AXX 9100 CONNECT

R1.0

Technical Reference

ERICSSON

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1 System Overview

1.1 General

This is the Technical Reference manual describing the features and hardware for AXX 9100 CONNECT .

1.2 AXX 9100 CONNECT OVERVIEW

The AXX 9100 CONNECT is an Integrated Access Device (IAD) for use in fibre-based networks. The AXX 9100 CONNECT connects end customers to operators network. It handles both Ethernet-and TDM-traffic and is able to interface to a TDM backbone network.

It can also be used as a Multi-Service Provision Platform (MSPP) to build the infrastructure in the metro access area.

The AXX 9100 CONNECT is a very flexible network component that can be used in star networks, ring networks, chained networks and meshed networks. It supports both terminal multiplexing (TM) and add and drop multiplexing (ADM) applications.

The AXX 9100 CONNECT is a fully working standalone SDH network element (NE). An element manager (EM) or a network manager (NM) that supervises both the Ethernet- and TDM-parts of the system manages the AXX 9100 CONNECT remotely. Local and remote craft interfaces are also supported with a similar user interface.

The AXX 9100 CONNECT consists of a low-cost shelf (compatible with 19" or ETSI racks) with support for a variety of service modules and aggregate interfaces. Two kinds of options for chassis can be ordered. The difference between them is with or without fixed 16xE1 interfaces. The two aggregate interfaces can be either the STM-1 or STM-4 kind. STM-4 is a licensed feature, which may be supplied activated from factory or operator in field can upload a license key via TFTP. The interfaces being "fixed" in AXX 9100 CONNECT are hereafter described as the "aggregate module".

Two slots are available for service modules. E.g. nxE1, 4xFE + SMAP, 3xE3 etc. may be fitted in here. These modules supports hot insertion.

The fan module in AXX 9100 CONNECT may be replaced in field, supports hot insertion and provides ventilation for high temperature environments

The rear side of the AXX 9100 CONNECT with 16 fixed E1 interfaces is shown in Figure 1

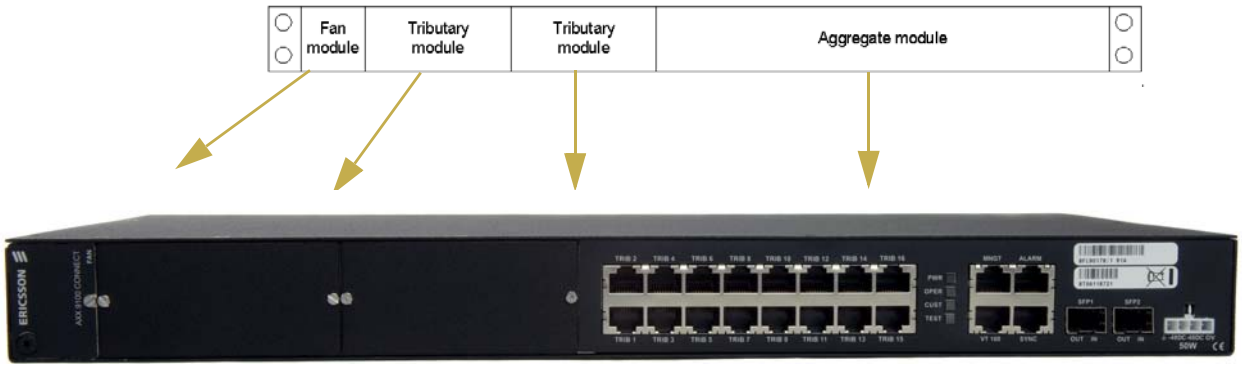

Figure 1 AXX 9100 CONNECT rear view

1.3 Applications of AXX 9100 CONNECT

1.3.1 AXX 9100 CONNECT as an ADM

The main application for AXX 9100 CONNECT is to use it as an ADM. A number of sites are connected together with a ring network topology. The AXX 9100 CONNECT is used to drop traffic in the different sites. This is shown in Figure 2

The AXX 9100 CONNECT is typically deployed in the operator's point of presence, but it may also be deployed in customer sites. The AXX 9100 CONNECT must be mounted in a room that is only accessible for the operators if more than one customer shall be handled in a site.

The AXX 9100 CONNECT provides a number of services at the sites (e.g. TDM leased lines, ISDN PRA, Ethernet leased lines and Internet access).

The AXX 9100 CONNECT can be connected to one or multiple customers at a site. The aggregate capacity and the number of

physical interfaces limit the number of customers. The physical interfaces can be E1, E3 and FE.

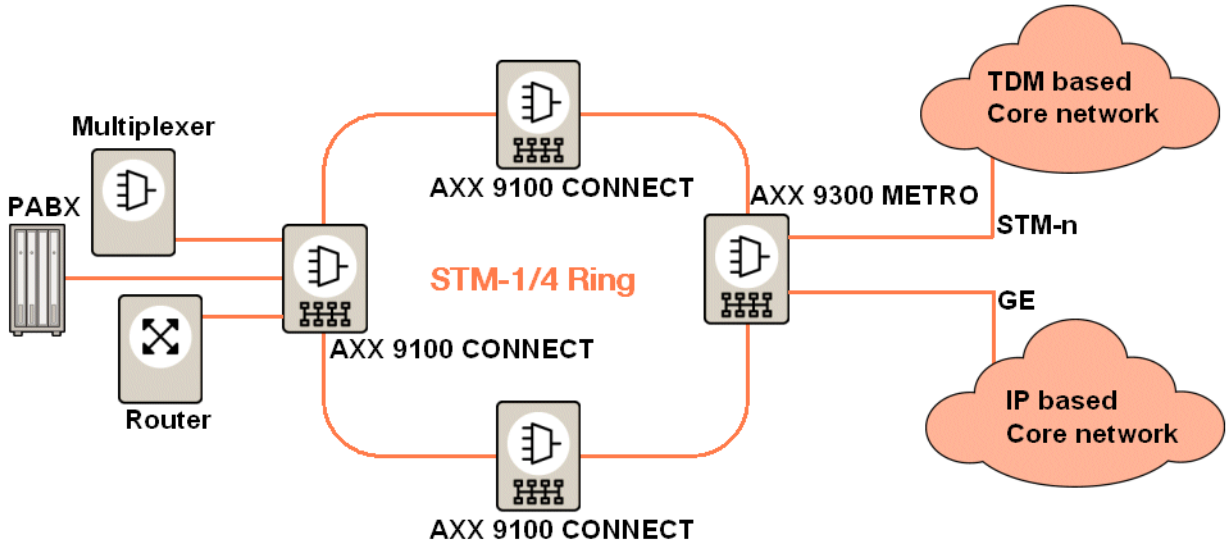

Figure 2 A typical system with AXX 9100 CONNECT used as an ADM

1.3.2 AXX 9100 CONNECT as an Integrated Access Device

The AXX 9100 CONNECT can also be used as an IAD at the customer premises as shown in Figure 3

The AXX 9100 CONNECT concentrates local TDM and Ethernet based traffic at the customer premises before sending it to the operators network. The IAD deliver the services from the operators to the end customer.

The AXX 9100 CONNECT can be connected to one or multiple customers at a site. The aggregate capacity and the number of physical interfaces limit the number of customers.

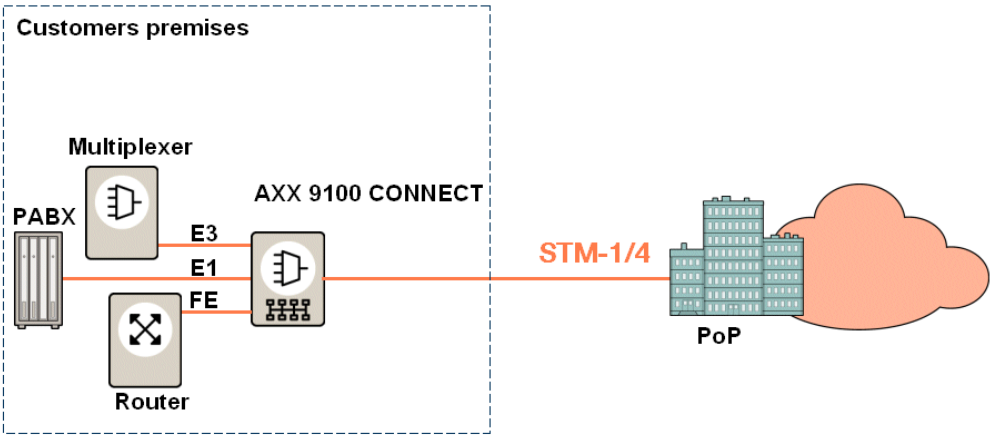

Figure 3 AXX 9100 CONNECT used as an IAD

The AXX 9100 CONNECT support different protection schemes as shown in Figure 4
Link protection is supported with MSP 1+1 for the aggregate interfaces. SNC protection is used in ring topologies and for dual homing applications.Lcas can be used as protection mechanism for Ethernet.

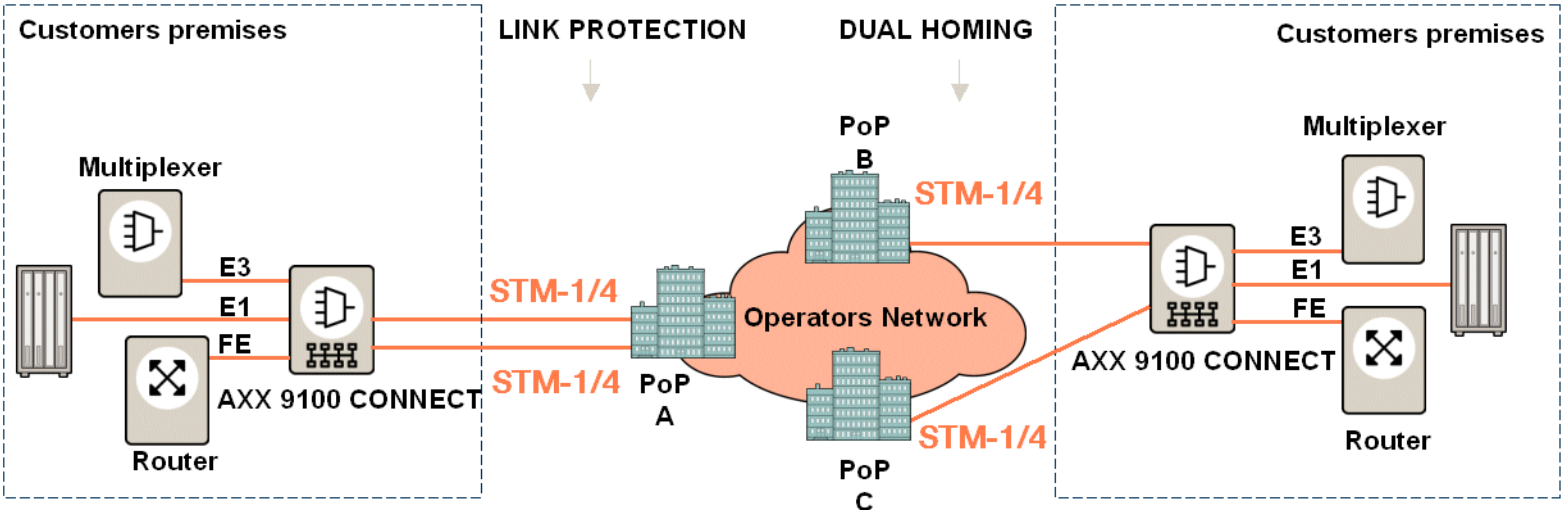

Figure 4 AXX 9100 CONNECT protection schemes

1.4 MODULES

1.4.1 General information

AXX 9100 CONNECT is based on a modular concept and supports three different types of modules. The shelf has room for an aggregate module, two tributary modules and a fan module.

The chassis includes a small back plane for interconnection between the different modules.

