Release 6.1 and later versions is not possible. It is always necessary to unassign the X12SHDSL card completely, so that all connections are removed. Then the upgrade can be done and the X12SHDSL card can be assigned and configured from scratch.

E1 and TU12 payload mapping

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS LTU supports two types of payload mapping into the SHDSL signal:

- E1 mode, maps an E1 directly into the SHDSL signal
- TU-12 mode, maps a TU-12 containing a VC-12 into the SHDSL signal. The VC-12 may contain various signal types, e.g. E1, Ethernet data, etc.

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NTU management

> The third party NTU modems can be managed remotely. For this purpose a communication channel is reserved in the SHDSL overhead, called the EOC (Embedded Operations Channel). The message set ist defined in ITU-T Rec. G991.2. This message set deals with SHDSL layer aspects. Additionally there is a proprietary extension, here called EOC- ext. which addresses the non-SHDSL aspects of modem management. This proprietary message set enhances the standard EOC messages by messages covering the interface towards the end-user.

Naming system for SRUs and NTUs

> The LTU can manage up to 12 NTUs and 24 SRUs. In order to identify the particular SRU or NT quickly, a fixed naming scheme is to be used for NTU and SRU identification on the GUIs that allows easy recognition of the relative location of the device:

> Each NTU or SRU is identified with a four digit number prefixed with a string "SRU" or "NTU" depending on the object that is addressed.

> The first digit indicates the slot number in which the SHDSL unit is inserted in the LTU. For 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS this value is "2".

> The following two digits indicate the LTU port number, ranging from 01 to 12, corresponding with the TP 1 to TP12 numbering that is used on the X12 SBDSHL faceplate.

> The last digit can be "1", "2" or "3". The "1" is used for the NTU, while "2"and "3" are used for numbering the SRUs, starting from the SRU connected to the LTU and numbering incrementally in the direction of the NTU.

> For NT10ETH NTUs, the LTU port number connected to NTU port #1 is used.

> The following figure shows an example for the name assignment:

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Slot number of the SHDSL option card in the LTU (always "2")

LTU port number (01...12)

Device: NTU = "1", SRU = "2" or "3"

....
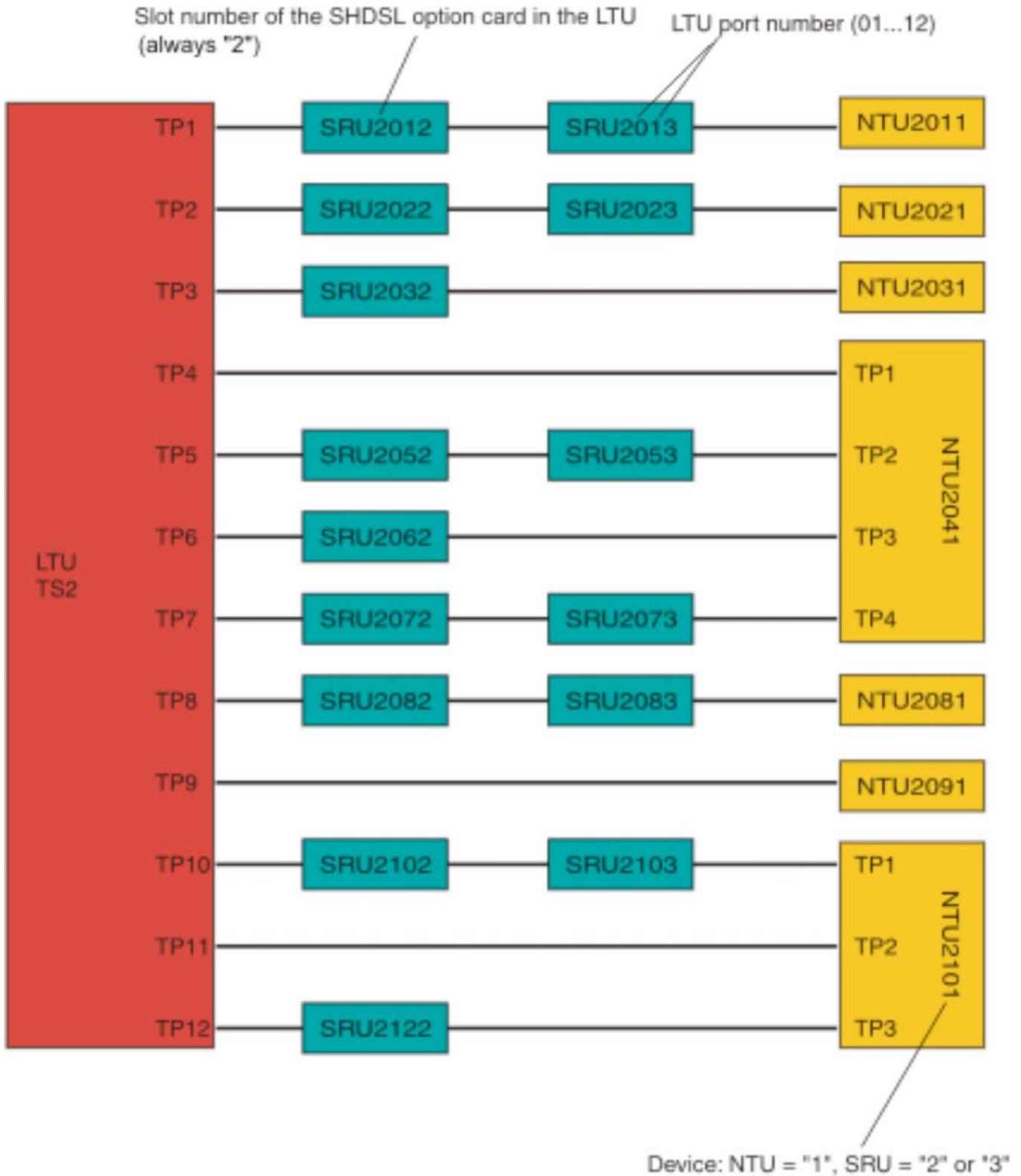
SHDSL frame structure

Purpose

This chapter explains the SHDSL frame structure.

General structure and overhead

An SHDSL line can transport a payload of max. 2312 kbit/s. The overhead of the SHDSL signal adds, nominally, 8 kbit/s to the payload rate which makes the overall maximum bitrate 2320 kbit/s.

The SHDSL signal is organized in frames with a nominal length of 6 ms, where each frame contains 4 payload blocks of $k = 12 \times (i + 8 \times n)$ bits each and, overall, nominally 48 overhead bits. But this number can also be 46 or 50 to allow for positive and negative stuff operations, to align the payload to the SHDSL line clock in case of asynchronous operation. The payload bits associated with the parameter i are often called "Z-bits".

The length of an SHDSL frame, expressed in bits, depends on the payload rate, so on the parameters n and i. The structure is always the same; the payload is divided in four equal blocks separated and surrounded by overhead bits as shown in the figure below.
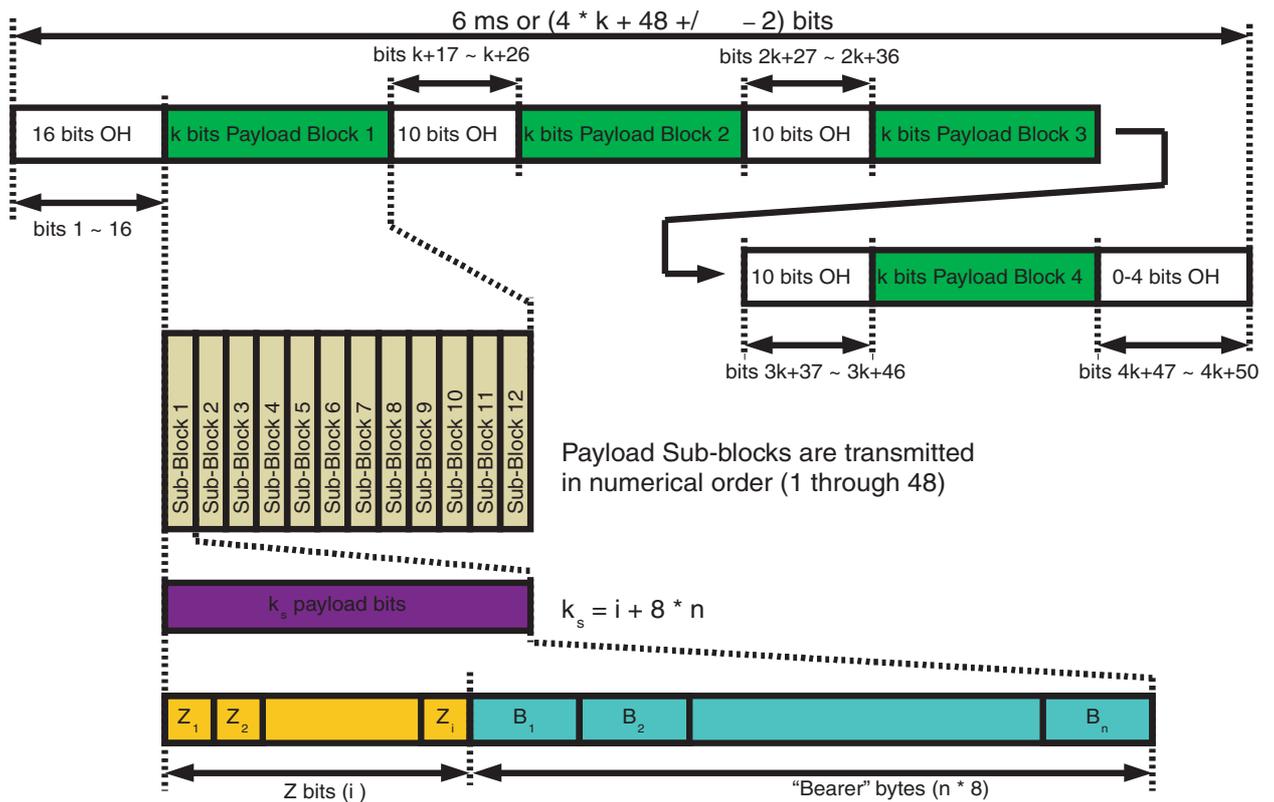
The SHDSL frame structure and the overhead bits are defined in ITU-T Rec. G.991.2.

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Payload mapping

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS LTU supports the "unaligned" E1 mapping according to ITU-T Rec. G991.2 and the TU-12 mapping.

The two mapping schemes are described in the following.

E1 mapping acc. to ITU-T Rec. G.991.2/Annex E.5, E.6 and E.7

The SHDSL standards define E1 over SHDSL mapping to use the parameters $n = 32$ and $i = 0$, i.e. there is no Z-bit channel and 32 bytes per SHDSL payload subblock, sufficient to hold 125 ms of E1 traffic. In the "unaligned" mode there is no further relationship between the position of the E1 bits and the SHDSL payload octets: An E1 frame can start anywhere, even in the middle of an octet position.

This mode is implemented asynchronously, i.e. the SHDSL bit-stuffing mechanism is used to accommodate the frequency differences between the SHDSL carrier, frequency locked to the LTU NE clock, and the E1 signal of which the timing is set by the NE that created this signal. In asynchronous mode each SHDSL frame has either four or zero stuff bits present. The long term average is such that the clock differences are exactly compensated.

TU-12 mapping

The TU-12 frame has a length of 144 octets or 500 µs. The octets are numbered according to the figure below:
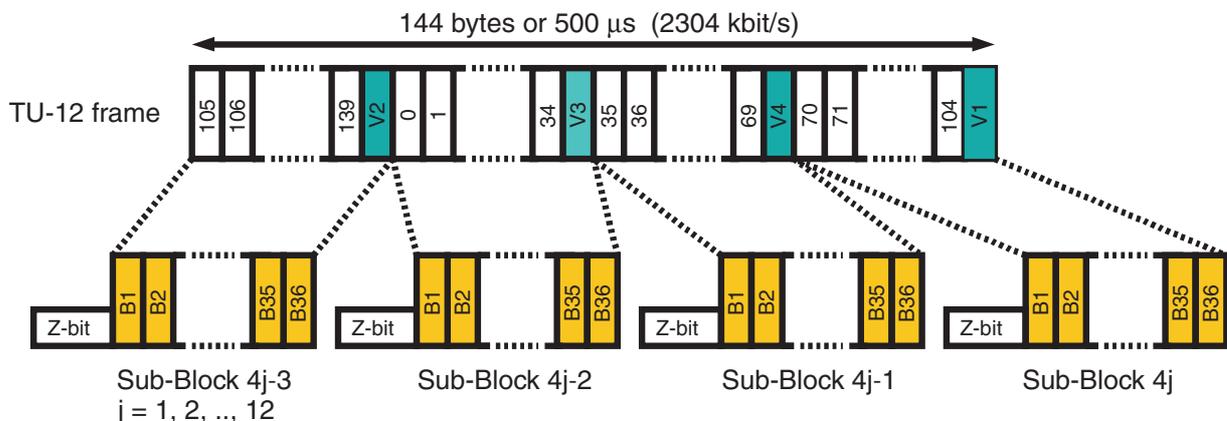
Each TU-12 frame is mapped into four subsequent subblocks with $n = 36$, using positions B1 through B36 in each sub-block. The first TU-12 frame uses subblocks 1 through 4, the second uses subblocks 5 through 8, all the way up to the 12th TU-12 frame in subblocks 45 through 48. The TU-12 mode operates synchronously, i.e. the SHDSL stuffing mechanism is not used and the SHDSL line clock and TU-12 payload clock are the same. They are both derived from the TG function in the LTU in the downstream direction. Since the NTU is supposed to operate in loop-timed mode, the same is true for the upstream signal. SRUs operate in through-timed mode, so the synchronisation keeps untouched.

Concatenation of SHDSL links

It is possible to combine the capacity of multiple SHDSL links that run in parallel. Thus the bandwidth of a link between LTU and NTU can be increased. Ethernet traffic of up to 8 Mbit/s can be transported via a VC-12-4v. The individual SHDSL links carry one TU-12 which contains one VC-12 member of the VC-12-4v group. The Ethernet frames are encapsulated using GFP (Generic Framing Procedure) before mapping into the VC-12-4v group. The LCAS protocol is used to dynamically control the size of the VC-12-4v group.

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Remote management and supervision of SHDSL devices

Purpose

This chapter describes the remote management of NTUs and SRUs which is controlled by the LTU.

EOC Management Reference Model

The LTU maintains an information database of all attached NTUs and SRUs for the purpose of configuration, performance and fault information retrieval or control by network management. All elements attached to an SHDSL span have to respond to queries made to them from other elements. The database in the LTU is considered the "master database". Conflicts between the entities in the SHDSL span are resolved in favour of the LTU. For 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS only communication initiated by the LTU is supported.

The alarm status of the SHDSL devices (NTU and SRUs) that are attached to an SHDSL port on the LTU is polled by the LTU in regular intervals. Polling is realized by means of EOC messages or by a combination of EOC and EOC-ext. messages (see below).

The following figure shows the reference configuration for management purposes:

N = "Network facing", C = "Customer facing"
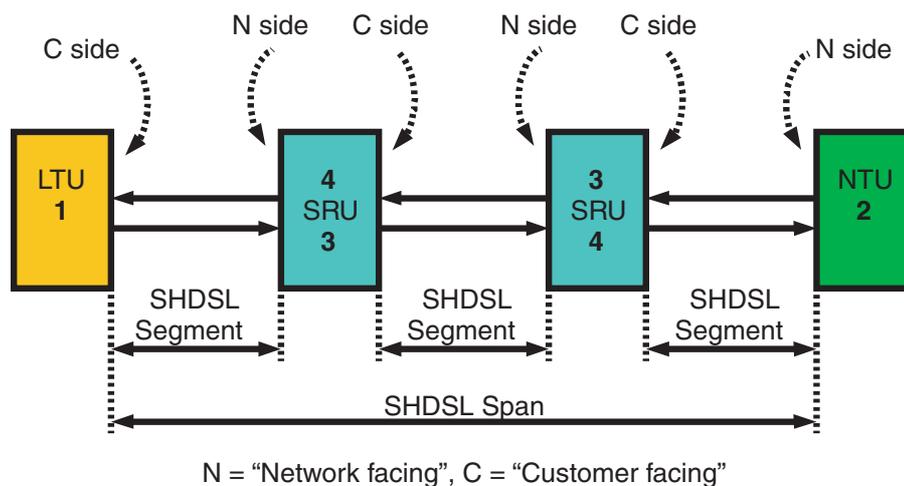
EOC messages

Management of the SRUs and NTUs is exercised via the Embedded Operations Channel (EOC) in the SDHSL overhead. The capacity of this channel is 20 bits per 6 ms frame or 3333 kbit/s. EOC messages are protected by a CRC16 code, appended in the last two octets of the message.

EOC addressing

The addressing scheme on the EOC can distinguish between the LTU, the NTU and up to 8 SRUs per SHDSL span. At most two SRUs per LTU port are possible. During a discovery phase, the number of SRUs and their addresses are established.

The detailed procedure for address discovery is described in clause 9.5.3 of ITU-T Rec. G.991.2. Note that SRUs can have different addresses in each direction of transmission.

Proprietary messages (EOC-ext.)

In addition to a subset of the G.991.2 (EOC) message set, a number of proprietary messages for remote management of SRUs and NTUs is supported. The reason for this proprietary addition is that the standard message set is only covering the SHDSL aspects of the service, but not the interface towards the enduser, which can be E1, ISDN-PRI, ISDN-LL or E/FE. In the following this additional message set ist called EOC-ext.

When the LTU processes an EOC-ext. message, it is already validated as an EOC message (correct CRC). The LTU only supports EOC-ext. commands and requests in the transmit direction and confirmation and response messages in the receive direction.

EOC management communication

The communication from the LTU to an SRU or an NTU goes through three distinct phases:

- Discovery phase:

  This is the initial phase where the presence of the SHDSL devices (NTU and SRUs) is detected. Additionally the EOC addresses are assigned and distributed.

- Inventory phase:

  This is the secondary phase where the inventory data from a discovered SHDSL device is collected. The LTU can determine the equipment type (SRU, NT2M or NT10ETH). and whether an NTU is already connected to the LTU via another SHDSL port.

- Operational phase:

  This phase is entered after the completion of the inventory phase of an SHDSL device. At the start of the operational phase and automatic configuration download to the NTu or SRU is initiated in case the target was discovered on the port before. Otherwise, the user has to provide a manual command to download the configuration. After that normal alarm and performance monitoring starts. On user request additional reconfiguration requests are possible.

Software download

Attached SHDSL devices that support the EOC-ext. message extension can be provided with new software images remotely from the NE. In the system the image is stored in a non-volatile memory. To initiate the software download a user command is needed. Once the software is successfully downloaded, a reset command needs to be issued to the SHDSL device in order to activate the new software image. Only one SW image for an NTU can be stored in the NE of at most 2 Mbyte.

The 1643 AM/1643 AMS supports the ITM-CIT and Alcatel-Lucent OMS to display a dynamic software download progress indicator per module. This module also indicates the software download percentage for the SHDSL module.

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Configuration download

The NE keeps in its MIB a copy of all (managed) configurational settings related to each attached SHDSL device. Upon user request these settings can be downloaded to the target device, causing the device settings to be synchronized with the NE MIB. Automatic download of the configuration happens after a power cycle of an SHDSL device or after an interruption of the link. The NE detects in both cases the same SHDSL device (same serial number etc.) to be present.

In case a new SHDSL device is detected on an LTU SHDSL port (i.e. different serial number etc.), you will be notified by means of a "new device detected" alarm. You then have the option to initiate a configuration download in order to download the configuration of a previously connected SHDSL device to the new SHDSL device (provided the new SHDSL device is of the same type).

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SHDSL features

Electronic label

A user can remotely retrieve, on request, information of an electronic label of an NTU or SRU. The LTU keeps this information in its database. The GUI can display the information on request; it is not used by the LTU for any other purpose.

The following information can be retrieved:

- Module type
- Vendor SISA identifier
- Production year
- Production number
- Product identification
- Manufacturer ID
- Hardware version
- Hardware revision

SHDSL Performance Monitoring

The performance of SHDSL segments that are terminated on the LTU, SRU and NTU can be monitored. The SHDSL standard (ITU-T Rec. G.991.2) prescribes a set of parameters that needs to be monitored and stored in 15 minute and 24 hour bins for near-end Performance Monitoring. The following table provides an overview of the PM parameters:

Parameter	Name	Definition
CV/BBE	Code Violation/background Block Error	Each CRC6 anomaly is counted a CV/BBE during non-SES and non-UAS seconds
ES	Errored Seconds	Each second with one or more CRC6 anomaly is counted as an ES, unless that second is UAS
SES	Severely Errored Second	Each second with 50 or more CRC6 anomalies (> 30%)or one or more LOSW events is counted as an SES, unless that second is UAS
LOSWS	Loss of SyncWord Second	Each second in which LOSW is declared as LOSWS
UAS/US	Unavailable Second	Each second that is part of unavailable time (UAT) is counted as UAS. UAT is declared at the begin of 10 consecutive SES and cleared at the begin of 10 consecutive non-SES.

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Parameter	Name	Definition
OFS/AIS	OOF or AIS Second	Second containing ab LOSW or AIS event
CRC6	CRC6 anomaly	Number of CRC6 block errors (same as BBE, but not inhibited by SES or UAS)
TMP	Total Measurement Period	Elapsed time in current interval

The default thresholds of the parameters are fix preset and cannot be changed. For more details, please refer to the *User Operations Guide, Chapter Performance monitoring concepts - Available PM data.*

Definitions of PM Parameters for SHDSL

For SHDSL, a performance monitoring block coincides with an SHDSL frame. Since the SHDSL frame length is 6 ms, there are 1662/3 blocks per second. The following definitions are applicable for PM parameters that are used for SHDSL segment termination points:

- UAS:

  Each second that is part of unavailable time is counted as a UAS. Unavailable time starts after 10 consecutive SESs. These 10 seconds are part of unavailable time. Unavailable time stops after 10 consecutive non-SESs. These 10 seconds are not part of unavailable time.

- SES:

  Each second in which 50 or more CRC-6 words are in error or in which a LOSW defect is active is counted as a Severely Errored Second, provided the second is not a UAS. An SES detection threshold of 30% is equivalent to 50 errored blocks.

- ES:

  Each second in which one or more CRC-6 word is errored or in which a LOSW defect is active is counted as an Errored Second, provided the second is not a UAS.

- BBE (CV):

  Each SHDSL frame with an errored CRC-6 word is counted as a Background Block Error (Code Violation), provided the second in which the error occurs is not an SES or a UAS. Hence, the maximum possible number of BBEs per second is 49.

Individual Sa bit provisioning case of ISDN modes

Three types of 2 Mbit/s services can be provided over SHDSL links, which can be selected from the user interface per NTU. These features work only for NEs which support QD2.

- Transparent E1:

In this case there is a leased-line connection between two end-user sites providing 2048 kbit/s throughput. This signal remains unmonitored and does not have G.704 framing. From a TS0 processing and monitoring point of view this is a trivial case: TS0 is not monitored and transparently passed through.

- ISDN-PRI:

  In this case there is a "traditional" ISDN-PRI connection between the end-user on one end and a 64 kbit/s PSTN switch with ISDN features on the other. The effective throughput is 1920 kbit/s (30 B-channels). TS0 is used for monitoring and maintenance purposes by the operator. TS16 is used for signaling between the switch and the end-user client equipment. From a transport perspective TS16 is transparently transported. Compared with the ISDN-LL mode, the ISDN terminating equipment on both ends of the ISDN link have a different role (ET or TE); it is asymmetric.

- ISDN-LL: In this case there is a leased-line connection between two end-user sites providing 1984 kbit/s throughput. TS0 is used for monitoring and maintenance purposes by the operator. Compared with the ISDN-PRI mode, the ISDN terminating equipment on both ends of the ISDN link have the same role (TE); it is symmetric. The role of the LTU is to translate request and response messages between the management system and the NTUs regarding the provisioning of the TS0 functions.

AIS options in NTUs

It is possible for the user to provide certain AIS options via the GUI. This feature works only for NEs which support EOC-ext..

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The following options are possible:

- NTU to End-user direction (SDH/SHDSL to PDH):

    - Force S-interface or customer interface AIS – enable/disable: This command is applicable in all modes and forces an all ones AIS pattern on the outgoing E1 interface in the end-user direction.

    - Channel AIS conversion – enable/disable: This command is applicable in both ISDN modes and controls whether a Channel AIS request in Sa6 ("1100") received from the LTU direction is converted to an all ones pattern on the E1 output towards the end-user or is transparently passed through as channel AIS.

- NTU to LTU direction (PDH to SDH/SHDSL):

    - Force U-interface or network interface AIS – enable/disable: This command is applicable in all modes and forces an AIS pattern according to the selected format on the P12 logical interface towards the LTU.