The interconnections between the modules are shown in Figure 5

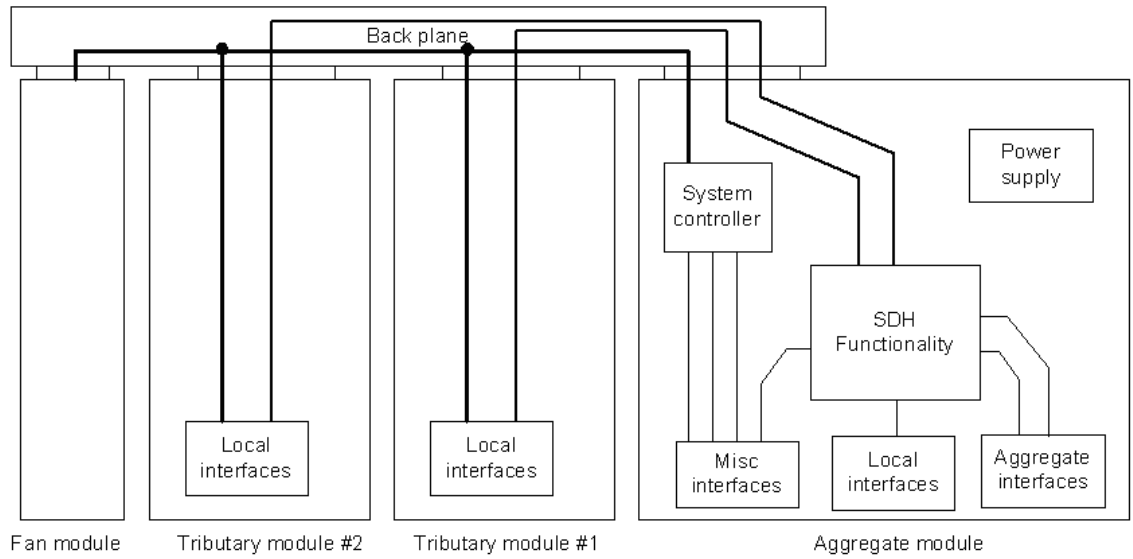

Figure 5 Overview of modules for AXX 9100 CONNECT

Figure 6 Service modules - *Slot positions*

1.4.1.1 Positioning of Service modules

Service modules that can be placed in **slot 3**:

TM-4xFEL2-4xMAP-RJ45 (can only be used in this slot position)

TM-3xE3/T3-1.0/2.3

Service modules that can be placed in **slot 4**:

TM-3xE3/T3-1.0/2.3

Details on the different modules found in:

“AM-2xSTM1/4-16xE1-SFP”

“AM-2xSTM1/4-SFP”

“AC Power Adaptor”

“TM-3xE3/T3-1.0/2.3”

“TM-4xFEL2-4xMAP-RJ45”

1.4.2 FM-FAN

Overview

The module is a fan module that only includes 2 independent fans. All fan control functionality is included in the Aggregate Module. Very basic inventory information is coded in the printed circuit board (PCB).

Usually only a single fan is active at a time. The fan is activated for a specified time (24 hour). When the fan has been active for the specified time the fan is stopped and the other fan is activated. This is done to increase the MTBF for the fan module.

An alarm is reported if a fan fails. The other fan runs continuously if a fan fails. The fan module should be replaced if this happens since the remaining fan is not protected anymore.

Feature summary of FM-FAN module

Description
The module has two fans
The fans are controlled from the AM
It is possible to change a fan module without affecting the rest of the system in the shelf
Inventory EEPROM not include in the module

Table 1 Feature summary - FM-FAN

1.4.3 DEFINITIONS

1.4.3.1 Shelf

The shelf consists of the mechanical sub-rack with an internal back plane.

1.4.3.2 Module

A module consists of one or multiple cards, sub-modules, interface modules and mechanical parts (e.g. front panel, ejectors, shielding plate, etc.) that can be plugged into a shelf as a single physical unit.

1.4.3.3 Sub-module

A small module consisting of one or multiple cards, interface modules and mechanical parts that can be plugged into a module.

1.4.3.4 Interface module

A physical interface module that can be plugged into a module or a sub-module (e.g. modules based on the SFP multi-source agreement)

1.4.3.5 Card

A single printed circuit board with components.

1.4.3.6 Hitless

Used in protection switching and denote less than 50ms traffic disruption.

1.4.3.7 Errorless

Used in protection switching and denote no bit errors.

1.4.3.8 Upstream

The direction towards the matrix.

1.4.3.9 Downstream

The direction from the matrix.

1.4.3.10 Uplink

The uplink concept is used in ISDN PRA and it is defined as the direction from the TE towards the ET.

1.4.3.11 Downlink

The downlink concept is used in ISDN PRA and it is defined as the direction from the ET towards the TE.

1.4.3.12 Line loopback

The incoming (upstream) signal is looped back towards the line. The loopback shall be as close as possible to the physical interface.

1.4.3.13 Terminal loopback

The outgoing (downstream) signal is looped back towards the matrix. The loopback shall be as close as possible to the physical interface.

1.4.3.14 EOS mapper

A functionality that maps Ethernet traffic into SDH virtual containers.

1.4.3.15 LANx port

This is a standard physical Ethernet port according to IEEE specifications. The LANx port is internally connected to a port on the internal Ethernet switch for L2 functions or to an EOS mapper for L1 functions

1.4.3.16 WANx port

This is a port on the internal Ethernet switch that is always connected to an EOS mapper.

1.5 ABBREVIATIONS

Abbreviation	Description
2F	Two fibre
4F	Four fibre
AC	Alternating Current
ADM	Add and drop multiplexer
AIS	Alarm Indicating Signal
ALS	Automatic Laser Shutdown
AM	Aggregate Module
ANSI	American National Standards Institute
ARP	Address Resolution Protocol
AUG	Administrative Unit Group
B3ZS	Bipolar 3 Zero Substitution
BALUN	BALanced to UNbalanced
BBE	Background Block Error
BBER	Background Block Error ratio
BPDU	Bridge Protocol Data Unit
BW	Bandwidth
CIR	Committed Information Rate
CBR	Committed Burst Rate
CLI	Command Line Interface
CLNP	ConnectionLess Network Protocol
CMI	Coded Mark Inversion
COS	Class Of Service
CORBA	Common Object Request Broker Architecture
CPE	Customer Premises Equipment
CPLD	Complex Programmable Logic Device
CPR	Coupled Power Ratio
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CT	Craft Terminal
CU	Consolidation Unit
CWDM	Cource Wavelength Division Multiplexing
DC	Direct Current
DCC	Data Communication Channel
DCCX	Data Communication Channel Cross-connect

Abbreviation	Description
DCD	Duty Cycle Distortion
DCN	Data communication network
DECNET	Digital Equipment Corporation Networking architecture
DMUX	DeMultiplexer
DNU	Do Not Use
DSCP	DiffServe Code Points
DSUB	SubMiniature D connector
DWDM	Dense Wavelength Division Multiplexing
EBR	Excessive Burst Rate
EEPROM	Electrical Erasable Programable Read Only Memory
EIR	Excessive Information Rate
E-LAN	Ethernet LAN service
E-LINE	Ethernet LINE service
EM	Element manager
EMC	ElectroMagnetic Compatibility
EMEA	Europe, Middle East and Africa
EOS	Ethernet Over SDH
EPL	Ethernet Private Line
EPLAN	Ethernet Private LAN
ES	Errored Second
ESR	Errored Second Ratio
ET	Exchange Terminal
ETSI	European Telecommunications Standards Institute
EVPL	Ethernet Virtual Private Line
EVPLAN	Ethernet Virtual Private LAN
FC/PC	Fibre Connector/Polished Contact
FCS	Frame Check Sequence
FE	Fast Ethernet
FIFO	First In First Out
FPGA	Field Programmable Gate Array
GARP	Generic Attribute Registration Protocol
GE	Gigabit Ethernet
GFP	Generic Framing Procedure
GMRP	GARP Multicast Registration Protocol
GUI	Graphical User Interface

Abbreviation	Description
GVRP	GARP VLAN Registration Protocol
GW	GateWay
HDB3	High Density Bipolar order 3
HDLC	High-level Data Link Control
HEC	Header Error Check
HO	Hold Off time
HOLB	Head Of Line Blocking
I2C(IIC)	Inter-IC bus
IAD	Integrated Access Device
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPPM	Intermediate Path Performance Monitoring
IPX	Internetwork Packet eXchange
IS	Intermediate System
ISDN	Integrated Services Digital Network
ISO	International organisation for standardisation
ITU	International Telecommunication Union
L1	Layer 1
L2	Layer 2
L3	Layer 3
LACP	Link Aggregation Control Protocol
LACPDU	LACP Data Unit
LAN	Local Area Network
LAG	Link Aggregation Group
LAPS	Link Access Procedure SDH
LC	Lucent Connector
LCAS	Link Capacity Adjustment Scheme
LED	Light Emitting Diode
LFA	Loss of Frame Alignment
LFH	Low Force Helix
LLC	Logical Link Control
LOF	Loss Of Frame alignment

Abbreviation	Description
LOS	Loss Of Signal
MAC	Management Communication Network
MDI	Medium Dependent Interface
MMF	Multi Mode Fibre
MPLS	Multi protocol Label Switching
MSA	Multi Source Agreement
MSOH	Multiplex Section OverHead
MSP	Multiplex Section Protection
MSPP	Multi Service Provision Platform
MS-AIS	Multiplex section - Alarm Indication Signal
MS-SPRING	Multiplex Section Shared Protection Rings
MSTP	Multiple Spanning Tree Protocol
MTBF	Mean Time Between failures
MUX	Multiplexer
NE	Network Element
NetBIOS	Network Basic Input/Output System
NIM	Non Intrusive Monitoring
NM	Network manager
NNI	Network Network Interface
NSAP	Network Service Access Point
OAM	Operation Administration Maintenance
OSI	Open System Interconnect
OSPF	Open Shortest Path First
PABX	Public Access Business eXchange
PC	Personal Computer
PCB	Printed Circuit Board
PCI	Physical Coding Sublayer
PFI	Payload FCS Identifier
PHY	PHYsical layer device
PJE	Pointer Justification Event
PJEL	Pointer Justification Event Limit
PM	Performance Monitoring
PMA	Physical Medium Attachment
PMD	Physical Medium Dependent
POP	Point Of Presence

Abbreviation	Description
PPP	Point to Point Protocol
PRA	Primary Rate Access
PRC	Primary Reference Clock
PSC	Protection Switch Count
PSD	Protection Switch Duration
QL	Quality Level
QLM	Quality Level Minimum Threshold
RDI	Remote Defect Indicator
RFC	Request For Comments
RMII	Reduced Media Independent Interface
RMON	Remote MONitoring
RMS	Root Mean Square
RS-TIM	Regenerator Section - Trace Identifier Mismatch
RSOH	Regenerator Section OverHead
RSTP	Rapid Spanning Tree Protocol
RTC	Real Time Clock
RU	Rack Units
SA	Spare bits
SC	Subscription Channel Connector
SDH	Synchronous Digital Hierarchy
SDRAM	Synchronous Dynamic Random Access Memory
SEC	SDH Equipment Clock
SERDES	Serialiser deserialiser
SES	Severely Errored Second
SESR	Severely Errored Second Ratio
SETS	Station Equipment Timing Synchronisation
SFP	Small Form-factor Pluggable
SLA	Service Level Agreement
SMF	Single Mode Fibre
SNA	System Network Architecture
SNAP	Sub Network Access Protocol
SNC/I	Sub Network Connection/Inherent
SNC/N	Sub Network Connection/Non Inherent
SNCP	Sub Network Connection Protection
SNMP	Simple Network Management Protocol

Abbreviation	Description
SONET	Synchronous Optical NETwork
SSM	Synchronisation Status Messages
SSU	Synchronisation Supply Unit
STM	Synchronous Transport Module
STP	Spanning Tree Protocol
TBA	To Be Added
TBD	To Be Decided
TDM	Time Division Multiplexing
TE	Terminal Equipment
TM	Tributary module
TMF	TeleManagement Forum
TMN	Telecommunication Management Network
TOS	Type Of Service
UART	Universal Asynchronous Receiver Transmitter
UAS	Unavailable Seconds
UNI	User Network Interface
USB	Universal Serial Bus
UTP	Un-screened Twisted Pair
VC	Virtual Container
VCG	Virtual Container Group
VID	VLAN IDentifier
VLAN	Virtual Local Area Network
VTP	VLAN Trunk Protocol
WAN	Wide Area Network
WTR	Wait To Restore
XFP	10 gigabit Small Form-factor Pluggable

2 Features

2.1 SDH features

2.1.1 Multiplexing structure

The AXX 9100 CONNECT complies with the basic multiplexing principles outlined in Clause 6 in ITU-T G.707 and ETSI EN 300147 clause 4.

The AXX 9100 CONNECT supports the multiplexing structure outlined in Figure 7 This is a subset of the possible multiplexing structures defined in ITU-T G.707 clause 6 and ETSI EN 300 147 clause 4.

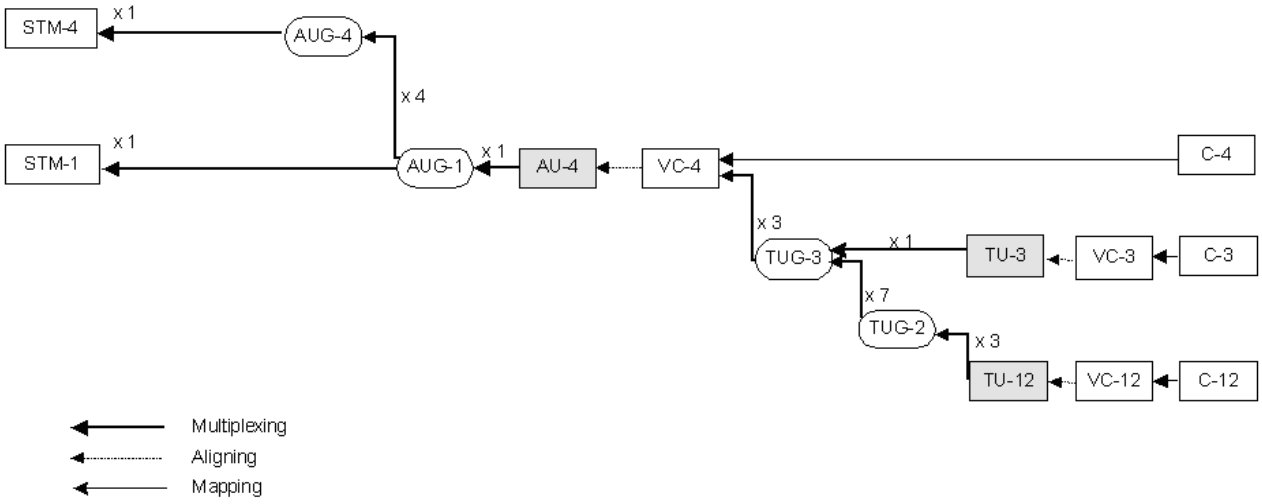

Figure 7 Supported multiplexing structures

The AXX 9100 CONNECT complies with the multiplexing methods outlined in clause 7 in ITU-T G.707 and ETSI EN 300 147 clause 5 for the supported multiplexing structures.

2.1.2 Mapping of tributaries into VC-n

Asynchronous mapping of 44 736 kbps

The AXX 9100 CONNECT supports asynchronous mapping of 44 736 Kbps signal into a VC-3 container as shown in Figure 8 The mapping is in accordance to ITU-T G.707 clause 10.1.2.1 and ETSI EN 300 147 Clause 8.

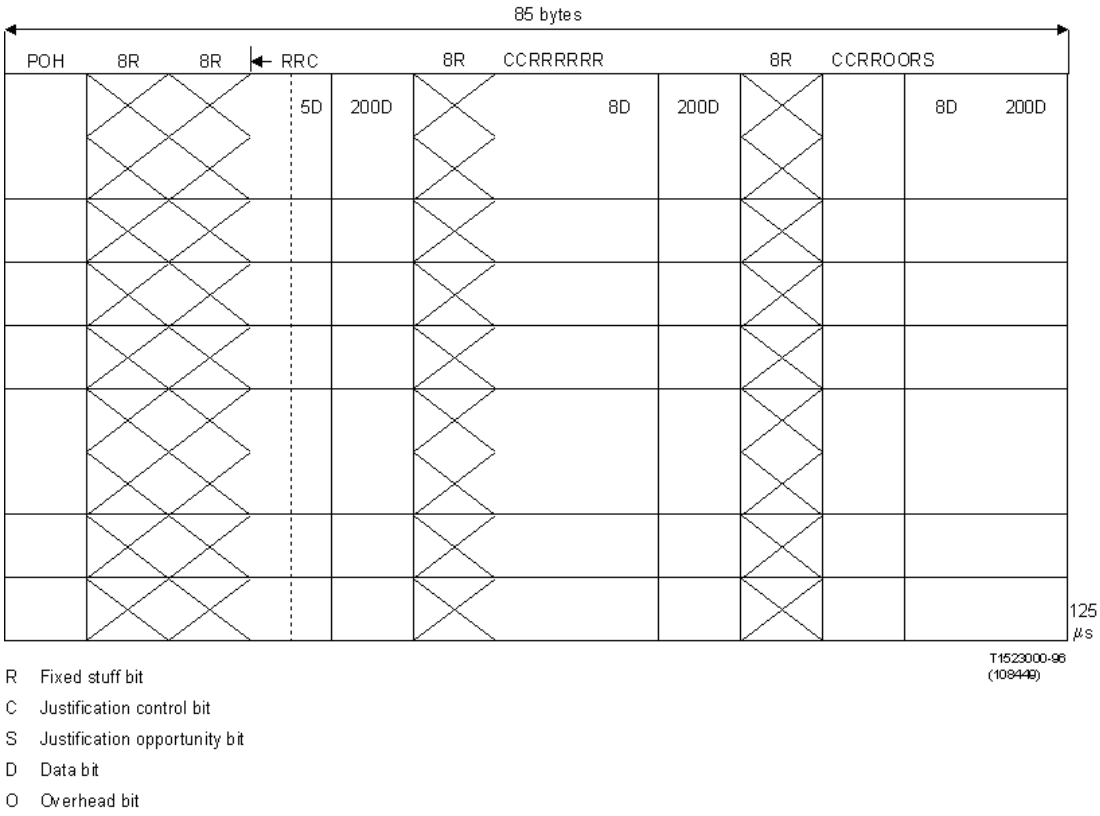

Figure 8 Asynchronous mapping of 44 736 kbps tributary into VC-3

Asynchronous mapping of 34 368 kbps

The AXX 9100 CONNECT supports asynchronous mapping of 34 368 kbps signal into a VC-3 container as shown in Figure 9 The mapping is in accordance to ITU-T G.707 clause 10.1.2.2 and ETSI EN 300 147 Clause 8

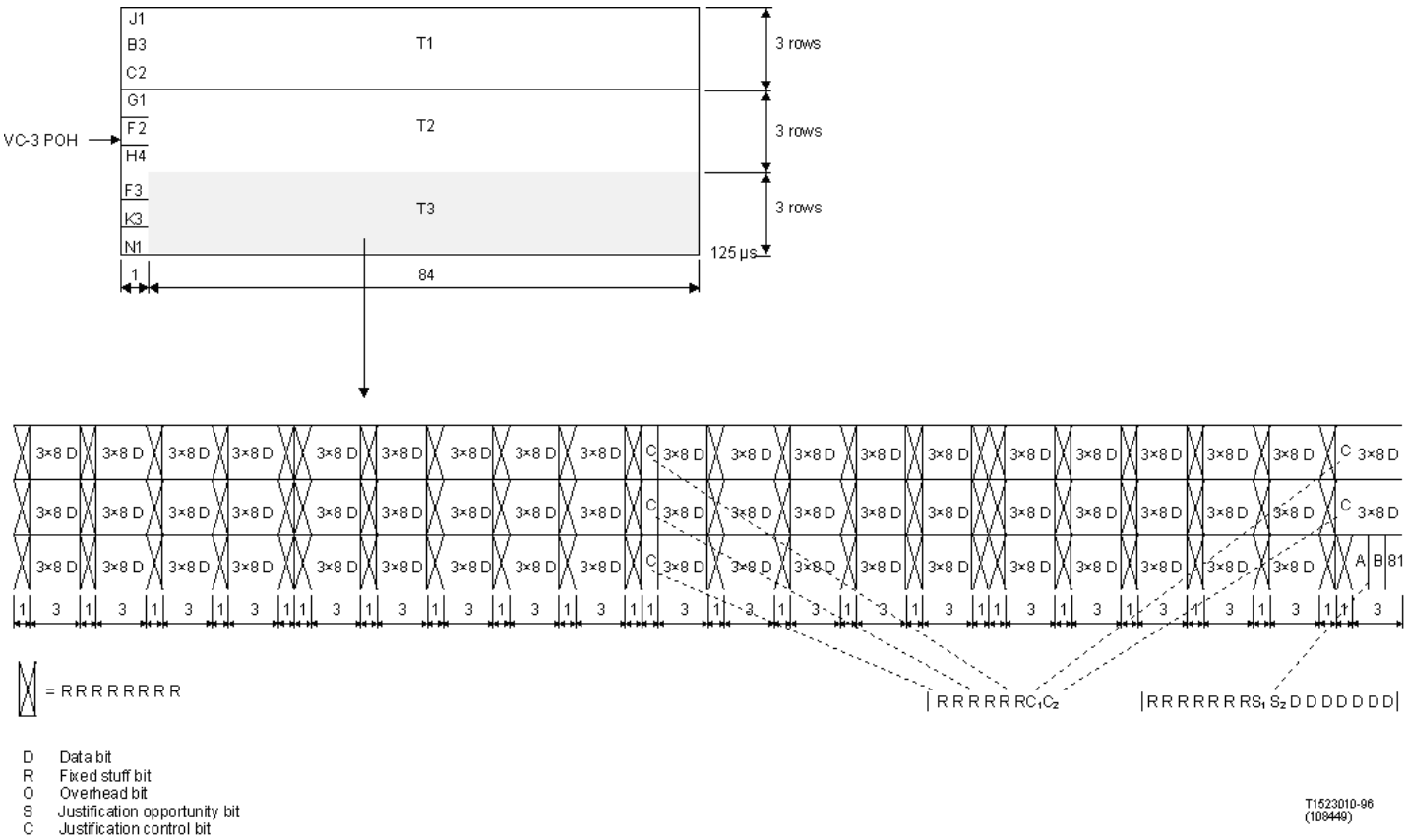

Figure 9 Asynchronous mapping of 34 368 kbps tributary into VC-3

Asynchronous mapping of 2048kbps

The AXX 9100 CONNECT supports asynchronous mapping of 2048kbps signal into a VC-12 container as shown in Figure 10 The mapping is in accordance to ITU-T G.707 clause 10.1.4.1 and ETSI EN 300 147 Clause 8.

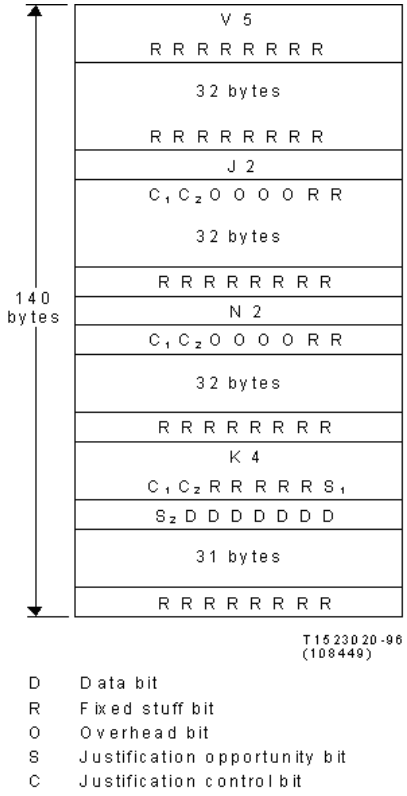

Figure 10 Asynchronous mapping 2048 kbps tributary into VC-12

Mapping of GFP frames

The AXX 9100 CONNECT supports the generic framing procedure (GFP) to encapsulate variable length payload of various client signals for subsequent transport over SDH networks as defined in ITU-T G.707 The AXX 9100 CONNECT supports mapping of a GFP frame stream into a Container-n (n=12/3/4-Xv) as shown in Figure 11 The mapping is in accordance to ITU-T G.707 clause 10.6.