    - AIS Signaling Method for ISDN – Channel AIS ("1100"), Channel AIS ("1000"): This command is applicable in both ISDN modes and controls the sa6 Alarm Code to be used towards the network in case a failure is detected on the incoming E1 signal from the end-user or when AIS is forced via management. Channel AIS is defined as an all-ones pattern in TS 1-31 and a valid TS0 (regenerated CRC-4 and E-bits based on signal from network; A-bit set to "0"; Sa5 set to "1"), with an Sa6 bit-pattern of "1100" or "1000", whichever is selected.

    - Channel AIS/Full AIS selection – This command is available in both ISDN modes and determines whether "channel AIS" or "full AIS (all ones)" is sent to the network during E1 input failures or when AIS is forced by management.

Loopback Control

For maintenance operations, the user has the option to activate and release loopbacks via the management systems on the following interfaces:

- LTU: Supports an SHDSL outloop

- SRU: Supports an SHDSL outloop (loop on the customer side of the SRU)

- E1 NTU in E1 mode (E1 over SHDSL): Supports an SHDSL outloop (on the SHDSL side of the E1 NTU) and supports an outloop on the customer interface (on the E1 side of the modem)

- E1 NTU (NT2M) in TU12 mode (TU12 over SHDSL): Supports an outloop on the customer interface (on the E1 side of the TU12 mode E1 NTU)

- Ethernet NTU (NT10ETH): Supports an inloop on the Ethernet NTU (on the SHDSL side of the Ethernet NTU)

SSM messaging

An NT2M modem has two functions for which a synchronization reference signal is necessary:

- Supplying a 2048 kHz timing output signal (according to G.703-13), 120W symmetrical.

- Retiming the outgoing 2048 kbit/s E1 signal towards the end-user.

To be able to provide these synchronization services, the NT2M derives the synchronization reference signal from the incoming SHDSL signal. This timing signal can be traced back immediately to the LTU internal clock, since this clock is used to generate the timing for the outgoing SHDSL links on the LTU. Possible SRUs in the link will not change the traceability of the timing, since they always operate in through-timed mode. In order for the NT2M to know the quality of the recovered clock signal, the LTU sends the current quality level (SSM) to the NTU on a regular basis, but certainly after each completed inventory phase and each time the Quality Level of the internal clock changes in the LTU.

The NT2M will declare the recovered reference as insufficient, when the quality level is SEC or worse. So a 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS clock that is free-running or in hold-over will not be accepted by the NT2M. For the 2048 kHz output of the NT2M, the following requirements are important. It is turned-off (squelched) as long as the SHDSL link is not functioning and when the level of the reference is SEC or worse. Finally, it is possible to turn-off the timing output by management command.

Performance Monitoring on LAN ports

On NT10ETH the following PM parameters are monitored: TxOctets, RxOctets and RxDiscardedFrames. They are supported on both Ethernet ports and on the single WAN port. The support includes threshold alarms for discarded frames.

NTU support

The following sections describe Ethernet NTU support features for SHDSL configurations.

Enhanced NTU Ethernet PM: Ethernet traffic and error bin

The 1643 AM/1643 AMS supports a 2 port Ethernet SHDSL modem as an NTU, which is connected via 1 to 4 parallel TU12s over SHDSL mapped links. For increased bandwidth, the Ethernet traffic is encapsulated in GFP-F and uses VC12-Xv virtual concatenation with LCAS support.

The 1643 AM/1643 AMS supports the following Enhanced NTU Ethernet ports PM counters via the QD2-Lite extension.

- Ethernet Outgoing Number of Bytes (pCbS)
- Ethernet Incoming Number of Good Bytes (pCbR)
- Ethernet Outgoing Number of Frames (eONF)
- Ethernet Incoming Number of Good Frames (eINF)
- Ethernet Outgoing Number of Pause Frames transmitted (pPPS)
- Ethernet Number of Layer1 Link Down (eNLD)
- Ethernet Incoming Number of Frames with CRC Error (pPCR)
- Ethernet Incoming Number of Frames with oversize (eINFO)
- Ethernet Incoming Number of Frame with undersize (eINFU)

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- Ethernet Dropped Frames due to Error (ppDE)
- Ethernet Incoming Number of Frame with collisions (eINFC)
- Ethernet Outgoing Number of Frame with collisions (eONFC)
- Ethernet Forwarded Discarded Frames due to overflow in egress direction (eFDFO).
- Ethernet Outgoing Discarded Frames due to lifetime end (eODFT).

Note that the above Ethernet Traffic and Error PM bins are applicable for both LAN and WAN ports of the NTU. However, the WAN port does not support pPPS, eINFC, and eONFC counters.

Note: The PM counters -pCbR, -pCbS and -ppDE are supported since 1643 AM/1643 AMS Release 6.1.

NTUs Bridge Mode Provisioning

The 1643 AM/1643 AMS supports bridge mode provisioning to the Ethernet NTU.

The following bridge modes are supported.

- Self learning bridge (IEEE 802.1D)
- V-LAN bridge (IEEE 802.1Q)
- Provider bridge (IEEE 802.1ad)

NTU V-LAN Bridge Mode Support

The 1643 AM/1643 AMS provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

When an NTU works in V-LAN bridge mode (IEEE802.1Q), the NTU's V-LAN table is used to assign the VID to ETH ports and WAN ports. The QD2-Lite message is only used to write to the table; a readout of the existing entries is not provided. The network element is the configuration master and retains a V-LAN table of its own. It ensures by corresponding commands that the V-LAN table in the NTU matches the V-LAN table in the AM.

Using the V-LAN Entry command, individual entries in the table can be added, modified or deleted. This command is used when individual V-LAN entries are changed by the EMS.

A table entry for a VID is deleted by a V-LAN Table Entry command in which all WAN(x) bits and LAN(x) bits are set to "0". The V-LAN Table command can be used to copy the entire V-LAN table from the AM to the NT10ETH. The entire V-LAN table is deleted by an "empty" V-LAN Table command that contains no table entry. The length of such a message is L=2.

After the restoration of an SDSL link, the NE (AM) must refresh the entire V-LAN table with the V-LAN Table command. Refreshing the V-LAN table with the V-LAN Table command is not allowed to result in the interruption of individual or of all V-LANs.

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NTU LPT Support

The 1643 AM/1643 AMS supports Link Pass Through (LPT) functionality via EOC commands.

Users can enable or disable LPT using the following parameters.

- CA-CSF: GFP Client Signal Fail Signalling
- CA-SSF: Disabling LAN interfaces during WAN connection failure

NTU Ethernet QoS support

The 1643 AM/1643 AMS provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1643 AM/1643 AMS supports the following NTU Ethernet QoS functions.

- PriorityMode
- IngressRateControl
- CIRAverageBitRate
- CIRMaxBurstSize
- PortPriority

NTU software download

The 1643 AM/1643 AMS provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1643 AM/1643 AMS can use up to four SHDSL links in parallel via z-bits to download NTU software.

NTU web interface

The OMS of the 1643 AM/1643 AMS can be used to set user passwords for the NTU web interface.

NTU general configuration support

The 1643 AM/1643 AMS provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1643 AM/1643 AMS supports the following enhanced NTU configuration.

1. Enhanced NTU SDH port configuration:

   - `CA-PLM_cmd`
   - `TIMdis_cmd`

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- **`rxTTI`**
- **`exTTI`**
- **`txTTI`**
- **`rxTSL`**

Note that these configurations are supported in Release 6.0.

2. Enhanced NTU Ethernet port configuration

- **`FlowCtrlPause`**
- **`Tagging`**
- **`C-TagDefaultVID`**
- **`PortPriority`**
- **`S-TagDefaultVID`**
- **`CIRAverageBitRate`**
- **`CIRMaxBurstSize`**

Note that the following configurations are supported in Release 6.0.

- **`AutoNegMode`**
- **`DuplexMode`**
- **`Speed`**
- **`AutoNegRestart`**
- **`CrossoverMode`**
- **`LinkAdminCtrl`**

3. Enhanced NTU Ethernet WAN port configuration:

- **`LCAS-Enable`**
- **`CA-CSF`**
- **`CA-SSF`**

Note that the following configurations are supported in Release 6.0.

- **`VC(n)AdminCtrl`**
- **`HoldOffTime`**
- **`WaitToRestoreTime`**

4. NTU Ethernet Bridging Configuration

- **`BridgeMode`**
- **`PriorityMode`**
- **`RestartBridge`**
- **`IngressRateCtrl`**

NTU Alarms and Status Reports

The 1643 AM/1643 AMS provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

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The 1643 AM/1643 AMS supports the following enhanced NTU alarms and status reports.

- SDH port status

   Note that dEQP, dINTB, dNAE, dDEG-N, dAIS-U, dLOP-U, dPLM-V, dTIM-V, dRDI-V, dDEG-V, and dUNEQ-V are supported in Release 6.0.

- Ethernet port status

   Note that dANM and dLOS are supported in Release 6.0.

- Updated Encaps and VCG status: TLCR, PLCR, FOPR, TLCT, PLCT, FOPT, LOA

   Note that dLOF-G, dPLM-G, SQM

Remote SHDSL Power Supply (RPS) Support

The 1643 AM/1643 AMS manages an external Remote SHDSL Power Supply (RPS) box via the MDI/MDO interfaces. Note that remote power supply must be set to 'managed mode' by the DIP switch=ON in the power box.

The Alcatel-Lucent OMS can also be set to 'managed mode' for the remote power supply.

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS supports the following remote power supply provisioning functions.

- `Restart_cmd`: Restarts the RPS module after forced shutdown
- Enable/Disable RPS related alarms (per port and not per alarm). This provisioning is used to suppress alarms generated by the RPS module.

The 1643 Access Multiplexer AM/1643 Access Multiplexer Small AMS remote power supply module supports the following alarms.

- RPS power failure (per box)
- Overl: Overload (per port)
- OpenC: Open circuit (per port)
- FSD: Forced shut down (per port)
- Leak: Leakage asymmetrical (per port)
- HVolt: Overvoltage alarm (per port)

Note that the external power supply module has a maximum number of 12 SHDSL ports.

Note that the MDI interfaces 1...4 and MDO interfaces 1...4 will not function as normal when the RPS is set to managed mode.

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Appendix A: An SDH overview

Overview

Purpose

This chapter briefly describes the Synchronous Digital Hierarchy (SDH).

Synchronous Digital Hierarchy

In 1988, the ITU-T (formerly CCITT) came to an agreement on the Synchronous Digital Hierarchy (SDH). The corresponding ITU-T Recommendation G.707 forms the basis of a global, uniform optical transmission network. SDH can operate with plesiochronous networks and therefore allows the continuous evolution of existing digital transmission networks.

The major features and advantages of SDH are:

- Compatibility of transmission equipment and networks on a worldwide basis
- Uniform physical interfaces
- Easy cross connection of signals in the network nodes
- Possibility of transmitting PDH (Plesiochronous Digital Hierarchy) tributary signals at bit rates commonly used at present
- Simple adding and dropping of individual channels without special multiplexers (add/drop facility)
- Easy transition to higher transmission rates
- Due to the standardization of the network element functions SDH supports a superordinate network management and new monitoring functions and provides transport capacity and protocols (Telecommunication Management Network, TMN) for this purpose in the overheads of the multiplex signals.
- High flexibility and user-friendly monitoring possibilities, e.g. end-to-end monitoring of the bit error ratio.

Purpose of SDH

The basic purpose of SDH is to provide a standard synchronous optical hierarchy with sufficient flexibility to accommodate digital signals that currently exist in today's network, as well as those planned for the future.

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SDH currently defines standard rates and formats and optical interfaces. Today, mid-span meet is possible at the optical transmission level. These and other related issues continue to evolve through the ITU-T committees.