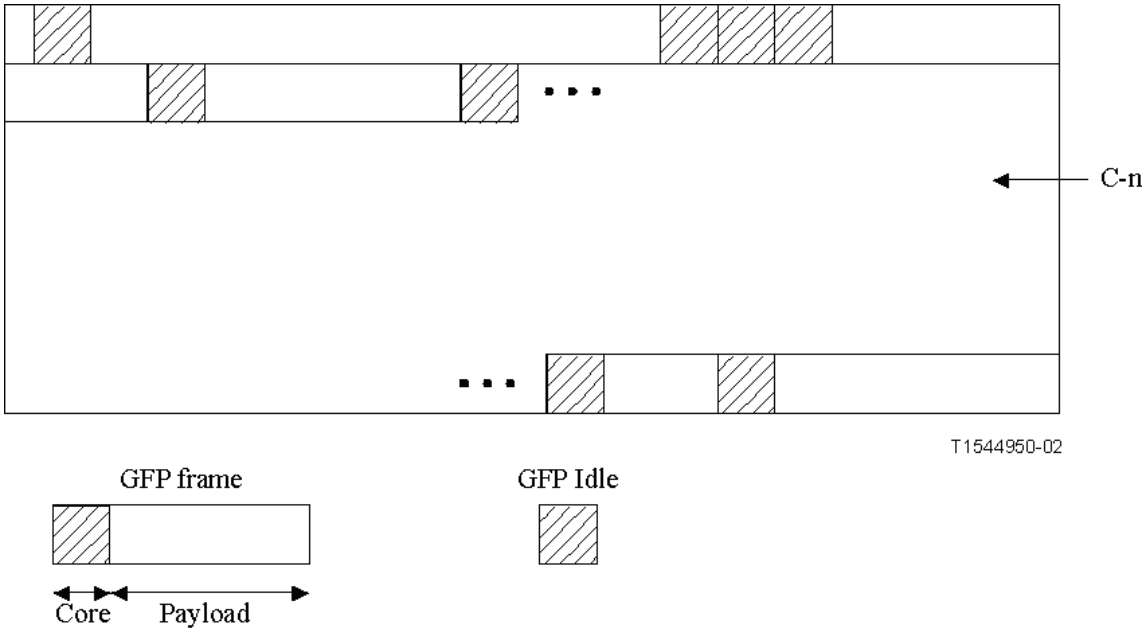

Figure 11 Mapping of GFP frames into C-n

Ericsson AXXESSIT proprietary mapping of HDLC frames

The AXX 9100 CONNECT provides a proprietary mapping scheme for mapping of HDLC encapsulated Ethernet frames traffic into VC-12 containers. The proprietary mapping scheme used to map the data into a VC-12 container is described in Figure 12

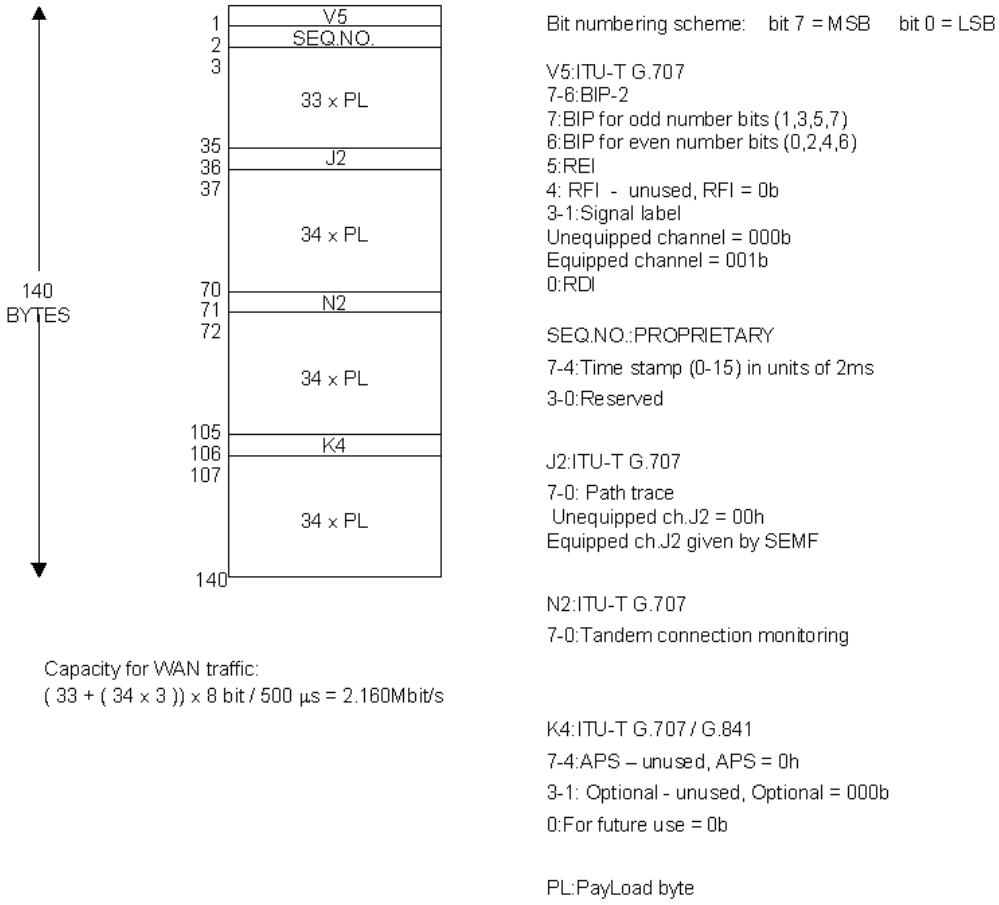

Figure 12 Ericsson AXXESSIT proprietary mapping of HDLC frames

The mapping scheme is compliant to the mapping scheme offered in other Ericsson AXXESSIT network elements.

Summary - Multiplexing and mapping

Description	Specification
Only a subset of multiplexing structures are supported	ITU-T G.707 Clause 6ETSI EN 300147 Clause 4
Asynchronous mapping of 44736kbps	ITU-T G.707 Clause 10.1.2.1ETSI EN 300147 Clause 8
Asynchronous mapping of 34368kbps	ITU-T G.707 Clause 10.1.2.2ETSI EN 300147 Clause 8
Asynchronous mapping of 2048kbps	ITU-T G.707 Clause 10.1.4.1ETSI EN 300147 Clause 8
Mapping of GFP frames	ITU-T G.707 Clause 10.6
Ericsson AXXESSIT proprietary mapping of HDLC frames	Internal Ericsson AXXESSIT spec45001-04xxDS VCTE

Table 2 Feature summary - Multiplexing and mapping

2.1.3 SDH layer functions

STM-N Physical layer

The AXX 9100 CONNECT offers the following physical interfaces:

- Optical STM-1 interfaces, S1.1, L1.1, L1.2
- Optical STM-4 interfaces, S4.1, L4.1, L4.2
- Electrical STM-1 interface

The AXX 9100 CONNECT implements the supported Physical layer functions in accordance to ITU-T G.783 clause 9.

A detailed specification of each physical interface is given in chapter 3“Physical Interfaces”.

STM-N Regenerator and Multiplex Section layer

The AXX 9100 CONNECT implements the STM-N (n=1 and 4) Regenerator and Multiplex Section layer functions in accordance to ITU-T G.783 clause 10 and 11.

2.1.3.1 SOH implementation

The AXX 9100 CONNECT complies with the SOH implementation methods outlined in clause 9 in ITU-T G.707 and ETSI EN 300 147

clause 7. The assignment of the STM-1 SOH is outlined in Figure 13

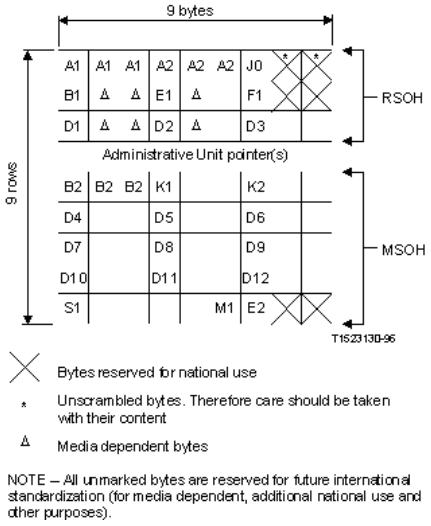

Figure 13 STM-1 SOH

The AXX 9100 CONNECT supports all the SOH bytes except the E1, E2 and F1 bytes, as described in ITU-T G.707 Clause 9.2.

VC-n/m Path layer

The AXX 9100 CONNECT offers the support of the following payloads:

- VC-4
- VC-4-Xv
- VC-3
- VC-3-Xv
- VC-12
- VC-12-Xv

The support of the VC-12/3/4-Xv virtual concatenation is described in “Concatenation schemes” on page 27.

The AXX 9100 CONNECT implements the supported Path layer functions in accordance to ITU-T G.783 clause 12 for VC-n, where n=4-Xv, 4, 3-X or 3.

The AXX 9100 CONNECT implements the supported Path layer functions in accordance to ITU-T G.783 clause 13 for VC-m, where m=12-Xv or 12.

2.1.3.2 VC-4/VC-3 POH implementation

The AXX 9100 CONNECT complies with the POH implementation methods outlined in clause 9 in ITU-T G.707 and ETSI EN 300 147 clause 7. The assignment of the VC-4 POH is outlined in Figure 14

The AXX 9100 CONNECT supports all the VC-4/VC-3 POH bytes as described in ITU-T G.707 Clause 9.3.1, with the following exceptions:

- G1 bit 6 and 7 Enhanced RDI, Clause 9.3.1.4 are not supported
- Path user channels F2 and F3, Clause 9.3.1.5 are not supported
- K3 byte, Clause 9.3.1.7, 9.3.1.9-10 is not supported
- Network operator byte N1, Clause 9.3.1.8 is not supported

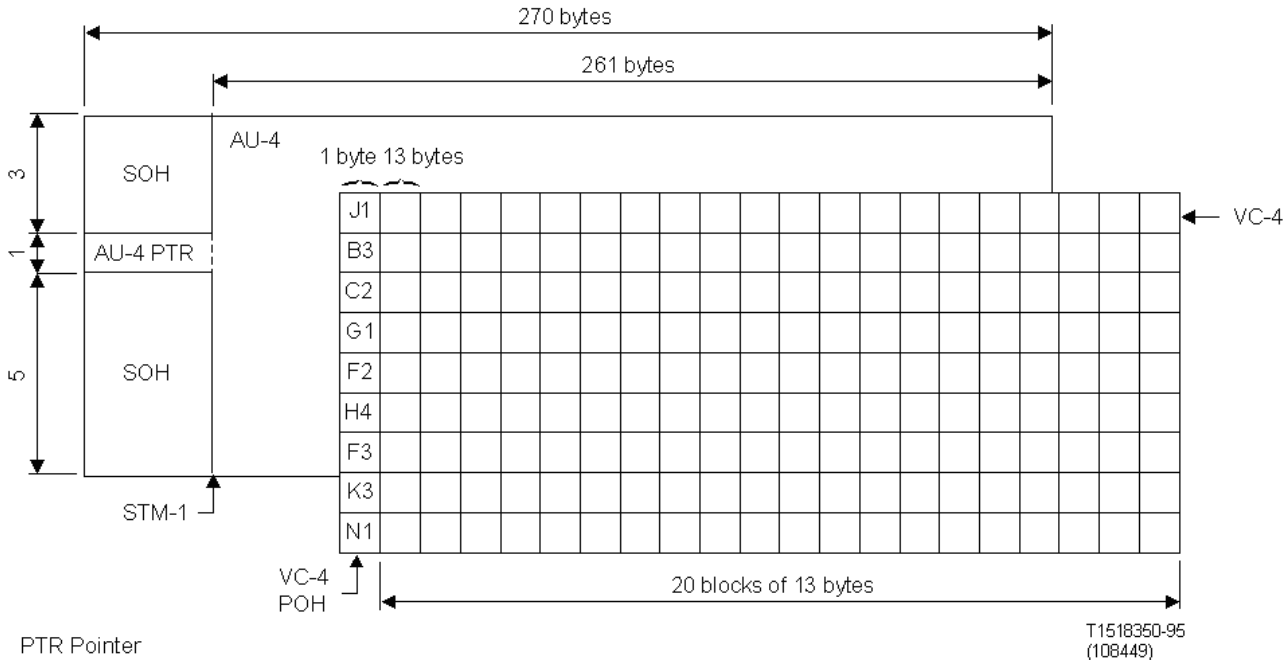

Figure 14 VC-4 POH

2.1.3.3 VC-12 POH implementation

The AXX 9100 CONNECT complies with the POH implementation methods outlined in clause 9 in ITU-T G.707 and ETSI EN 300 147 clause 7. The assignment of the VC-12 POH is outlined in Figure 15

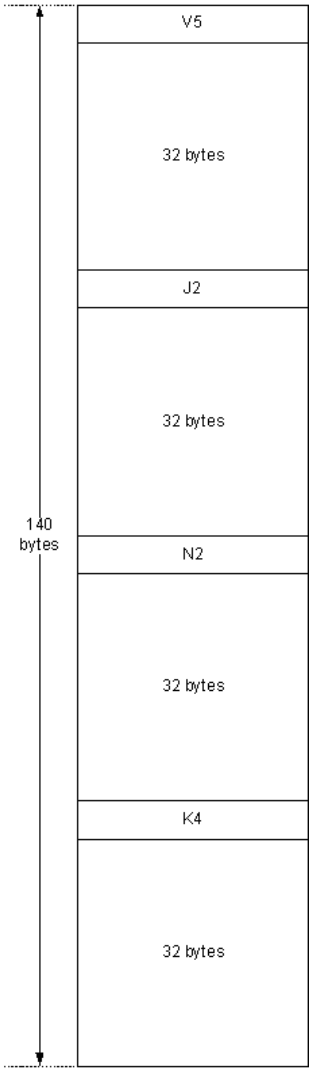

Figure 15 VC-12 POH

The AXX 9100 CONNECT supports all the VC-1 POH bytes as described in ITU-T G.707 Clause 9.3.2, with the following exceptions:

- Network operator byte N2, Clause 9.3.2.3 is not supported
- K4 byte (b3-b8), clause 9.3.2.6-8 is not supported

Summary - SDH layer functions

Description	Specification
Implementation of physical layer functions	ITU-T G.783 Clause 9
Regenerator and Multiplex section layer functions	ITU-T G.783 Clause 10 and 11
SOH termination is supported according to clause 9.2	ITU-T G.707 Clause 9ETSI EN 300147 Clause 7
Path layer functions for VC-n where n=4-Xv, 4, 3-Xv, 3	ITU-T G.783 Clause 12
Path layer functions for VC-n where n=12-Xv	ITU-T G.783 Clause 13
POH termination at VC-3, VC-4, with the following exceptions: Enhanced RDI, Clause 9.3.1.4 not supported F2 and F3 Clause 9.3.1.5 not supported K3 byte 9.3.1.7,9.3.1.9-10 not supported N1 byte, Clause 9.3.1.8 not supported	ITU-T G.707 Clause 9ETSI EN 300147 Clause 7
POH termination at VC-12, with the following exceptions: N2 byte Clause 9.3.2.3 not supported K4 byte (b3-b8) Clause 9.3.2.6-8 not supported	ITU-T G.707 Clause 9ETSI EN 300147 Clause 7

Table 3 Feature summary - SDH layer functions

2.1.4 Concatenation schemes

Virtual concatenation

AXX 9100 CONNECT supports virtual concatenation and the following VC-n-Xv are supported:

- VC-12-Xv
- VC-3-Xv
- VC-4-Xv

FE: nxVC-12 (n=1..50), nxVC-3 (n=1..3) or 1xVC-4.

The AXX 9100 CONNECT implements the supported VC-4-Xv and VC-3-Xv functionality in accordance to ITU-T G.707 clause 11.2 and ETSI EN 300 147 Clause 9.

The AXX 9100 CONNECT implements the supported VC-12-Xv functionality in accordance to ITU-T G.707 clause 11.4 and ETSI EN 300 147 Clause 9.

Virtual concatenation is supported in conjunction with EOS mapping and is module dependent. The EOS mapping is described in chapter “Ethernet over SDH mapping” on page 44.

2.1.5 Cross-connect support

General information

The AXX 9100 CONNECT implements a single stage cross-connect. The matrix is non-blocking and equal to 24x24 STM-1 equivalents and offer connections for the following objects:

- VC-4
- VC-3
- VC-12

The AXX 9100 CONNECT cross connect matrix supports different cross connect basic types, which are used to build more complex cross connects. The basic cross connect types are:

- Basic cross connect types:
  - Uni-directional, un-protected point-to-point
  - Bi-directional, un-protected point-to-point
  - Uni-directional, protected point-to-point of type "add"
  - Uni-directional, protected point-to-point of type "drop"
  - Bi-directional, protected point-to-point of type

Basic cross connect Types

The cross connect term is used both to describe a connection internally across the termination points of a Cross-connect matrix.

The cross connects are performed in any AU or TU layer of the SDH cross connect. All termination points must be located in the same layer.

A cross-connect contains up to three termination points, uni- or bi-directional: A (source/transmit), B (sink/receive) and P (protecting).

Depending on the type of P-t-P, the XC matrix allows various internal connections between the termination points.

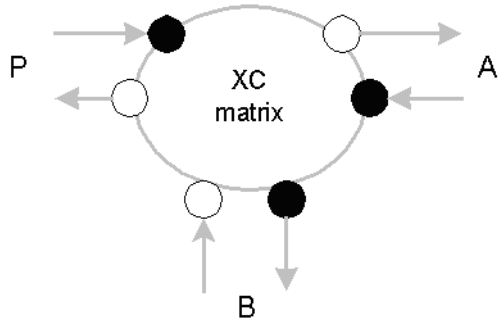

Figure 16 Generic basic cross connect

Uni-directional traffic flow through the matrix is fixed to one path between the "A" termination point to the "B" termination point as shown in Figure 17

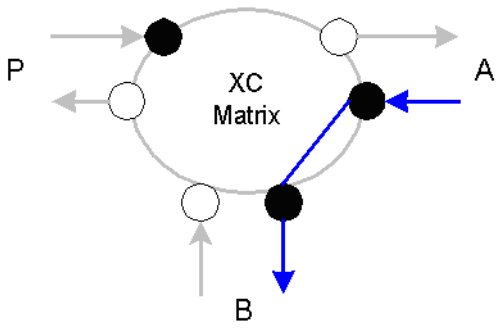

Figure 17 Uni-directional PtP cross connect

Bi-directional traffic flows through the matrix in both direction, between A and B during normal operation as shown in Figure 18

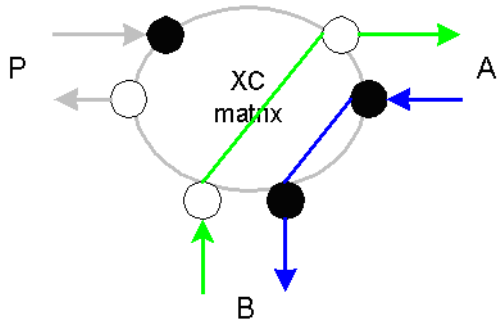

Figure 18 Bi-directional PtP cross connect

Circuit protection is established by splitting the circuit in two paths. This uni-directional protected PtP cross connect of type add is used to split the traffic.

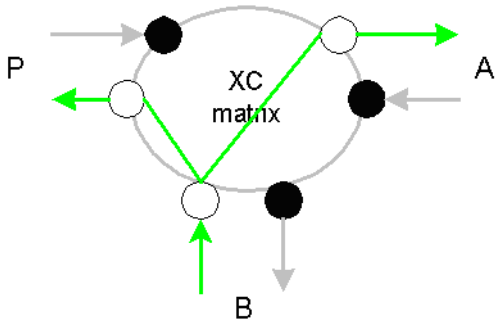

Figure 19 Uni-directional PtP cross connect with protection (add)

This uni-directional protected PtP cross connect of type drop is used to assemble circuits that was split with a previous "add" cross connect.

Traffic through B is routed from either the "A" termination point or "P" termination point.

The criteria for switching A or P to B is the measured quality of the signals received from A and P (unless forced by the TMN operator).

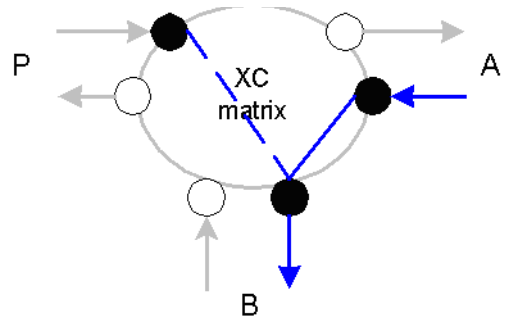

Figure 20 Uni-directional PtP cross connect with protection (drop)

The bi-directional connection from A to B is protected. In this configuration the B termination point is protected.

The criteria for switching A or P to B is the measured quality of the signals received from A and P (unless forced by the TMN operator).

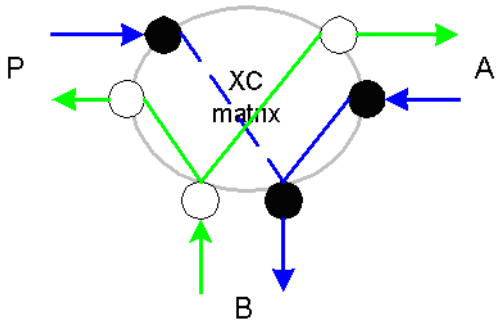

Figure 21 Bi-directional PtP cross-connect with protection

Summary - Concatenation and cross connect

Table 4 Feature summary - Concatenation and cross connect

Description	Specification
VC-4-Xv and VC-3-Xv support	ITU-T G.707 Clause 11.2ETSI EN 300147 Clause 9
VC-12-Xv support	ITU-T G.707 Clause 11.4ETSI EN 300147 Clause 9
Bi-directional connections on all levels are supported	
Unidirectional connections on all levels are supported	

2.1.6 Protection

AXX 9100 CONNECT offers different protection schemes and this release supports the following:

- 1+1 MSP protection
- SNC protection

1+1 linear MSP

AXX 9100 CONNECT offers 1+1 linear Multiplex Section Protection (MSP) on all optical STM-N interfaces.

The following rule applies for the 1+1 MSP protection:

- Protection can only be enabled between two ports of the same STM-N type

The 1+1 MSP functionality is in accordance with ITU-T G.841, clause 7.1. The following parameters are configurable on an MSP object:

- Enabled/disabled
- Mode, unidirectional or bi-directional
- Operation Type, revertive or non-revertive
- WTR time (Wait to restore time), configurable from 0-15minutes, default 5 minutes

The protocol used for K1 and K2 (b1-b5) is defined in ITU-T G.841, clause 7.1.4.5.1. The protocol used is 1+1 bi-directional switching compatible with 1:n bi-directional switching.

SNC Protection

AXX 9100 CONNECT supports two types of SNC protection, SNC/I (Sub Network Connection protection with Inherent monitoring) and SNC/N (Sub Network Connection protection with non-intrusive monitoring).SNC/I switch on signal failure (SF) while SNC/N switch for signal degrade (SD). The default threshold for SD alarm conditions is 1E-7. This threshold can be configured within the range 1E-6 to 1E-9. SNC Protection (SNCP) is supported for the following layers:

- VC-12
- VC-3
- VC-4

The SNCP functionality is in accordance with ITU-T G.841 Clause 8. The following parameters are configurable on an SNCP object:

- Enabled/disabled
- Operation Type, revertive or non-revertive
- Hold-off time, configurable from 0-10s in 100ms steps, default 0s. The resolution of the Hold-off timer is N x 100ms +/- 60 ms. That is for a 500 ms Hold-off timer, the real timer value may be any value between 440 ms and 560 ms.
- WTR time (Wait to restore time), configurable from 0-15 minutes, default 5 minutes

The Application architecture supported is 1+1 unidirectional switching according to ITU-T G.841 clause 8.3.2. The switch initiation criteria are implemented as described in ITU-T G.841 clause 8.4.

The protection algorithm is implemented according to ITU-T G.841 clause 8.6.

Summary - Protection

Table 5 Feature summary - Protection

Description	Specification
Support of MSP 1+1 protection	ITU-T G.841 Clause 7.1
Support of SNCP	ITU-T G.841 Clause 8

2.1.7 Performance monitoring

In the subsequent sections the following definitions are used, according to G.826:

2.1.7.1 Errored second (ES)

A one second period with one or more errored blocks or at least one defect.

2.1.7.2 Severely errored second (SES)

A one second period which contains >= X% errored blocks or at least one defect (where X is defined in the relevant recommendation e.g. G.826, G.828 and G.829)

2.1.7.3 Background block error (BBE)

An errored block not occurring as a part of an SES

2.1.7.4 Unavailable seconds (UAS)

A period of unavailable time begins at the onset of ten consecutive SES events. These ten seconds are considered to be part of unavailable time. A new period of available time begins at the onset of 10 consecutive non-SES events. These ten seconds are considered to be part of available time. UAS is the number of second of unavailable time.

Regenerator and multiplex section performance monitoring

AXX 9100 CONNECT offers full performance monitoring on regenerator and multiplex sections according to G.829.

The following parameters are calculated:

- ES
- SES
- BBE
- UAS

For the regenerator section near end data is presented, for the multiplex section both near end and far end data are presented.

The available time periods are:

- 15 minutes

- 24 hours

The system presents current data and historical data, the number of time periods are:

- 16x15 minute
- 1x24 hours

AXX 9100 CONNECT calculates excessive error and degrade signal defects assuming Poisson distribution of errors, according to ITU-T G.826.

The excessive error defect (dEXC) is detected if the equivalent BER exceeds a pre-set threshold of 10E-5, and cleared if the equivalent BER is better than 10E-6, according to ITU-T G.806.

The degraded signal defect (dDEG) is detected if the equivalent BER exceeds a pre-set threshold of 10E-X, where X=6, 7, 8 or 9. The dDEG is cleared if the equivalent BER is better than 10E-(X+1), according to ITU-T G.806. The thresholds are individual configurable for the regenerator and multiplex section, from 10E-6 to 10E-9.

Path performance monitoring

AXX 9100 CONNECT offers full performance monitoring on the SDH path level according to G.828. The following objects are supported:

- VC-12
- VC-3
- VC-4

The following parameters are calculated:

- ES
- SES
- BBE
- UAS

Both near end and far end data are presented.