ITU-T addressed issues

The set of ITU-T Recommendations defines

- Optical parameters
- Multiplexing schemes to map existing digital signals (PDH) into SDH payload signals
- Overhead channels to support standard operation, administration, maintenance, and provisioning (OAM&P) functions
- Criteria for optical line Automatic Protection Switch (APS)

References

For more detailed information on SDH, refer to

- ITU-T Recommendation G.703, "Physical/electrical characteristics of hierarchical digital interfaces", October 1996
- ITU-T Recommendation G.707, "Network Node Interface For The Synchronous Digital Hierarchy (SDH)", March 1996
- ITU-T Recommendation G.780, "Vocabulary of terms for synchronous digital hierarchy (SDH) networks and equipment" , November 1993
- ITU-T Recommendation G.783, "Characteristics of Synchronous Digital Hierarchy (SDH) Multiplexing Equipment Functional Blocks ", April 1997
- ITU-T Recommendation G.784, "Synchronous Digital Hierarchy (SDH) Management ", January 1994
- ITU-T Recommendation G.785, "Characteristics of a flexible multiplexer in a synchronous digital hierarchy environment ", November 1996
- ITU-T Recommendation G.813, "Timing characteristics of SDH equipment slave clocks (SEC)", August 1996
- ITU-T Recommendation G.823, "The control of jitter and wander within digital networks which are based on the 2048-kbit/s hierarchy", March 1993
- ITU-T Recommendation G.825, "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)", March 1993
- ITU-T Recommendation G.826, " Error performance Parameters and Objectives for International, Constant Bit Rate Digital Paths at or Above the Primary Rate", February 1999
- ITU-T Recommendation G.957, "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy", July 1995

Contents

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SDH signal hierarchy

This section describes the basics of the SDH hierarchy.

STM-1 Frame

The SDH signal hierarchy is based on a basic "building block" frame called the Synchronous Transport Module 1 (STM-1), as shown in "SDH STM-1 frame" (p. A-5).

The STM-1 frame has a rate of 8000 frames per second and a duration of 125 microseconds

The STM-1 frame consists of 270 columns and 9 rows.

Each cell in the matrix represents an 8-bit byte.

Transmitting Signals

The STM-1 frame (STM = Synchronous Transport Module) is transmitted serially starting from the left with row 1 column 1 through column 270, then row 2 column 1 through 270, continuing on, row-by-row, until all 2430 bytes (9x270) of the STM-1 frame have been transmitted. Because each STM-1 frame consists of 2430 bytes and each byte has 8 bits, the frame contains 19440 bits a frame. There are 8000 STM-1 frames a second, at the STM-1 signal rate of 155.520.000 (19440 x 8000) kbit/s.

Three higher bit rates are also defined:

- 622.080 Mbit/s (STM-4)
- 2488.320 Mbit/s (STM-16)
- 9953.280 Mbit/s (STM-64)
- 39813.120 Mbit/s (STM-256)

The bit rates of the higher order hierarchy levels are integer multiples of the STM-1 transmission rate.

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SDH STM-1 frame

STM-1 Frame Format
270 Columns

| 1 2 3 4 5 6 7 8 9 | 10 | 11 | 12 | 269 | 270 |

Regenerator
Section
Overhead

AU Pointer

9
Rows

Multiplex
Section
Overhead

P
a
t
h

O
v
e
r
h
e
a
d

9 Columns

STM-1 Payload 261 Columns

W10gsdh01.00e

Section overhead (SOH)

The first nine bytes of each row with exception of the fourth row are part of the SOH (Section OverHead). The first nine byte of the fourth row contain the AU pointer (AU = Administrative Unit).

STM-1 payload

Columns 10 through 270 (the remainder of the frame), are reserved for payload signals.

....

SDH path and line sections

This section describes and illustrates the SDH path and line sections.

SDH layers

SDH divides its processing functions into the following three path and line sections:

- Regenerator section
- Multiplex section
- Path

These three path and line sections are associated with

- Equipment that reflects the natural divisions in network spans
- Overhead bytes that carry information used by various network elements

Equipment layers

The following table lists and defines each SDH equipment path and line section.

Path and line sections	Definition
Regenerator section	A regenerator section describes the section between two network elements. The network elements, however, do not necessarily have to be regenerators.
Multiplex section	A multiplex section is the section between two multiplexers. A multiplex section is defined as that part of a path where no multiplexing or demultiplexing of the STM-N frame takes place.
Path	A path is the logical signal connection between two termination points. A path can be composed of a number of multiplex sections which themselves can consist of several regenerator sections.

....

Path, MS and RS

The following figure illustrates the equipment path, multiplex sections and regenerator sections in a signal path.
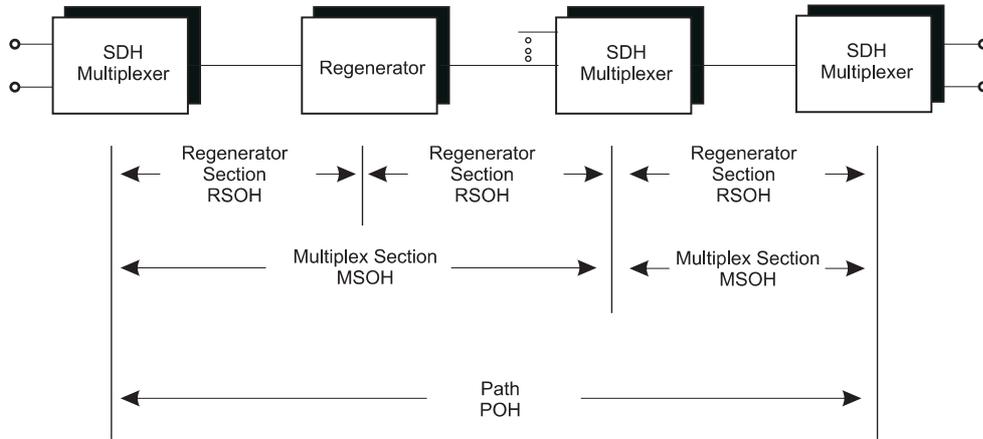
W10gsdh02.00e

Overhead bytes

The following table lists and defines the overhead associated with each SDH path and line section.

Overhead byte section	Definition
Regenerator section	Contains information that is used by all SDH equipment including repeaters.
Multiplex section	Used by all SDH equipment except repeaters.
Path	The POH contains all the additional signals of the respective hierarchy level so that a VC can be transmitted and switched through independently of its contents.

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SDH frame

The following figure illustrates the SDH frame sections and its set of overhead bytes.

STM-1 Frame Format
270 Columns

	1	2	3	4	5	6	7	8	9	10	11	269	270
Regenerator Section Overhead	A1	A1	A1	A2	A2	A2	J0	NU	NU	Trace J1			
	B1			E1			F1	NU	NU	BIP-8 B3			
	D1			D2			D3			Signal Label C2			
AU Pointer	H1	Y	Y	H2	1	1	H3	H3	H3	Path Status G1			
Multiplex Section Overhead	B2	B2	B2	K1			K2			User Channel F2			
	D4			D5			D6			Indicator H4			
	D7			D8			D9			User Channel F3			
	D10			D11			D12			VC Trail Prot. K3			
	S1					M1	E2	NU	NU	Tandem Connection N1			

VC-4
Path OH

9 Columns   STM-1 Payload
                   261 Columns

W10gsdh03.00e

....

SDH frame structure

This section provides detailed information on the locations and functions of various overhead bytes for each of the following SDH path and line sections:

- Regenerator Section
- Multiplex Section
- Path

Section overhead

The following table identifies the location and function of each regenerator section overhead byte.

Bytes	Function
A1, A2	Frame alignment A1 = 1111 0110 ; A2 = 0010 1000 ; These fixed-value bytes are used for synchronization.
B1	BIP-8 parity test Regenerator section error monitoring; BIP-8 : Computed over all bits of the previous frame after scrambling; B1 is placed into the SOH before scrambling; BIP-X: (Bit Interleaved Parity X bits) Even parity, X-bit code; first bit of code = even parity over first bit of all X-bit sequences;
B2	Multiplex section error monitoring; BIP-24 : B2 is computed over all bits of the previous STM-1 frame except for row 1 to 3 of the SOH (RSOH); B2 is computed after and placed before scrambling;
Z0	Spare bytes
D1 - D3 (= DCC_R) D4 - D12 (= DCC_M)	Data Communication Channel (network management information exchange)
E1	Orderwire channel
E2	Orderwire channel
F1	User channel
K1, K2	Automatic protection switch
K2	MS-AIS/RDI indicator
S1	Synchronization Status Message
M1	REI (Remote Error Indication) byte
NU	National Usage

Path overhead

The Path Overhead (POH) is generated for all plesiochronous tributary signals in accordance with ITU-T Rec. G.709. The POH provides for integrity of communication between the point of assembly of a Virtual Container VC and its point of disassembly. The following table shows the POH bytes and their functions.

Byte	Location and Function
J1	Path Trace Identifier byte
B3	Path Bit Interleaved Parity (BIP-8) Provides each path performance monitoring. This byte is calculated over all bits of the previous payload before scrambling.
C2	Signal Label All "0" means unequipped; other and "00000001" means equipped
G1	Path Status Conveys the STM-1 path terminating status, performance, and remote defect indication (RDI) signal conditions back to an originating path terminating equipment.
F2, F3	User Data Channel Reserved for user communication.
H4	Multiframe Indicator Provides a general multiframe indicator for VC-structured payloads.
K3	VC Trail protection.
N1	Tandem connection OH

AU pointer

The AU pointer together with the last 261 columns of the STM-1 frame forms an AUG (Administrative Unit Group). An AUG may contain one AU-4 or three byte-multiplexed AU-3s (an AU-3 is exactly one third of the size of an AU-4). AU-3s are also compatible with the SONET standard (Synchronous Optical NETwork) which is the predecessor of SDH (and still the prevailing technology within the USA). Three byte-multiplexed STS frames (SONET frame), each containing one AU-3 can be mapped into one STM-1.

SDH digital multiplexing

Digital multiplexing is SDH's method of byte mapping tributary signals to a higher signal rate, which permits economical extraction of a single tributary signal without the need to demultiplex the entire STM-1 payload. In addition, SDH provides overhead channels for use by OAM&P groups.

SDH digital multiplexing

The following figure illustrates the SDH technique of mapping tributary signals into the STM frames.
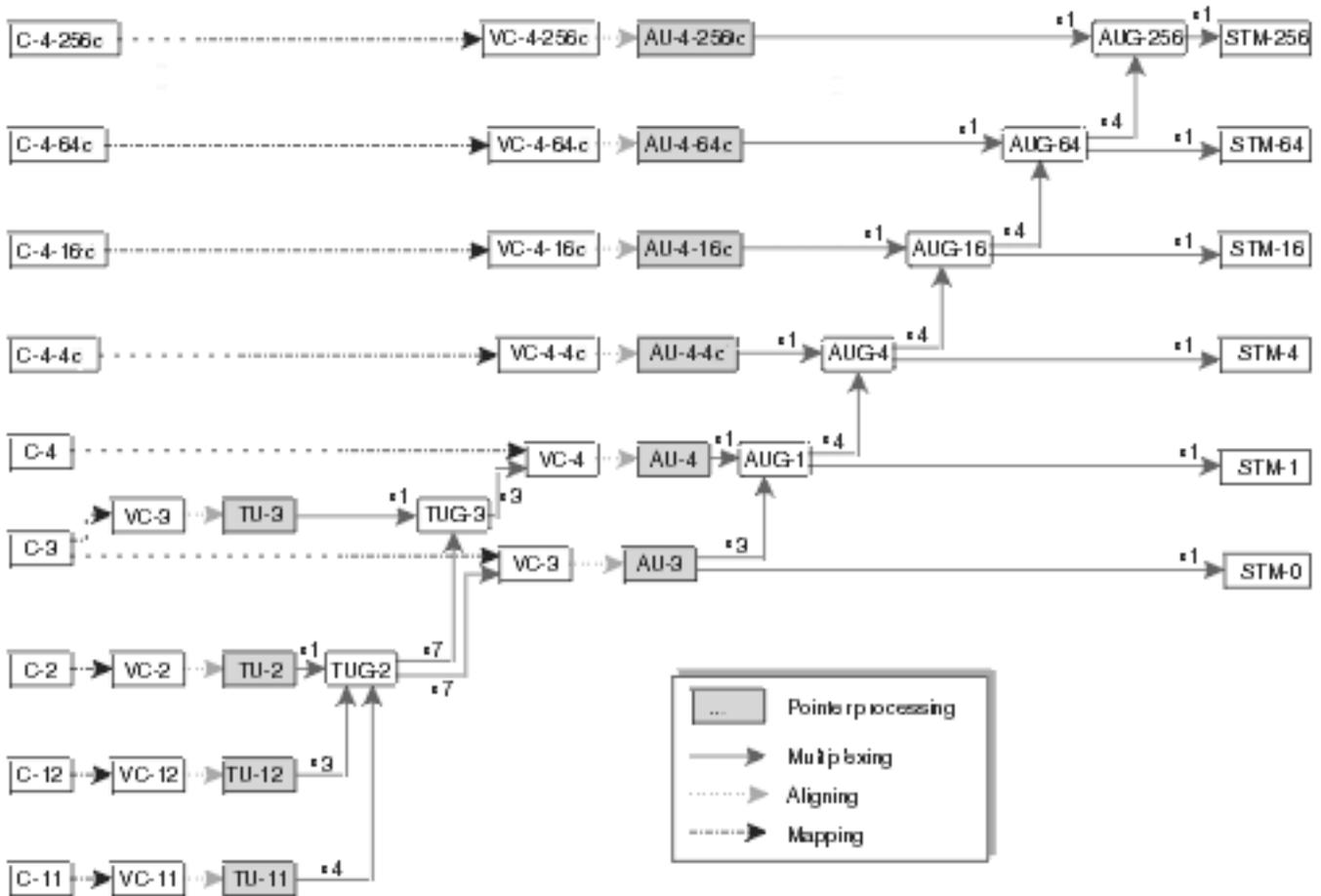
Transporting SDH payloads

Tributary signals are mapped into a digital signal called a virtual container (VC). The VC is a structure designed for the transport and switching of STM payloads. There are various sizes of VCs: VC-11, VC-12, VC-2, VC-3, VC-4, VC-4-4c, VC-4-16c, VC-4-64c and VC-4-256c.