The available time periods are:

- 15 minutes
- 24 hours

The system presents current data and historical data, the number of historical time periods are:

- 16x15 minute
- 1x24 hours

AXX 9100 CONNECT calculates excessive error and degrade signal defects assuming Poisson distribution of errors, according to ITU-T G.826.

The excessive error defect (dEXC) is detected if the equivalent BER exceeds a pre-set threshold of 10E-5, and cleared if the equivalent BER is better than 10E-6, according to ITU-T G.806.

The degraded signal defect (dDEG) is detected if the equivalent BER exceeds a pre-set threshold of 10E-X, where X=6, 7, 8 or 9. The dDEG is cleared if the equivalent BER is better than 10E-(X+1), according to ITU-T G.806. The thresholds are individual configurable for the different objects, from 10E-6 to 10E-9.

Non-intrusive monitoring

AXX 9100 CONNECT support non-intrusive monitoring (NIM) also called Intermediate Path Performance monitoring (IPPM) functions on the following objects:

- VC-12
- VC-3
- VC-4

The functionality is used to monitor relayed cross connects in the system, the functionality is especially useful for debugging of errored paths, to determine which section that is causing the problem. The functionality is also used to monitor paths crossing operator boarders.

The functionality is supported by use of the non-intrusive monitor points used by the SNCP process. A probe is placed on the selected object, and the performance monitoring is then automatically turned on.

The following parameters are calculated:

- ES
- SES
- BBE
- UAS

Both near end and far end data are presented.

The available time periods are:

- 15 minutes
- 24 hours

The system presents current data and historical data, the number of historical time periods are:

- 16x15 minute
- 1x24 hours

AXX 9100 CONNECT calculates excessive error and degrade signal defects assuming Poisson distribution of errors, according to ITU-T G.826.

The excessive error defect (dEXC) is detected if the equivalent BER exceeds a pre-set threshold of 10E-5, and cleared if the equivalent BER is better than 10E-6, according to ITU-T G.806.

The degraded signal defect (dDEG) is detected if the equivalent BER exceeds a pre-set threshold of 10E-X, where X=6, 7, 8 or 9. The dDEG is cleared if the equivalent BER is better than 10E-(X+1), according to ITU-T G.806.The thresholds are individual configurable for the different objects, from 10E-6 to 10E-9.

The number of simultaneously probes supported in the system are 63.

SNCP Performance Parameters

AXX 9100 CONNECT implements the following SNCP Performance Parameters:

- PSC (Protection Switching Count) is the total accumulated number of protection switching events
- PSD (Protection Switching Duration) is the accumulated time that the Protection path has been selected
- Measured Time is the number of seconds since this protection instance was enabled.

PSC is incremented automatically each time a switch occurs. PSD and Measured Time are updated once each second. PSD is only meaningful for revertive mode.

The parameters are cleared when the protection instance is disabled or if a "ClearAllPmData" command is issued from the operator.

MSP 1+1 parameters

AXX 9100 CONNECT implements the following MSP 1+1 Performance Parameters:

- PSC (Protection Switching Count) is the total accumulated number of protection switching events
- PSD (Protection Switching Duration) is the accumulated time that the Protection link has been selected
- Measured Time is the number of seconds since this protection instance was enabled.

PSC is incremented automatically each time a switch occurs. PSD and Measured Time are updated once each second. PSD is only meaningful for revertive mode.

The parameters are cleared when the protection instance is disabled or if a "ClearAllPmData" command is issued from the operator.

Pointer justification performance parameters

To identify synchronisation "problems", the AXX 9100 CONNECT offers pointer justification performance parameters, PJE for the following object:

- AU-4

PJE, both positive and negative justifications, are counted and measured over a 24-hour interval. Both current and past 24hour interval counters are available.

In addition to the PJE counters an alarm is raised if the number of PJE's over a 15-minute period is greater than a configurable number, PJEL (Pointer Justification Event Limit). The threshold for PJE alarms to be reported is configurable and by default set to 100 events within an interval. The alarm can be suppressed by increasing the threshold to a greater number than the actual events being reported per interval.

Be aware that the EPJ alarm quite commonly propagates to several nodes (paths) in the network whenever synchronisation is not properly configured in the network. EPJ alarms are seldom traffic affecting, and sometimes they must be accepted due to e.g. interconnections between different SDH networks.The PJEL is configurable from 1 to 1024 events.

Summary - Performance monitoring

Description	Specification
PM support for regenerator and multiplex sections	ITU-T G.829
dEXC and dDEG calculation procedure	ITU-T G.806
dEXC and dDEG thresholds	ITU-T G.806
PM support for SDH path level	ITU-T G.828
Support of NIM as described in 2.1.7.3	
Support of SNCP performance parameters, PSC (Protection Switching Count) and PSD (Protection Switching Duration) as described in 2.1.7.4	
Support of MSP 1+1 performance parameters, PSC (Protection Switching Count) and PSD (Protection Switching Duration) as described in 2.1.7.5	
Support of PJE counters on AU-4 level as described in 2.1.7.6	

Table 6 Feature summary - Performance monitoring

2.1.8 Synchronisation

Functional Requirements

AXX 9100 CONNECT conforms to ETSI ETS 300 417-6-1 regarding requirements specified for a SEC device. AXX 9100 CONNECT also conforms to ITU-T Recommendation G.781.

Functional Model

The model in Figure 22 illustrates the internal AXX 9100 CONNECT functionality related to synchronization. The following sections describe some of these blocks in more detail.

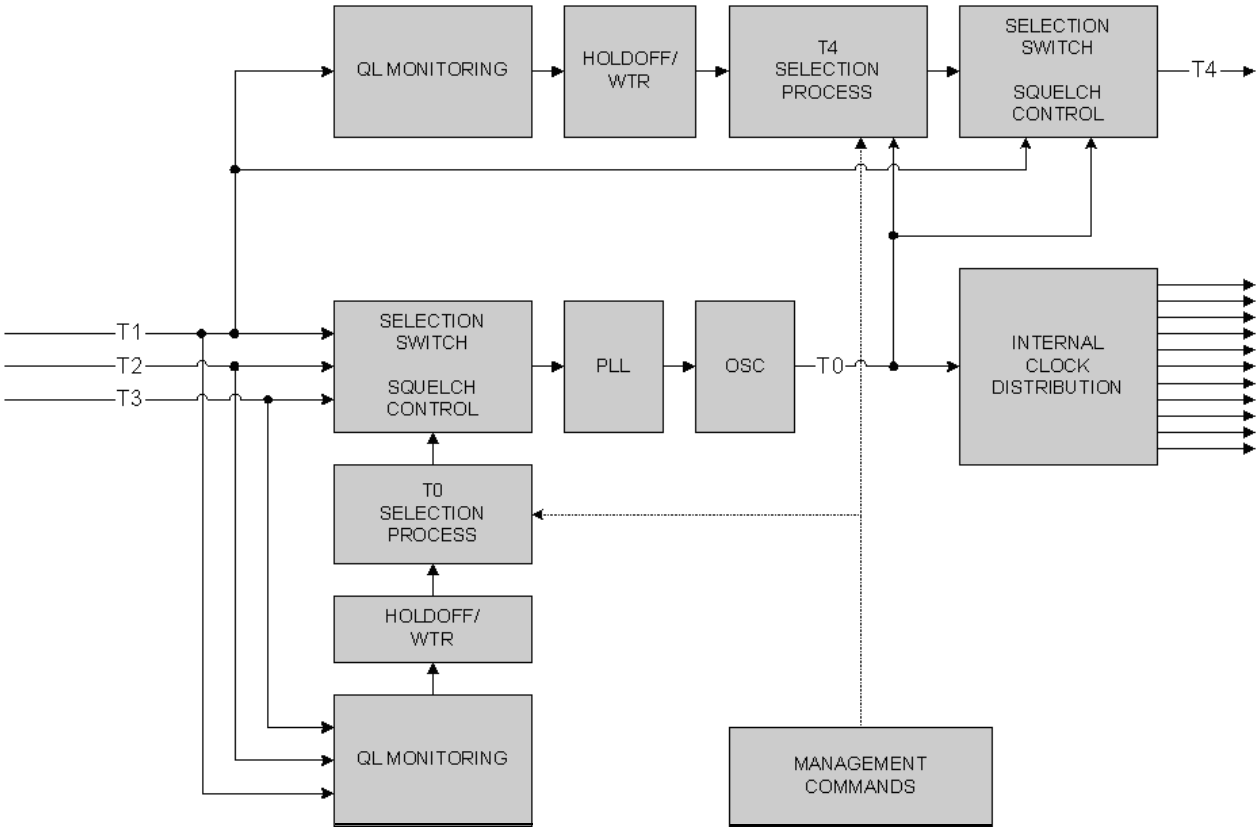

Figure 22 Sync functional model

The AXX 9100 CONNECT contains a T0 synchronization selection process, operating in QL-enabled mode. The process is responsible for selecting the best signal source to be used as reference input for the SETS, generating the T0 clock. The selection is done among a number of nominated sources (within the signal types T1, T2 and T3) as configured by the network operator. In the free-running mode, the T0 clock complies with the SEC clock requirements as described in ITU-T Recommendation G.813. When operating in the locked mode, the internal oscillator output (T0) is aligned to the selected reference source. This frequency in turn applies to all egress STM-N signals (going out from the NE).

The AXX 9100 CONNECT also contains a selection process, responsible for selecting the reference source for the T4 port (which is the synchronization output port). This selection is done among ingress T1 signal sources contained in a selection list. The T4 output ports can also be locked to the internal T0 clock.

Sync Interfaces

Each of the reference points T1, T2 and T3 (Figure 22) contains one ore more signals applicable for synchronization purposes. For

the AXX 9100 CONNECT, the following interface types apply to the synchronization selection processes:

- T1 inputs:STM-N signals (N = 1 and 4) with or without SSM (S1 used for carrying QL)
- T2 inputs:2.048 Mbps signals (E1) in ISDN PRA mode
- T3 input: 2.048 MHz external synchronization signal (T12) derived from a station clock

The operator configures the signal reference candidates associated with each of the two (T0, T4) selection processes.

QL Support

The referred synchronization reference signals may or may not provide in-band QL provisioning (SSM). As the internal selection processes operates in QL enabled mode with synchronization sources of both categories, the operator must configure whether or not each synchronization source candidate supports SSM. If it does, the received SSM is used for obtaining the corresponding QL. If SSM is not supported, the operator must assign a fixed QL for the corresponding reference signal. The selection process uses the QL when there are no signal failures (alarms or faults) associated with the reference signal.

Hence, the total performance (QL) for a synchronization source depends on the following parameters:

- The signal condition
- The in-band SSM (if enabled) or assigned QL-level (if in-band SSM usage is disabled)

A signal failure condition is defined as any of the following alarms:

- For STM-N ports:LOS, LOF, RS-TIM, MS-AIS
- For E1 ports:LOS, AIS, LFA

If supported, the QL of a signal candidate is carried in-band by means of the SSM. For STM-N links the S1-byte (in MSOH) is used for this purpose. SSM is not supported for E1 ports.

The AXX 9100 CONNECT provides one 2.048 MHz interface (T4) to which other NEs can be synchronized, either directly or via a SASE, as described in ITU-T Recommendation G.803 appendix III.7.1, SSM.

Sync Table

For the T0 selection process, the AXX 9100 CONNECT maintains a table containing up to 5 possible synchronization signal candidates. Each entry in this table contain the following information:

- Identification of the synchronization source candidate (via its slot number, port number etc.)
- Whether SSM usage is enabled for the corresponding candidate. If SSM is not enabled, the operator is free to assign a fixed performance code (QL) to be used by the selection process when there are no alarms associated with the reference signal. Refer to ETS 300 417-6-1 § 4.4.3.
- The corresponding priority for the corresponding candidate. This priority applies only when there are multiple candidates all having the highest QL among all possible source candidates.
- Hold-off timer, configurable parameter with a value in the range 300-1800 ms. Refer to ETS 300 417-6-1 § 4.8.
- Wait To Restore timer, configurable parameter with a value in the range of 0-12 minutes (one minute step)
-

For the T4 selection process, the AXX 9100 CONNECT maintains up to 5 possible synchronization source candidates. External synchronization candidates must be of the T1 type (STM-N).

However, another legal candidate for the T4 selection process is the internal T0 clock. Hence, T4 can be locked either to an arbitrary T1 (STM-N) port or the internal T0 clock. Applicable ports (among the T1 candidates) are configured by the operator and stored in a table with the same parameters as for the T0 selection process.

If the QL of the selected signal source falls below a configurable minimum threshold (QLM), the T4 output is immediately squelched.

Searching for an alternative reference source is started when the hold-off time for the signal has elapsed. Selecting a new T4 reference source is done provided that the QL of the candidate equals or exceeds the QLM value.

Summary - Synchronization

Specification	Description
ETSI ETS 300 417-6-1 to ITU-T G.813	Regarding requirements specified for a SEC device.
ITU-T Recommendation G.781	
ITU-T G.703	2048KHz clock supported
	Synchronisation available from all STM-N ports
	Synchronisation available from the following PDH ports: E1 in framed mode
	QL support available on all STM-N ports and on the T4 port when configured in framed mode
	Supports an external synchronisation input
	Supports an external synchronisation output

Table 7 Feature summary - Synchronization

2.2 Ethernet over SDH mapping

AXX 9100 CONNECT supports two different modes of Ethernet over SDH (EOS) mapping:

- Ericsson AXXESSIT proprietary mapping, (see “Ericsson AXXESSIT proprietary mapping of HDLC frames” on page 21) combined with inverse multiplexing at VC-12 level
- GFP-F mapping, (see “Mapping of GFP frames” on page 20) combined with VCAT, at VC-12, VC-3 and VC-4 level, and LCAS

The EOS mapping functionality is module dependent, and the EOS mapping is supported on the following modules:

- “TM-4xFEL2-4xMAP-RJ45”

2.2.1 Ericsson AXXESSIT proprietary mapping

The AXX 9100 CONNECT provides a proprietary mapping scheme for mapping of Ethernet traffic into a number of VC-12 containers.

The HDLC encapsulated Ethernet frames are mapped into a number of VC-12 containers in a round-robin fashion with an inverse multiplexer function. The mapping process is described in “Ericsson AXXESSIT proprietary mapping of HDLC frames” on page 21.

A total differential delay of up to 8ms is supported

The total bandwidth for one WAN channel is 100 Mbps or 50xVC-12 containers. Ericsson AXXESSIT proprietary VC-12 mapping scheme for Ethernet takes advantage of 2.16 Mbps in each VC-12, which means that 47xVC-12s are sufficient to transport 100 Mbps Ethernet.

The VC-12 k.l.m reference assignment for the Ethernet WANx port is fully flexible, and controlled in the same way as a VC-12 cross connect.

The sequence number attached to each VC-12 is used for alarm indication only in case of a sequence mismatch, the sequence number is not used for reordering of the incoming VC-12's. The order of VC's carrying Ethernet traffic between two WAN-ports therefore needs to be maintained.

In case of a failure on one of the VC-12's, the effected VC-12 is removed from the channel, allowing the traffic to flow on the remaining VC-12 connections. RDI is used to indicate a failure to the remote side.

2.2.2 Standardised mapping

AXX 9100 CONNECT supports standardised ways of mapping Ethernet over SDH. The mapping schemes include mapping protocol, concatenation scheme and control protocols.

2.2.2.1 GPF

General

AXX 9100 CONNECT supports framed mapped GFP (GFP-F) according to ITU-T G.7041. The GFP implementation supports the following functions:

- The implementation only supports GFP null extension header
- Client data frames are supported
- Client management frames are supported
- For control frames, the implementation only supports GFP idle frames insertion and processing, other unspecified control frames are dropped
- Standard GFP scrambling is supported, with the polynomial 1+x43
- The implementation supports the optional data FCS insertion and checking via the PFI bit
- The implementation supports frame sizes from 64 bytes up to 9 Kbytes

The mapping of GFP frames in VC-x containers are described in “Mapping of GFP frames” on page 20.

Alarm and Event Conditions

The GFP implementation supports the following alarm and event conditions:

- GFP Frame Delineation Loss Event, LFD
- Payload Mismatch, PLM
  - Alarm based on detection of PTI field value in ITU-T G.7041
- User Payload Mismatch, UPM
  - Alarm based on detection of UPI field value in ITU-T G.7041
- Payload FCS Mismatch, PFM.
  - Alarm based on detection of PFI field value in ITU-T G.7041
- Extension Header Mismatch, EXM
  - Alarm based on detection of EXI field value in ITU-T G.7041

Performance Monitoring

The GFP implementation collects the following performance parameters:

- Total number GFP frames transmitted and received

- Total number Client management frames transmitted and received
- Number of bad GFP frames received, based upon payload CRC calculation
- Number of cHEC corrected errors
- Number of cHEC uncorrected errors
- Number of tHEC corrected errors
- Number of tHEC uncorrected errors
- Number of Dropped GFP frames in GFP receiver

A degrade alarm is available for the following performance parameters:

- Number of bad GFP frames received, based upon payload CRC calculation, degFCS
- Number of tHEC corrected and uncorrected errors, degtHEC

The deg alarms are handled in a similar way as the SDH degrade alarms

2.2.2.2 VCAT and LCAS

General

AXX 9100 CONNECT supports virtual concatenation according to ITU-T G.707. The VCAT implementation supports the following functions:

- FE (Fast Ethernet) mapper interface
  - VC-12-nV, where n=1..50
  - VC-3-nV, where n=1..3
  - VC-4-nV, where n=1

The VC-x level is individually configurable pr. mapper port, a mix of different VC-x levels in one Virtual Concatenation Group (VCG) is not allowed.

A total differential delay of up to 62ms is supported for the different VCGs.

AXX 9100 CONNECT supports the LCAS protocol in conjunction with VCAT as defined in ITU-T G.7042. The LCAS protocol implemented covers the following functions:

- Automatically temporary removal of a faulty VCG member

- Automatically hitless insertion of a temporary removed VCG member when the fault is repaired
- Hitless increase of the VCG capacity by adding a VCG member
- Hitless decrease of the VCG capacity by removing a VCG member
- Inter-working with equipment supporting VCAT but not supporting LCAS

Configuration modes

The AXX 9100 CONNECT offers a single operation mode for the VCAT and LCAS functionality:

- VCAT without LCAS enabled

Mode 1

When VCAT is used without LCAS, there is no mechanism for removing of a faulty VC container in a VCG group. To solve this problem the AXX 9100 CONNECT implements, in addition to the standard mode, a proprietary mode.

The following configurations are available in mode 1:

- Default mode, unidirectional connections with the possibility of configuring symmetric capacity as explained in mode 1. Same features as in mode 1 but without LCAS
- SoftLCAS mode

If SoftLCAS mode is enabled, the cross connections are not uni-directional, but bi-directional. In addition RDI signalling is enabled. A faulty container in a VCG group is removed based upon the VC alarm condition or based upon RDI signalling (similar to Ericsson AXXESSIT proprietary mapping). This allows a VCG to continue operation even if the VCG has a failed member.

The SoftLCAS configuration mode is proprietary.

Alarm and Event Conditions

The following alarms related to the VCAT and LCAS are reported by default:

Alarm	Description
LOM	VCAT, loss of multiframe
SQM	VCAT sequence indicator mismatch
LOA	LCAS loss of alignment for channels with traffic
GIDERR	LCAS Group Id different for active channels
LCASCRC	LCAS CRC error detected
NONLCAS	LCAS non-LCAS source detected
PLCR	LCAS partial loss of capacity receive
TLCR	LCAS total loss of capacity receive
PLCT	LCAS partial loss of capacity transmit
TLCT	LCAS total loss of capacity transmit
FOPR	LCAS failure of protocol
SQNC	Inconsistent SQ numbers

Table 8 Default alarms related to the VCAT and LCAS

In addition to the above default alarms, the following alarms are available if enabled from the management system:

Alarm	Description
acMstTimeout	LCAS acMst timeout
rsAckTimeout	LCAS RS-ack timeout
eosMultiple	LCAS two or more channels have EOS
eosMissing	LCAS one channel has EOS
sqNonCont	LCAS missing SQ detected in set of channels
sqMultiple	LCAS equal SQ for two or more channels
sqOor	LCAS SQ outside of range
mnd	LCAS member not de-skewable
ctrlOor	LCAS undefined Ctrl-word for one or more channels

Table 9 Additional alarms related to the VCAT and LCAS - if enabled from the management system

Summary - EOS

Table 10 Feature summary of EOS

Description	Specification
AXX 9100 CONNECT supports Ericsson AXXESSIT proprietary mapping of Ethernet frames over nxVC-12	
Supports framed mapped GFP (GFP-F) as described in page 2-46	ITU-T G.7041
Supports GFP alarm and event conditions as described in page 2-46	
Supports GFP performance monitoring as described in page 2-46	
Supports virtual concatenation	ITU-T G.707
Supports up to 62mS of differential delay when running virtual concatenation	
Supports LCAS as described in page 2-47	ITU-T G.707
Supports two operation modes when running VCAT+LCAS as described in page 2-48	
Supports alarm and event conditions as described in page 2-49	

2.3 Ethernet features

2.3.1 General information

The AXX 9100 CONNECT includes Ethernet interfaces. It can support both Ethernet tunnelling (L1) and Ethernet switching (L2) depending on what type of Ethernet modules that are inserted in the shelf. Some modules support tunnelling, some support switching and some supports both tunnelling and switching. Note that the terms bridge and switch have the same meaning in this document. The fact the bridge has several ports makes it a multi-port bridge or a switch.

The modules that support tunnelling contain one or a number of Ethernet interfaces and mappers. The mappers are used to map the Ethernet traffic into SDH. The number of interfaces and mappers depend of the selected module.

Details on the different modules are found in:

“AM-2xSTM1/4-16xE1-SFP”

“AM-2xSTM1/4-SFP”

“TM-3xE3/T3-1.0/2.3”

“TM-32xE1-LFH”

“TM-4xFEL2-4xMAP-RJ45”

“TM-4xFEL1-4xMAP-RJ45”

“TM-4xGEL1-1xMAP-SFP”

The modules that support switching contain an Ethernet switch in addition to the Ethernet interfaces and the mappers.

The aggregate modules contains an Ethernet crossbar to make is possible to interconnect the different Ethernet switches on the modules.

The external ports are termed LANx ports. They are attached to the physical LAN connectors of the device.

The internal ports that are connected to the mappers are termed WANx ports. For each of the WANx ports, the WAN mapper can create a channel for the port's Ethernet traffic in the SDH aggregate interface. Such a channel consists of a configurable number of virtual containers. The Ethernet traffic on the WANx port in question is mapped into the payload of the virtual containers, and the number of VCs selected, decides the bandwidth of the channel. Each of mappers have the capacity of mapping a full 100 Mbps (FE mapper) WAN interface into virtual containers.

The fact that some of the ports of the bridge are connected to long distance channels makes the AXX 9100 CONNECT a remote bridge. The combination of two AXX 9100 CONNECTs on different geographical sites, with a WAN channel between them, can be viewed as a single bridge, with LANx ports at each site.

2.3.2 Ethernet services

AXX 9100 CONNECT delivers both L1 and L2 Ethernet services as described in the following sections.

Ethernet Private Line

The Ethernet private line (EPL) is the simplest of the Ethernet services. It is a point-to-point connection between the AXX 9100 CONNECT and a remote network element as shown in the figure below. The Ethernet traffic is mapped into virtual containers and transported through the SDH network. The remote NE must support standard GFP and VCAT or use one of the proprietary mapping schemes supported by AXX 9100 CONNECT.

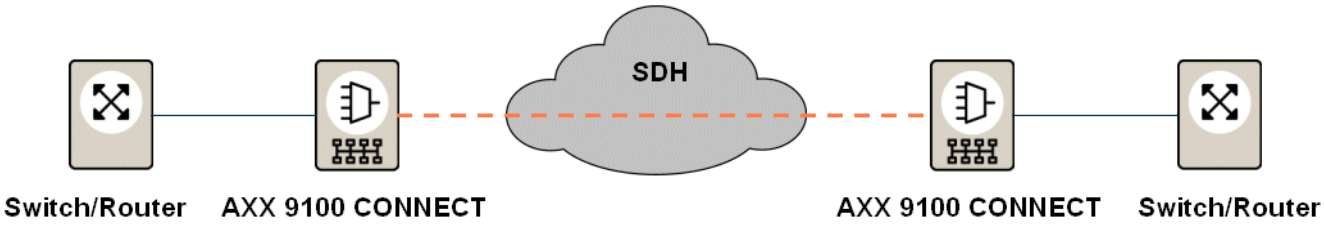

Figure 23 Ethernet Private Line service

EPL is a L1 service and the Ethernet frame is not processed. Some basic error checking of the Ethernet frames is performed (e.g. checking FCS, wrong Ethernet format, undersized packets or to big packets).