....

Table

The following table shows the mapping possibilities of some digital signals into SDH payloads.

Input tributary	Voice Channels	Rate	Mapped Into
1.5 Mbit/s	24	1.544 Mbit/s	VC-11
2 Mbit/s	32	2.048 Mbit/s	VC-12
6 Mbit/s	96	6.312 Mbit/s	VC-2
34 Mbit/s	672	34.368 Mbit/s	VC-3
45 Mbit/s	672	44.736 Mbit/s	VC-3
140 Mbit/s	2016	139.264 Mbit/s	VC-4

....

SDH interface

This section describes the SDH interface.

Description

The SDH interface provides the optical mid-span meet between SDH network elements. An SDH network element is the hardware and software that affects the termination or repeating of an SDH standard signal.

SDH interface

SDH Interface

```
          ┌──────────┐                      ┌──────────┐
          │   SDH    │                      │   SDH    │
──────────│ Network  │─────⊘─────┆──────────│ Network  │──────────
          │ Element  │           ┆          │ Element  │
          └──────────┘           ┆          └──────────┘
 Digital                                                  Digital
 Tributaries                                              Tributaries
```
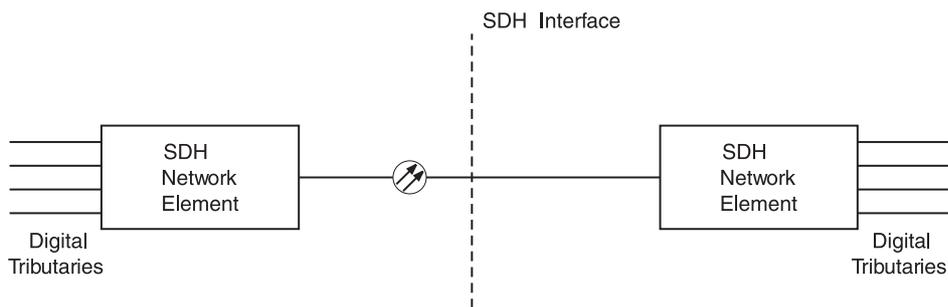
Standard optical interconnect at SDH interface

Family of standard rates at N x 155.52 Mbit/s [Synchronous Transport Module (STM-1)]

Overhead channels defined for interoffice operations and maintenance functions

W10gsdh06.00e

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SDH multiplexing process

SDH provides for multiplexing of 2-Mbit/s (C-12) and 34-Mbit/s (C-3) signals into an STM-1 frame.

Furthermore, multiplexing paths also exist for the SONET specific 1.5-Mbit/s, 6-Mbit/s and 45-Mbit/s signals.

Process

The following describes the process for multiplexing a 2-Mbit/s signal. The "SDH digital multiplexing" (p. A-11) illustrates the multiplexing process.

....

1   Input 2-Mbit/s tributary is mapped

- Each VC-12 carries a single 2-Mbit/s payload.

- The VC-12 is aligned into a Tributary Unit TU-2 using a TU pointer.

- Three TU-2 are then multiplexed into a Tributary Unit Group TUG-2.

- Seven TUG-2 are multiplexed into an TUG-3.

- Three TUG-3 are multiplexed into an VC-4.

- The VC-4 is aligned into an Administrative Unit AU-4 using a AU pointer.

- The AU-4 is mapped into an AUG which is then mapped into an STM-1 frame.

....

2   After VCs are multiplexed into the STM-1 payload, the section overhead is added.

....

3   Scrambled STM-1 signal is transported to the optical stage.

....

SDH demultiplexing process

Demultiplexing is the inverse of multiplexing. This topic describes how to demultiplex a signal.

Process

The following describes the process for demultiplexing an STM-1 signal to a 2 Mbit/s signal. The "SDH digital multiplexing" (p. A-11) illustrates the demultiplexing process.

1 The unscrambled STM-1 signal from the optical conversion stages is processed to extract the path overhead and accurately locate the payload.

2 The STM-1 path overhead is processed to locate the VCs. The individual VCs are then processed to extract VC overhead and, via the VC pointer, accurately locate the 2-Mbit/s signal.

3 The 2-Mbit/s signal is desynchronized, providing a standard 2-Mbit/s signal to the asynchronous network.

Key points

SDH STM pointers are used to locate the payload relative to the transport overhead.

Remember the following key points about signal demultiplexing:

- The SDH frame is a fixed time (125 μs) and no bit-stuffing is used.
- The synchronous payload can float within the frame. This is to permit compensation for small variations in frequency between the clocks of the two systems that may occur if the systems are independently timed (plesiochronous timing).

SDH transport rates

Higher rate STM-N frames are built through byte-multiplexing of N STM-1 signals.

Creating higher rate signals

A STM-N signal can only be multiplexed out of N STM-1 frames with their first A1 byte at the same position (i.e. the first A1 byte arriving at the same time).

STM-N frames are built through byte-multiplexing of N STM-1 signals. Not all bytes of the multiplexed SOH (size = N x SOH of STM-1) are relevant in an STM-4/16.

For example there is only one B1 byte in an STM-4/16 frame which is computed the same way as for an STM-1. Generally the SOH of the first STM-1 inside the STM-N is used for SOH bytes that are needed only once. The valid bytes are given in ITU-T G.707.

SDH transport rates

Designation	Line rate (Mbit/s)	Capacity
STM-1	155.520	1 AU-4 or 3 AU-3
STM-4	622.080	4 AU-4 or 12 AU-3
STM-16	2488.320	16 AU-4 or 48 AU-3
STM-64	9953.280	64 AU-4 or 192 AU-3
STM-256	39813.120	256 AU-4 or 768 AU-3

Glossary

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Numerics

12 digit Numerical Code (12NC)

Used to as the unique identifier of an item or product. The first ten digits identify an item. The eleventh digit specifies the particular variant of the item. The twelfth digit indicates the revision issue. Items for which the first eleven digits are the same are functionally equal and may be exchanged.

5ESS

Number 5 Electronic Switching System

5TAD

Five Tributary Add-Drop subrack

9TAD

Nine Tributary Add-Drop subrack

....

A   **AAU**

Alarm Adapter Unit. Radio Relay circuit pack that is used for the collection of external alarms and remote control of external equipment.

AC

Alternating Current

ACU

Alarm Collection Unit. Radio Relay circuit pack that collects of equipment alarms, analogue measurements from internal monitoring points and calculation data.

ADM

Add-Drop Multiplexer

Administrative Unit (AU)

Carrier for TUs

Administrative-Unit Pointer (AU PTR)

Indicates the phase alignment of the VC-n with respect to the STM-N frame. The pointer position is fixed with respect to the STM-N frame.

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Administrator

The Alcatel-Lucent OMS administrator.

Agent

Performs operations on managed objects and issues events on behalf of these managed objects. All SDH managed objects will support at least one agent. Control of distant agents is possible via local "Managers".

Alarm

The notification (audible or visual) of a significant event. See also Event.

Alarm Indication Signal (AIS)

Code transmitted downstream in a digital Network that shows that an upstream failure has been detected and also alarmed if the upstream alarm has not been suppressed. Also called to as All OneS.

Alarm Severity

An attribute that defines the priority of the alarm message. The way in which alarms are processed depends on the severity.

Aligning

Using a pointer to indicate the head of a virtual container, e.g. to create an Administrative Unit (AU) or a Tributary Unit (TU).

ALS

Automatic Laser Shutdown

Alternate Mark Inversion (AMI)

A line code that employs a ternary signal to convert binary digits. In this line code successive binary ones are represented by signal elements that are normally of alternately positive and negative polarity but are equal in amplitude, binary zeros are represented by signal elements that have zero amplitude.

American Standard Code for Information Interchange (ASCII)

A standard 8-bit code that is used to exchange information among data processing systems and associated equipment.

Anomaly

A difference between the actual and the desired operation of a function.

ANSI

American National Standards Institute

APS

Automatic Protection Switching

AS

Alarm Suppression assembly

Assembly

Gathering together of payload data with overhead and pointer information (an indication of the direction of the signal).

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Association

A logical connection between manager and agent through which management information can be exchanged.

Asynchronous

See Non-synchronous.

ATC

Auxiliary Transmission Channel

ATM

Asynchronous Transfer Mode

ATPC

Automatic Transmit-Power Control

AU

Administrative Unit

AU4AD

Administrative Unit 4 Assembler/Disassembler

AUG

Administrative Unit Group

AUTO

Automatic

Automatic Transmit Power Control (ATPC)

Reduces the power output from the transmitter during normal propagation conditions and increases the power output to maximum during fading periods to try to maintain the nominal level of receiver input.

Autonomous Message

A message transmitted from the controlled network element to the Alcatel-Lucent OMS and was not a response to a command that originated in the Alcatel-Lucent OMS.

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B   **B3ZS**

Bipolar 3-Zero Substitution

B8ZS

Bipolar 8-Zero Substitution

BBTR

Backplane Bus Transceiver

BC

Board Controller

BCC

Board Controller Complex

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BIN

BINary

BIP

Bit-Interleaved Parity

BISDN

Broadband Integrated Services Digital Network

Bit Error Ratio (BER)

The ratio of bits received in error to bits sent.

Bit Interleaved Parity (BIP)

A method of error monitoring that uses a specified number of bits (BIP-8)

BLD OUT LG

Build-Out Lightguide

Board Controller Local Area Network (BC-LAN)

The internal local area network that provides communications between the Line Controller circuit pack and board controllers on the circuit packs that are associated with a high-speed line.

Branching

Interconnection of independent line systems.

Broadband Communication

Voice, data, and/or video communication at greater than 2 Mbit/s rates.

Broadband Service Transport

STM-1 concatenation transport over the SLM for ATM applications.

BUSTR

BUS Transmitter and Receiver

....

C   **CAS**

Channel Associated Signaling

CAT

CATastrophic

CC

Cross-Connection, Cross-Connect

CCIR

See ITU-R.

CCITT

See ITU-T.

CCS

Common Channel Signaling

....

CEPT

Conférence Européenne des Administrations des Postes et des Télécommunications

Channel

A sub-unit of transmission capacity within a defined higher level of transmission capacity, e.g. a CEPT-4 (140 Mbit/s) within a 565 Mbit fiber system.

CIR

Committed Information Rate

Circuit

A combination of two transmission channels that permits bidirectional transmission of signals between two points to support a single communication.

CIT

Craft Interface Terminal

Clear Channel (Cl. Ch.)

A provisionable mode for the 34 and 140 Mbit/s tributary outputs that causes parity violations not to be monitored or corrected before the 34 and 140 Mbit/s outputs are encoded.

Client

Computer in a computer network that generally offers a user interface to a server. See also Server.

CMI

Coded Mark Inversion

CO

Central Office

Co-resident

A hardware configuration where the Alcatel-Lucent OMS and ITM-NM applications can be independently active at the same time on the same hardware and software platform without interfering with each other's functioning.

Common Object Request Broker Architecture (CORBA)

CORBA allows applications to communicate with one another no matter where they are located or who has designed them.

Concatenation

A procedure whereby a multiplicity of Virtual Containers are associated with each other with the result that their combined capacity can be used as a single container across which bit-sequence integrity is maintained.

Configuration Management (CM)

Subsystem of the *WaveStar*® ITM-SC that, among other things, configures the network and processes messages from the network.

CONN PCB

Connector Printed Circuit Board

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Container (C)

Carries plesiochronous signal, the "payload".

CP

Circuit Pack

Craft Interface Terminal (CIT)

Local manager for SDH network elements.

CRC

Cyclic Redundancy Check

Cross-Connect Map

Connection map for an SDH network element; contains information about how signals are connected between high speed time slots and low speed tributaries. See also Squelch Map.

Cross-Polarization Interference Cancellation

This feature permits both orthogonal polarizations of one Radio Frequency carrier to be used simultaneously, which provides greater spectral efficiency.

CTP

Connection Termination Point

CV

Code Violation

....

D   **DACS**

Digital Access & Cross-connect System

DACScan-T

See Integrated Transport Management Network Manager.

Data Communication Channel (DCC)

The embedded overhead communication channel in the SDH line. The DCC is used for end-to-end communication and maintenance. It carries alarm, control, and status information between network elements in an SDH network.

Data Communication Equipment (DCE)

Provides the signal conversion and coding between the data terminating equipment and the line. The DCE may be separate equipment or a part of the data terminating equipment.

Data Terminating Equipment (DTE)

Originates data for transmission and accepts transmitted data.

Database Administrator

A user who administers the database of the Alcatel-Lucent OMS application. See also User Privilege.

DC

Direct Current

....

DCF

Data Communications Function

DCN

Data Communications Network

DCS

Digital Cross-connect System

DDF

Digital Distribution Frame

Dedicated Protection Ring (DP-Ring)

A protection method used in some network elements.

Default Value Provisioning

The original values are preprogrammed at the factory. These values can be overridden using local or remote provisioning.

Defect

A limited interruption of the ability of an item to perform a required function. The defect may or may not lead to maintenance action this depends on the results of additional analysis.

Demultiplexing

A process applied to a multiplexed signal to recover signals combined within it and restore the distinct individual channels of these signals.

Digital Link

A transmission span such as a point-to-point 2 Mbit/s, 34 Mbit/s, 140 Mbit/s, VC12, VC3 or VC4 link between controlled network elements. The channels within a digital link are insignificant.

Digital Section

A transmission span such as an STM-N or 565 Mbit/s signal. A digital section may contain multiple digital channels.

DIL

Dual In Line

Directory-Service Network Element (DSNE)

A designated network element that is responsible for administering a database that maps network element names (node names) to addresses (node Id). There can be one DSNE per (sub)network.

Disassembly

Splitting up of a signal into its constituents as payload data and overhead (an indication of the direction of a signal).

Domain

The domain of a Alcatel-Lucent OMS is the set of all SDH network elements that are controlled by that particular Alcatel-Lucent OMS.

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Downstream

At or towards the destination of the considered transmission stream, i.e. in the direction of transmission.

DPLL

Digital Phase-Locked Loop

DPS

Data communication Packet Switch

DR

Digital Radio

DRI

Dual-Ring Interworking

DS-n

Digital Signal, Level n

DSL

Digital Subscriber Line

DTMF

Dual-Tone Multi-Frequency

Dual Homing

An STM-1/STM-4 ring with AM-1 Plus equipment can be dual homed on a ring consisting of 1643 AM products.

Dual-Node Interworking

Dual Node Interworking (DNI) is a configuration of two ring networks that share two common nodes. DNI allows a circuit with one termination in one ring and one termination in another ring to survive a loss-of-signal failure of the shared node that is currently carrying service for the circuit.

DUS

Do not Use for Synchronization

DWDM

Dense-Wavelength Division Multiplexing

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E   **EC-n**

Electrical Carrier, Level n

ECC

Embedded Control Channel

ECI

Equipment Code Identifier

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EH&S

Environmental Health and Safety

EINB

Ethernet Incoming Number of Mbytes

Electronic Industries Association (EIA)

A trade association of the electronic industry that establishes electrical and functional standards.

Element Management System (EMS)

See Integrated Transport Management Subnetwork Controller.

EMC

ElectroMagnetic Compatibility

EMI

ElectroMagnetic Interference

EOC

Embedded Operations Channel

EOC-ext. (Proprietary EOC message extension)

A proprietary message set to enhance the standard EOC management capabilities.

EONB

Ethernet Outgoing Number of Mbytes

EOW

Engineering Order Wire

Equivalent Bit Error Ratio (EBER)

The calculated average bit error rate over a data stream.

Errored Second (ES)

A performance monitoring parameter.

ES

End System

ESD

ElectroStatic Discharge

ESPG

Elastic Store & Pointer Generator

ETSI

European Telecommunication Standardisation Institute

Event

A significant change. Events in controlled network elements include signal failures, equipment failures, signals exceeding thresholds, and protection switch activity. When an event occurs in a controlled network element, the controlled network element will generate an alarm or status message and send it to the Alcatel-Lucent OMS.

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Event Management (EM)

Subsystem of the Alcatel-Lucent OMS that processes and logs event reports of the network.

Externally Timed

An operating condition of a clock in which it is locked to an external reference and uses time constants that are altered to quickly bring the local oscillator's frequency into approximate agreement with the synchronization reference frequency.

Extra Traffic

Unprotected traffic that is carried over the protection channels when that capacity is not used for the protection of service traffic.

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F **Far End Block Error (FEBE)**

An indication returned to the transmitting node that an errored block has been detected at the receiving node. A block is a specified grouping of bits.

Far End Receive Failure (FERF)

An indication returned to a transmitting network element that the receiving network element has detected an incoming section failure.

FAS

Frame Alignment Signal

FAW

Frame Alignment Word

FC

Full contact Connector

FCC

Federal Communications Commission

FDDI

Fiber Distributed Data Interface

FEP

Front End Processor

Free Running

An operating condition of a network element in which its local oscillator is not locked to any synchronization reference and uses no storage techniques to sustain its accuracy.

....

G **GARP**

Generic Attribute Registration Protocol

Gateway Network Element (GNE)

Passes information between other network elements and management systems via a Data Communications Network.

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Glossary

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Gbit/s

Gigabits per second

Geographic Location

Location of the Alcatel-Lucent OMS server. The geographic location is entered as part of the installation procedure of the Alcatel-Lucent OMS.

Geographic Redundancy (GR)

Allows protection of management for a network element by assigning the network element to two Alcatel-Lucent OMSs. The first primary Alcatel-Lucent OMS usually manages the Network Element and is now in the protected domain. If the primary Alcatel-Lucent OMS or the link between the network element and the primary Alcatel-Lucent OMS fails, the secondary Alcatel-Lucent OMS will automatically take over management of the network element and is now in the protecting domain. The two Alcatel-Lucent OMSs are connected by a peer to peer link, which they use to pass Geographic Redundancy management information to each other. This link must be established before any network element can be protected by Geographic Redundancy.

GFP

Generic Framing Procedure

Global Wait to Restore Time

The time to wait before switching back to the timing reference occurs after a timing link failure has cleared. This time applies for all timing sources in a system hence the name global. This can be between 0 and 60 minutes, in increments of one minute.

GNE

Gateway network element - A network element that passes information between other network elements and operations systems via a data communications network.

GUI

Graphical User Interface

GVRP

GARP VLAN Registration Protocol (refer to "GARP" (p. GL-10))

....

H   HE

Host Exchange

High Density Bipolar 3 code (HDB3)

Line code for e.g. 2 Mbit/s transmission systems.

High level Data Link Control (HDLC)

Protocol in the data-link layer of the OSI reference model.

Higher order Path Adaptation (HPA)

Function that adapts a lower order Virtual Container to a higher order Virtual Container by processing the Tributary Unit pointer which indicates the phase of the lower order Virtual Container Path Overhead relative to the higher order Virtual-Container Path Overhead, and assembling/disassembling the complete higher order Virtual Container.

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Higher order Path Connection (HPC)

Function that provides for flexible assignment of higher order Virtual Containers within an STM-N signal.

Higher order Path Termination (HPT)

Function that terminates a higher order path by generating and adding the appropriate Virtual-Container Path Overhead to the relevant container at the path source and removing the Virtual-Container Path Overhead and reading it at the path sink.

HMI

Human Machine Interface

HO

High Order

Holdover

An operating condition of a clock in which its local oscillator is not locked to an external reference but uses storage techniques to maintain its accuracy with respect to the last known frequency comparison with a synchronized reference.

Host Name

Name of the server on which the Alcatel-Lucent OMS is running.

HS

High Speed

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I   **I/O**

Input/Output

ICB

Interconnection Box

ICP

InterConnection Panel

IEC

International Electrotechnical Committee

IEEE

Institute of Electrical and Electronic Engineers

IF

Intermediate Frequency

IFT

InterFace Terminal

Integrated Transport Management Craft Interface Terminal (ITM-CIT)

Local manager for SDH network elements in a subnetwork. Also called the to as Craft Interface Terminal.

....

Intelligent Synchronous Multiplexer (ISM)

A network multiplexer that is designed to flexibly multiplex plesiochronous and STM-1 tributary port signals into STM-1 or STM-4 line port signals.

Intermediate System (IS)

A system that routes/relays management information. An SDH network element may be a combined Intermediate and end system.

IPS

Inter Processor Status

IS

In-Service

IS-IS Routing

The network elements in a management network, route packets (data) between each other using an IS-IS level protocol. The size of a network that is running IS-IS Level 1 is limited, and therefore certain mechanisms are employed to facilitate the management of larger networks. For STATIC ROUTING, it is possible to disable the protocol over the LAN connections and thereby effectively cause the management network to be partitioned into separate IS-IS Level 1 areas. In order for the Alcatel-Lucent OMS to communicate with a specific network element in one of these areas, the Alcatel-Lucent OMS must identify the Gateway network element through which this specific network element is connected to the LAN. All packets to this specific network element are routed directly to the Gateway network element by the Alcatel-Lucent OMS, before being re-routed (if necessary) within the Level 1 area. For DYNAMIC ROUTING an IS-IS Level 2 routing protocol is used that allows a number of Level 1 areas to interwork. The network elements that connect an IS-IS area to another area are set to run the IS-IS Level 2 protocol within the network element and on the connection to other network elements. Packets can now be routed between IS-IS areas and the Alcatel-Lucent OMS does not have to identify the Gateway network elements.

ISDN

Integrated Services Digital Network

ISO

International Standards Organisation

ITU

International Telecommunications Union

ITU-R

International Telecommunications Union - Radio standardization sector. Formerly known as CCIR: Comité Consultatif International Radio; International Radio Consultative Committee.

ITU-T

International Telecommunications Union - Telecommunication standardization sector. Formerly known as CCITT: Comité Consultatif International Télégraphique & Téléphonique; International Telegraph and Telephone Consultative Committee.

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J   Jitter

> Short term variations of amplitude and frequency components of a digital signal from their ideal position in time.

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L   LAN

> Local Area Network

LBA

> Lightwave Booster Amplifier.

LBO

> Line Build Out - An optical attenuator that guarantees the proper signal level and shape at the receiver input.

LCAS

> Link Capacity Adjustment Scheme

LCN

> Local Communications Network

LDI

> Linear Drop/Insert (Add-Drop)

LED

> Light Emitting Diode

LEN

> Local Exchange Node

LF

> Low Frequency

LH

> Long Haul

License key

> An encrypted code that is required to enable the use of specific modules in the Alcatel-Lucent OMS. Valid license keys can be obtained from your provider.

Line

> Transmission line; refers to a transmission medium, together with the associated high speed equipment, that are required transport information between two consecutive network elements, one of which originates the line signal and the other terminates the line signal.

Line Build Out (LBO)

> An optical attenuator that guarantees the proper signal level and shape at the receiver input.

LNC

> LiNe Controller (SLM)

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LO

Low Order

LOF

Loss Of Frame

LOM

Loss Of Multiframe

Loop Timing

A timing mode in which the terminal derives its transmit timing from the received line signal.

LOP

Loss Of Pointer

LOS

Loss Of Signal

Lower order Path Adaptation (LPA)

Function that adapts a PDH signal to a synchronous network by mapping the signal into or de-mapping the signal out of a synchronous container.

Lower order Path Connection (LPC)

Function that provides for flexible assignment of lower order VCs in a higher order VC.

Lower order Path Termination (LPT)

Function that terminates a lower order path by generating and adding the appropriate VC POH to the relevant container at the path source and removing the VC POH and reading it at the path sink.

LPU

Line Port Unit

LRX

Line Receiver

LS

Low Speed

LTA

Line Terminal Application

LTU

Line Termination Unit

LTX

Line Transmitter

M   MAF

Management Application Function

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Management Connection

Identifies the type of routing used (STATIC or DYNAMIC). If STATIC is selected, Management Connection allows the gateway network element to be identified. See also IS-IS Routing.

Management Information Base (MIB)

The database in the network element. Contains the configuration data of the network element. A copy of each MIB is available in the Alcatel-Lucent OMS and is called the MIB image. Under normal circumstances the MIB and MIB image of one Network Element are synchronized.

Manager

Is capable of issuing network management operations and receiving events

Manager

Capable of issuing network management operations and receiving events. The Manager communicates with the Agent in the controlled network element.

Manufacturer Executable Code (MEC)

Network element system software in binary format that is downloaded to one of the stores can be executed by the system controller of the network element.

Mapping

Gathering together of payload data with overhead, i.e. packing the PDH signal into a Virtual Container.

MDI

Miscellaneous Discrete Input

MDO

Miscellaneous Discrete Output

Mediation Device (MD)

Allows for exchange of management information between Operations System and network elements.

MEF

Maintenance Entity Function (in NE)

MEM

System MEMory unit

Message Communications Function (MCF)

Function that provides facilities for the transport and routing of Telecommunications Management Network messages to and from the Network Manager.

MF

Mediation Function

MFS

Multi Frame Synchronization signal

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MIB

The Management Information Base is the database in the node. The MIB contains the configuration data of the node. A copy of each MIB is available in the EMS and is called the MIB image. Under normal circumstances, the MIB and MIB image of one node are synchronized.

MIB image

See Management Information Base.

Midspan Meet

The capability to interface between two lightwave network elements of different vendors. This applies to high speed optical interfaces.

MLAN

MultiLAN

MMI

Man-Machine Interface Also called Human Machine Interface (HMI)

MO

Managed Object

Motif

X-Windows System supplied by Open Software Foundation.

MS

Multiplexer Section

MSOH

Multiplex Section Overhead. Part of the SOH (Section Overhead). Is accessible only at line terminals and multiplexers.

MSP

Multiplex Section Protection. Provides capability of switching a signal from a working to a protection section.

MTBF

Mean Time Between Failures

MTBMA

Mean Time Between Maintenance Activities

MTIE

Maximum Time Interval Error

MTPI

Multiplexer Timing Physical Interface

MTTR

Mean Time To Repair

Multiplexer Section OverHead (MSOH)

Part of the Section Overhead. Is accessible only at line terminals and multiplexers.

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Multiplexer Section Protection (MSP)

Provides capability of switching a signal from a working to a protection section.

Multiplexer Section Shared Protection Ring (MS-SPRING)

A protection method used in multiplex line systems.

Multiplexer Section Termination (MST)

Function that generates the Multiplexer Section Overhead in the transmit direction and terminates the Multiplexer Section Overhead in the receive direction.

Multiplexer Timing Source (MTS)

Function that provides the timing reference to the relevant component parts of the multiplex equipment and represents the SDH network element clock.

Multiplexing

A procedure by which multiple lower order path layer signals are adapted into a higher order path, or by which the multiple higher order path layer signals are adapted into a multiplex section.

....

N   **NE**

Network element. The NE is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment that performs network element functions. A Network Element has one or more standard Q-type interfaces.

NEF

Network element function

NEM

Network element manager

NEQ

Network Element Equivalence. NEQ calculations based on

Network Element (NE)

A network element is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment that performs network element functions. A Network Element has one or more standard Q-type interfaces. A network element can be directly managed by a management system. See also Node.

Network Element Equivalent (NEE)

The functionality, database size and processing power that are required from the Alcatel-Lucent OMS are different for each type of network element that is supported. Therefore each type represents a certain amount of Network Element Equivalent.

Network Mediation Unit (NMU)

Collects fault and alarm events from transmission equipment. The Alcatel-Lucent OMS can forward alarms to the NMU. The NMU can forward alarms to an Operations System.

Network Service Access Point (NSAP)

An end system address of the System Controller according to ISO 8348 AD2. The format is ISO_DCC_Alcatel-LUCENT, which has the following structure:

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NMC

Network Maintenance Center

NNE

Non-SDH network element

NNI

Network Node Interface

Node

A node or network element is defined as all equipment that is controlled by one system controller.

Node

Defined as all equipment that is controlled by one system controller. A node can not always be directly managed by a management system. See also network element.

NOMC

Network Operation Maintenance Channel

Non-revertive switching

In non-revertive switching, there is an active and standby high-speed line, circuit pack, etc. When a protection switch occurs, the standby line, circuit pack, etc., is selected causing the old standby line, circuit pack, etc., to be used for the new active line, circuit pack, etc. The original active line, circuit pack, etc., becomes the standby line, circuit pack, etc. This status remains in effect when the fault clears. Therefore, this protection scheme is "non-revertive" in that there is no switch back to the original status in effect before the fault occurred.

Non-revertive switching

In non-revertive switching there is an active and a standby high speed line, circuit pack, etc. When a protection switch occurs, the standby line, circuit pack, etc. is selected which causes the old standby line, circuit pack, etc, to be used for the new active line, circuit pack, etc. The original active line, circuit pack, etc. becomes the standby line, circuit pack, etc. This status remains in effect when the faults clears. Therefore, this protection scheme is non-revertive in that there is no switch back to the original status that was in effect before the fault occurred.

Non-synchronous

The essential characteristic of timescales or signals such that their significant instants do not necessarily occur at the same average rate.

Not Protected Domain

The Not Protected Domain for the Alcatel-Lucent OMS contains all the network elements that are managed by that Lucent OMS and are not currently protected by another Alcatel-Lucent OMS. If the Alcatel-Lucent OMS fails, the network elements in this domain are not managed by any Alcatel-Lucent OMS. See also Geographic Redundancy.

NPI

Null Pointer Indication

NRZ

Non-Return to Zero

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NSA

Non-Service Affecting

NTU

Network Termination Unit

NUT

Non pre-emptible Unprotected Traffic

NVM

Non-Volatile Memory

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O   **OA**

Optical Amplifier

OAA case tools

A software package/tool to aid the process of requirements, analysis, design and implementation of object orientated systems.

OAM&P

Operations, Administration, Maintenance and Provisioning

OC-n

Optical Carrier, Level n

ODF

Optical Distribution Frame

ODU

Optical Demultiplexer Unit

OFS

Out of Frame Second

OI

Optical Interface

OMU

Optical Multiplexer Unit

OOF

Out Of Frame

OOS

Out Of Service

Operations System (OS)

The Operations System is the system that provides operations, administration and maintenance functions.

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Operator

A user of the Alcatel-Lucent OMS application with Operator privileges. See also User Privilege.

Optical Line System (OLS)

A high-capacity lightwave system that is designed to multiplex eight optical signals with different wavelengths into one combined signal through an optical fiber. There is a difference of 1.5 micrometer in wavelength between two multiplexed signals.

OS

Operations System - A central computer-based system that is used to provide operations, administration and maintenance functions.

OSB

Optical Splice Box

OSI

Open Systems Interconnection

OW

(Engineering) Order Wire

P **PABX**

Private Automatic Branch eXchange

Paddle Board - Peripheral Control and Timing link (PB-PCT)

A small circuit board used in a 5ESS exchange for protection switching and optical to electrical conversion of the PCT-link.

Path

A logical connection between one termination point at which a standard format for a signal at the given rate is assembled and from which the signal is transmitted, and another termination point at which the received standard frame format for the signal is disassembled.

Path AIS

Path Alarm Indication Signal - A path-level code that is sent downstream in a digital network as an indication that an upstream failure has been detected and alarmed.

Path Overhead (POH)

The Virtual-Container Path Overhead provides integrity of communication between the point of assembly of a Virtual Container and its point of disassembly.

Path Terminating Equipment

Network elements in which the path overhead is terminated.

PC

Personal Computer

PCB

Printed Circuit Board

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PCM

Pulse Code Modulation

PCT-link

Peripheral Control and Timing-link

PDH

Plesiochronous Digital Hierarchy

Peer OMS

An OMS at the other end of the peer-to-peer link.

Peer to Peer link

Connection between two OMSs with Geographic Redundancy. The link is used to co-ordinate the management of a network element. See also Geographic Redundancy.

Performance Monitoring (PM)

Measures the quality of service and identifies degrading or marginally operating systems (before an alarm is generated).

Peripheral Control and Timing Facility Interface (PCTFI)

A proprietary physical link interface that supports the transport of 21 * 2 Mbit/s signals.

PI

Physical Interface, Plesiochronous Interface

PIR

Peak Information Rate

PJE

Pointer Justification Event

Platform

Family of equipment and software configurations that are designed to support a particular Application.

Plesiochronous Network

A network that contains multiple subnetworks, each of which is internally synchronous and operates at the same nominal frequency, but the timing of any of the subnetworks may be slightly different at any particular instant.

PLL

Phase Lock Loop

PM

Performance Monitoring - Measures the quality of service and identifies degrading or marginally operating systems (before an alarm is generated).

PMA

Performance Monitoring Application

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Pointer

An indicator whose value defines the frame offset of a virtual container with respect to the frame reference of the transport entity on which the Virtual Container is supported.

POTS

Plain Old Telephone Service

PP

Pointer Processing

PPC

Pointer Processor and Cross-connect

PPDE

Ethernet Dropped Frames due to errors

Primary OMS

An OMS that usually manages a network element. If the primary OMS fails, management of the network element is passed over to the secondary OMS. A network element should be provisioned normally on the primary OMS and then be configured for use on the secondary OMS. See also Geographic Redundancy.

Primary Reference Clock (PRC)

The main timing clock reference in SDH equipment.

Protected Domain

The protected domain for an OMS contains all the network elements for which this manager is the primary OMS and which are protected by another secondary OMS. See also Geographic Redundancy.

Protecting Domain

The protecting domain for an OMS contains all the network elements for which this manager is the secondary OMS. See also Geographic Redundancy.

Protection

Extra capacity (channels, circuit packs) in transmission equipment that is not intended to be used for service, but rather to serve as backup against equipment failures.

Provisioning

Assigning a value to a system parameter.

PSA

Partially Service Affecting

PSDN

Public Switched Data Network

PSF

Power Supply Filter

PSF-SIP

Power Supply Filter; originally designed for an Italian customer.

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PSN

Packet-Switched Network

PSTN

Public Switched Telephone Network

PT

Protected Terminal Power-supply filter and Timing circuit pack

PVID

Port VLAN ID

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Q   **Q-LAN**

Thin Ethernet LAN (10BaseT) that connects the manager to gateway network elements so that management information can be exchanged between network elements and management systems.

QAF

Q-Adapter Function (in NE)

QoS

Quality of Service

Quality Level (QL)

The quality of the timing signal(s) that are provided to clock a network element. The level is provided by the Synchronization Status Marker which can accompany the timing signal. If the System and Output Timing Quality Level mode is "Enabled", and if the signal selected for the Station-Clock Output has a quality level below the Acceptance Quality Level, the network element "squelches" the Station-Clock Output Signal, which means that no signal is forwarded at all. Possible levels are: - PRC (Primary Reference Clock) - SSU_T (Synchronization Supply Unit - Transit) - SSU_L (Synchronization Supply Unit - Local) - SEC (SDH Equipment Clock) - DUS (Do not Use for Synchronization).

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R   **RA**

Regenerator Application

Radio Protection Switching system (RPS)

The main function of the RPS is to handle the automatic and manual switching from a main channel to a common protection channel in an N+1 system.

Radio Relay (RR)

A point-to-point Digital Radio system to transport STM-1 signals via microwaves.

RCU

Rigid Connect Unit

RCVR Data Distribution Unit (RCVR)

Radio Relay circuit pack that distributes of the protection channel and the low-priority traffic in the receiver side.

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RDDU

RCVR Data Distribution Unit

RDI

Remote Defect Indicator. Previously known as Far End Receive Failure (FERF).

RDI

Ring Drop/Insert (Add-Drop)

RDSV

Running Digital Sum Violations

Receive-direction

The direction towards the cross-connect.

REGEN

Regenerator

Regenerator Loop

Loop in a network element between the Station Clock Output(s) and one or both Station Clock Inputs, which can be used to dejitterize the selected timing reference in network applications.

Regenerator Overhead Controller (ROC)

SLM circuit pack that provides user access to the SDH overhead channels at repeater sites.

Regenerator Section Termination (RST)

Function that generates the Regenerator Section Overhead (RSOH) in the transmit direction and terminates the RSOH in the receive direction.

REI

Remote Error Indication. Previously known as Far End Block Error (FEBE).

Relay Unit (RU)

Radio Relay circuit pack whose main function is to perform protection switching when the Alignment Switch in the demodulator unit is unable to perform protection switching.

Restore Timer

Counts down the time (in minutes) during which the switch waits to let the worker line recover before switching back to it. This option can be set to prevent the protection switch continually switching if a line has a continual transient fault. This field is greyed out if the mode is non-revertive.

Revertive Switching

In revertive switching, there is a working and protection high speed line, circuit pack, etc. When a protection switch occurs, the protection line, circuit pack, etc. is selected. When the fault clears, service reverts back to the original working line.

RF

Radio Frequency

RFI

Remote-Failure Indicator

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RGU

ReGenerator Unit

Route

A series of contiguous digital sections.

RPS

Ring Protection Switching

RSOH

Regenerator-Section OverHead; part of the SOH.

RZ

Return to Zero

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S   **SA**

Service Affecting Synchronous Adapter

SAI

Station Alarm Interface

SC

Square coupled Connector

SD

Signal Degrade

SDH

Synchronous Digital Hierarchy. Definition of the degree of control of the various clocks in a digital network over other clocks.

SDH-TE

SDH - Terminal Equipment

SEC

SDH Equipment Clock

Secondary OMS

Backup OMS for a network element should the primary OMS fail. A network element should be provisioned normally on the primary OMS and then be configured for use on the secondary OMS. See also Geographic Redundancy.

Section

A transport entity in the transmission media layer that provides integrity of information transfer across a section layer network connection by means of a termination function at the section layer.

Section Adaptation (SA)

Function that processes the AU-pointer to indicate the phase of the VC-3/4 POH relative to the STM-N SOH and assembles/disassembles the complete STM-N frame.

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Section Overhead (SOH)

Capacity added to either an AU-4 or to an assembly of AU-3s to create an STM-1. Always contains STM-1 framing and can contain maintenance and operational functions. SOH can be subdivided into MSOH (multiplex section overhead) and RSOH (regenerator section overhead).

SEF

Support Entity Function (in NE)

Self-healing

A network's ability to automatically recover from the failure of one or more of its components.

Server

Computer in a computer network that performs dedicated main tasks that require generally sufficient performance. See also Client.

Service

The operational mode of a physical entity that indicates that the entity is providing service. This designation will change with each switch action.

Severely Errored Frame Seconds (SEFS)

A performance monitoring parameter.

Severely Errored Second (SES)

A second that has a binary error ratio. SES is used as a performance monitoring parameter.

Severity

See Alarm Severity

SFP

Small Form-Factor Pluggable Optics

SH

Short Haul

SHDSL

Single-pair high-speed Digital Subscriber Line

SI

Synchronous Interface

SIB

Subrack Interface Box

SLC

Subscriber Loop Carrier

SLM

Signal Label Mismatch

Smart Communication Channel (SCC)

An HDLC messaging channel between the SDH-TE and the 5ESS host node. Similar to the DCC messaging channels that are located in the STM-N section overhead.

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SML

Service Management Level

SMN

SDH Management Network

SMS

SDH Management Subnetwork

SNC/I

SubNetwork Connection (protection)/Inherent monitoring

SNC/NI

SubNetwork Connection/Non Intrusive monitoring

SNR

Signal to Noise Ratio

Soft Windows

PC emulator package for HP platforms.

SOH

Section Overhead. Capacity added to either an AU-4 or to an assembly of AU-3s to create an STM-1. Always contains STM-1 framing and can contain maintenance and operational functions. SOH can be subdivided in MSOH (Multiplex Section OverHead) and RSOH (Regenerator Section OverHead).

SONET

Synchronous Optical Network

Space Diversity (SD)

Reception of the Radio signal via mirror effects on Earth.

SPB2M

Subrack Protection for 2 Mbit/s Board

Specification and Design Language (SDL)

This is a standard formal language for specifying (essentially) finite state machines.

SPI

SDH Physical Interface Synchronous-Plesiochronous Interface

Squelch Map

Traffic map for SLM Add-Drop Multiplexer network elements that contains information for each cross-connection in the ring and indicates the source and destination network elements for the low-speed circuit to which the cross-connection belongs. This information is used to prevent traffic misconnection in rings that have isolated network elements or segments. See also Cross-Connect Map.

SSM

Synchronization Status Marker

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Standby

The operational mode of a physical entity that indicates that the entity is not providing service, but standby. This designation changes with each switch action.

Standby

The operational mode of a physical entity that indicates that the entity is not providing service but is on standby. This designation will change with each switch action.

Station Clock Input (SCI)

An external clock may be connected to a Station Clock Input.

Station Clock Output (SCO)

A clock signal that can be used for other systems.

STM

Synchronous Transport Module Building block of SDH.

STM

Synchronous Transport Module building block of SDH

STP

Spanning Tree Protocol

Stretched Ring (STRING)

An open ring in which each node is an Add-Drop Multiplexer. The end nodes operate with one equipped high-speed line.

STS

Synchronous Transport Signal; used in SONET.

STVRP

Spanning Tree with VPN Registration Protocol

Subnetwork

A group of interconnected/interrelated network elements. The most common connotation is an SDH network in which the network elements have Data Communications Channels (DCC) connectivity.

Supervisor

A user of the OMS application with Supervisor privileges. See also User Privilege.

Supervisory Unit (SU)

Radio Relay circuit pack that gives comprehensive supervision and control facilities to the user by collecting information from the Alarm Collection Units and Alarm Adapter Units.

SVCE

Service

Switch Receive Unit (SWR)

SLM circuit pack that provides the cross-connect in the receive direction between high speed line timeslots and low speed tributaries.

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Switch Transmit Unit (SWT)

SLM circuit pack that provides the cross-connect in the transmit direction between high speed line timeslots and low speed tributaries.

Switching Module (SM)

An access module from the 5ESS switch.

Synchronization Supply Unit (SSU)

A circuit pack that recovers and reshapes the clock signal in order to filter out jitter. Local (SSU_L) and Transit (SSU_T) types are available.

Synchronous

The essential characteristic of time-scales or signals such that their corresponding significant instants occur at precisely the same average rate.

Synchronous Digital Hierarchy (SDH)

A hierarchical set of digital transport structures that is standardized for the transport of suitably adapted payloads over transmission networks.

Synchronous Equipment Management Function (SEMF)

Function that converts performance data and implementation-specific hardware alarms into object-oriented messages for transmission over the DCC and/or the Q-interface. The SEMF also converts object-oriented messages that are related to other management functions so that they can pass across the S reference points.

Synchronous Line Multiplexer (SLM)

A line multiplexer that is designed to multiplex VC-4 and STM-1 tributary port signals into STM-16 line port signals.

Synchronous Network

The synchronization of synchronous transmission systems with synchronous payloads to a master Network clock that can be traced to a single reference clock.

Synchronous Transport Module (STM)

The information structure that is used to support (section layer) connections in SDH.

System Administrator

A user of the computer system on which the OMS application can be installed. See also User Privilege.

System Controller (CTL)

ISM circuit pack that controls the configuration of an Intelligent Synchronous Multiplexer system.

System Controller (SC)

A circuit pack that controls and provisions all units. It also contains the data communication packet switch functionality that is necessary for routing of management information between network elements and their management system.

System Controller (SCT)

SLM Line Terminal and Regenerator network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The SCT circuit pack provides

....

overall administrative control of the system. The SCT memory is included in the same one circuit pack.

System Controller (STC)

SLM Add-Drop Multiplexer network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The STC circuit pack provides overall administrative control of the system. The STC memory is provided by the MEM circuit pack.

System Controller (SYSCTL)

OLS circuit pack that provides the highest level of system control for the Optical Line System. The SYSCTL circuit pack provides overall administrative control of the system. The SYSCTL memory is provided by the SYSMEM circuit pack.

System Memory Unit (MEM)

SLM Add-Drop Multiplexer network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The MEM circuit pack provides memory support for the System Controller (STC) circuit pack.

System Memory Unit (SYSMEM)

OLS circuit pack that provides the highest level of system control for the Optical Line System. The SYSMEM circuit pack provides memory support for the SYSCTL circuit pack.

T **TCA**

Threshold Crossing Alarm

TCP/IP

Transmission Control Protocol/Internet Protocol

TDEV

Timing DEViation

TDM

Timing Division Multiplexing

Template

A collection of parameters that define a specific network element configuration. A template gives the user the opportunity to configure parameters in a network element with a single operation. The template is re-usable and allow the user to configure the parameters in many Network Elements in the same way. A set of default templates is provided, and the user can create new templates and edit or delete user-created ones. Note that a template is always associated with one specific network element type and can not be used for other network element types.

TERM

Terminal Multiplexer

TGU

Timing Generator Unit

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TI

Timing Interface

TLM

TeLeMetry Unit

TLP

Terminal with Line Protection

TMN

Telecommunications Management Network

TPU-PCT

Tributary Port Unit - Peripheral Control and Timing link

TPU155

Tributary port Unit 155 Mbit/s

TPU2

Tributary port Unit 2 Mbit/s

Transmit-direction

The direction outwards from the cross-connect.

Trellis Code Modulation

A combined coding and modulation scheme for improving the reliability of a digital transmission system without increasing the transmitted power or the required bandwidth.

TRF

TRansFer unit

Tributary

A signal of a specific rate (2 Mbit/s, 34 Mbit/s, 140 Mbit/s, VC12, VC3, VC4, STM-1 or STM-4) that may be added to or dropped from a line signal.

Tributary Overhead Controller (TOC)

SLM circuit pack that allows access to the overhead bytes of the incoming tributary signal.

Tributary Overhead Controller (TOHCTL)

OLS circuit pack that allows access to the overhead bytes of the Supervisory channel.

Tributary Unit (TU)

An information structure that provides adaptation between the lower order path layer and the higher path layer. Consists of a VC-n plus a tributary unit pointer TU PTR.

Tributary Unit Pointer (TU PTR)

Indicates the phase alignment of the VC with respect to the TU in which it resides. The pointer position is fixed with respect to the TU frame.

TSA

Time Slot Assignment

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TSI

Time Slot Interchange

TTP

Trail Termination Point

TUG

Tributary Unit Group

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U   **UAS**

UnAvailable Seconds

ULDT

Ultra Long Distance Transmission

Unavailable Seconds

A performance monitoring parameter.

Uninterruptable Power Supply (UPS)

Allows connected computer equipment to gracefully shutdown and therefore prevents damage in the case of a power failure. Also absorbs dips in the power supply.

Universal Co-ordinated Time (UTC)

An indication of the time of an event that is independent of the time-zone in which the event occurred. The local time can be calculated from the Universal Co-ordinated Time.

Upgrade

An upgrade is the addition of new capabilities (feature). An upgrade requires new software and may require new hardware.

UPL

User PaneL

Upstream

At or towards the source of the considered transmission stream, i.e. in the direction that is opposite to the direction of transmission.

User Privilege

A permission of a user that allows to perform actions on the computer system on which the OMS application runs. There are the following different types of users:

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V   **Value**

A number, text string, or other menu selection that is associated with a parameter.

VCAT

Virtual Concatenation

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VF

Voice Frequency

Virtual Container (VC)

Container with a path overhead.

VLAN

Virtual LAN

VPN

Virtual Private Network

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W   **Wait to Restore Time (WRT)**

The time to wait before switching back after a failure has cleared in a revertive protection scheme. This time can be between 0 and 15 minutes, in increments of one minute.

WAN

Wide Area Network

Wander

Long term variations of amplitude frequency components (below 10 Hz) of a digital signal from their ideal position in time. Wander can result in buffer problems at a receiver.

WDM

Wavelength Division Multiplexing

What You See Is What You Get (WYSIWYG)

Information as displayed on the screen will appear in the same way on printed output.

Wideband Communications

Voice, data, and/or video communication at digital rates from 64 kbit/s to 2 Mbit/s.

Windows

Graphical User Interface on PC systems.

Working

Label attached to a physical entity. In the case of revertive switching the working line or unit is the entity that carry service under normal operation. In the case of non-revertive switching this label has no particular meaning.

WS

WorkStation

WSF

Work Station Facility

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X   **X-Terminal**

Workstation that can support an X-Windows interface

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XMTR

Transmitter

XSU

XMTR Switch Unit

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