The capacity of the WAN channel sets the maximum capacity of the service. It is possible to use rate limiting to reduce the traffic capacity of the EPL below the WAN capacity. This makes it possible to change the capacity of the customer traffic without affecting the SDH network.

Non-conforming traffic can be treated in two different ways by either using flow control to prevent buffer overflow or by dropping packets when the buffer is full.

Priority may be used to make it possible for high priority packets to bypass low priority packets in the buffer.

Performance monitoring is available with the RMON counters for the Ethernet part and SDH performance monitoring for the SDH part.

The physical interface can be either a FE port or a GE port and the AXX 9100 CONNECT supports a number of different physical interfaces.

It is possible to have multiple EPL services active in AXX 9100 CONNECT. The number is limited by the total aggregate capacity, the number of mappers and the number of physical Ethernet interfaces. The different Ethernet services can be routed in different directions in the network.

It is also possible to create LAN services with multiple EPL's. A network topology based on mesh (a) and hub and spoke (b) are shown in Figure 24

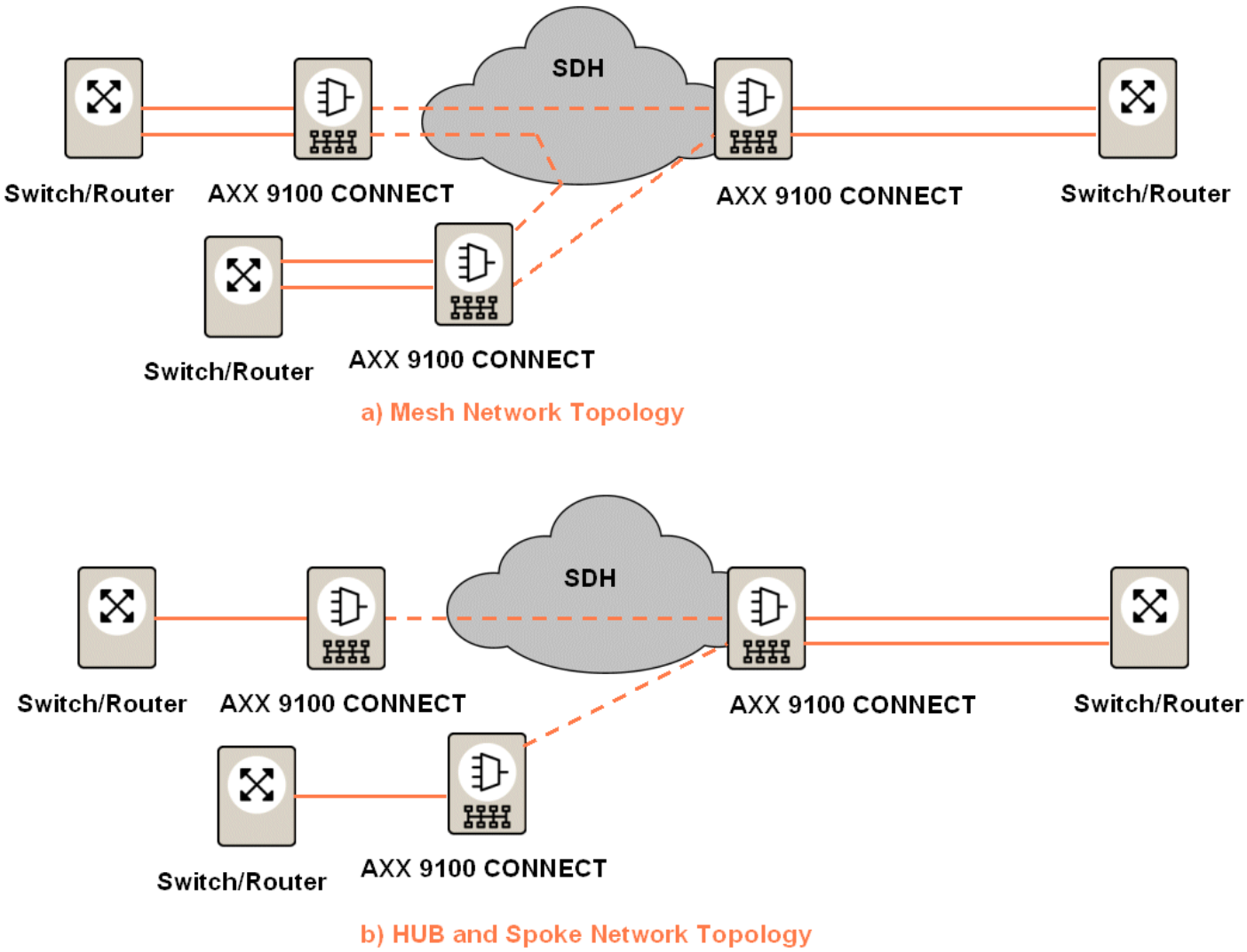

Figure 24 Network topologies for LAN based on EPL

Note that AXX 9100 CONNECT with only L1 support can be used together with other Ericsson AXXESSIT products (e.g. AXX 9100 CONNECT, AXX 9200 EDGE or AXX 9300 METRO) to create L2 services as shown in Figure 25

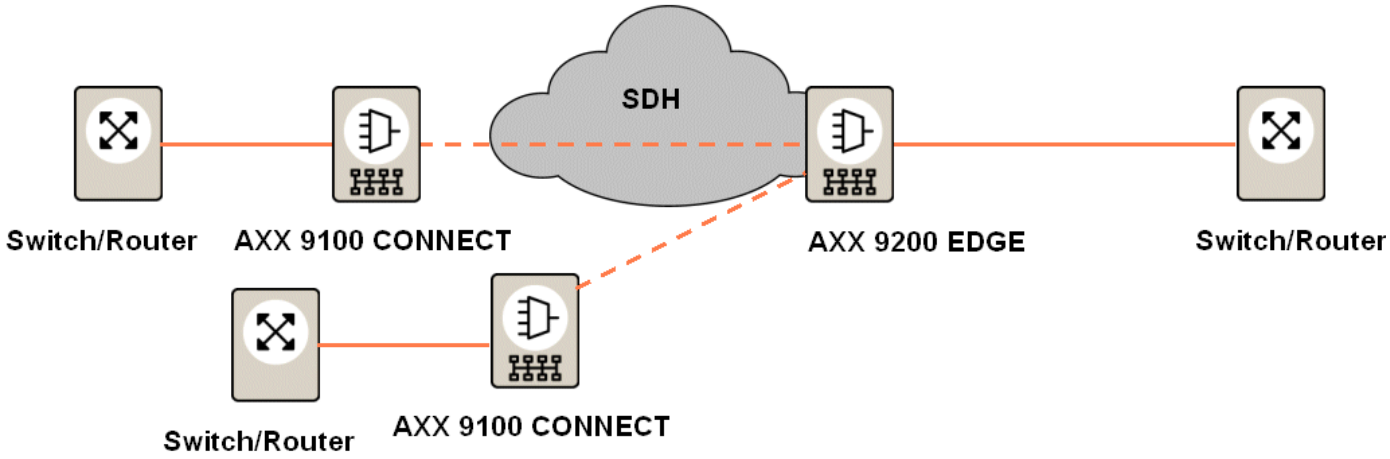

Figure 25 Network topologies for LAN based on EPL with other Ericsson AXXESSIT products

The AXX 9100 CONNECT supports tunnelling of user traffic and L2 control protocols that must be used in this application.

Ethernet Virtual Private Line

Ethernet Virtual Private Line (EVPL) is essentially an EPL service where the data streams from multiple customers share a common transport network resource. The shared resource is typically the bandwidth of a transport channel where the sharing allows an increase in transport network bandwidth efficiency through statistical multiplexing of the client data frames.

An example of EVPL with shared bandwidth is shown in Figure 26

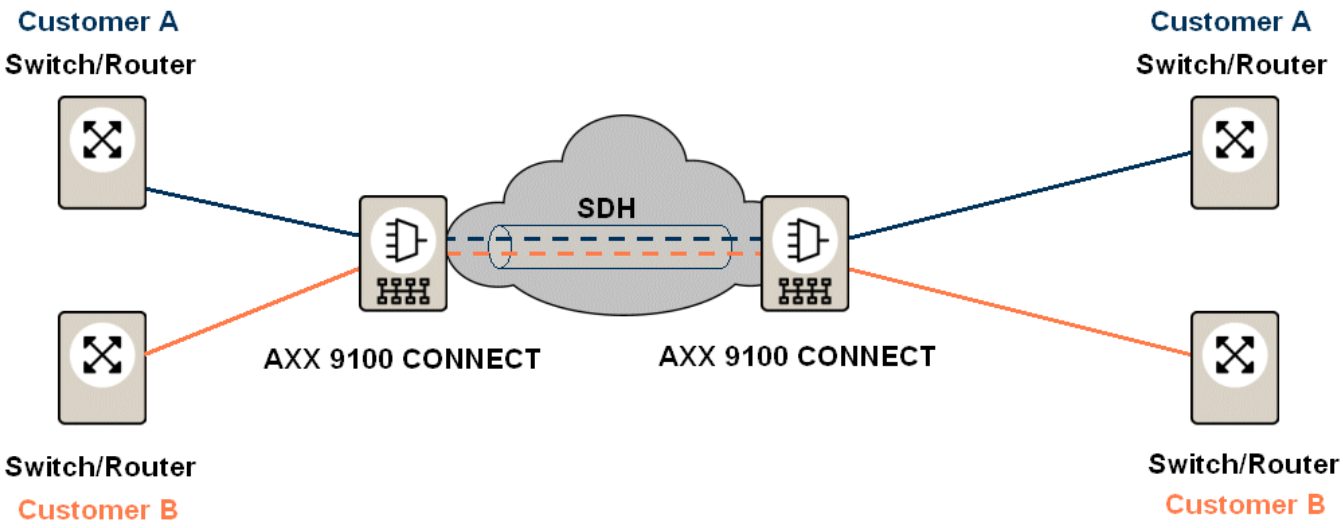

Figure 26 EVPL service

This is still a L1 service, but L2 switching capability is used for the grooming of the different customers. The capacity of the WAN channel sets the capacity of the service. Some basic error checking of the Ethernet frames is performed (e.g. checking FCS, wrong Ethernet format, undersized packets or too big packets).

The capacity of the WAN channel sets the maximum capacity of the service. Rate limiting is used to control the traffic capacity of the individual EVPL. The WAN capacity must be higher that the sum of all EVPLs that are using this WAN channel.

The statistical multiplexing of the traffic from the different customers is performed at the Ethernet layer.

Double tagging is used to transport the traffic from the different customers transparently through the network. The provider is inserting an additional VLAN tag that is unique for the customer. The VLAN tag is used to separate the traffic from the different customers.

L2 protocol tunnelling is also used to transport the L2 control protocols from the customers (e.g. STP). Rate limiting is used to police the ingress Ethernet traffic from the different customers to make it possible to meet the agreed service level agreements (SLA). Non-conforming traffic is remarked with lower priority. The non-conforming traffic is dropped if there is congestion in the network. It is also possible to drop non-conforming traffic without remarking the packets.

Non-conforming traffic can be treated in two different ways by using flow control to prevent buffer overflow or by dropping packets when the buffer is full.

Priority may be used to make it possible for high priority packets to bypass low priority packets in the buffer.

Performance monitoring is available with the RMON counters for the Ethernet part and SDH performance monitoring for the SDH part.

The physical interface can be either a FE port or a GE port and the AXX 9100 CONNECT supports a number of different physical interfaces (See module description chapter and interface description chapter).

It is possible to have multiple EVPL services active in AXX 9100 CONNECT. The number is limited by the total aggregate capacity, the number of mappers and the number of physical Ethernet interfaces. The different Ethernet services can be routed in different directions in the network.

Ethernet Private LAN

An Ethernet Private LAN (EPLAN) provides LAN-type connectivity between multiple customer sites through dedicated channels. The next three figures illustrates some of the different basic transport network topologies that can support this service. From the customer viewpoint, these topologies are equivalent (i.e., the carrier network architecture is transparent to the customer). In Figure 27 and Figure 29 , the carrier does the switching at the edge of the network. In the switching is done at one end of the network rather than at each end. In Figure 28 , the traffic is brought to a centralized switch (or a number of centralized switch points) in a star connection.

EPLAN is an L2 service and the Ethernet frame is fully processed. Error checking of the Ethernet frames performed (e.g. checking FCS, wrong Ethernet format, undersized packets or too big packets). The capacity of the WAN channel sets the capacity of the service.

Double tagging may be used to transport the traffic from the different customers transparently through the network. The provider is inserting an additional VLAN tag that is unique for the customer. The VLAN tag is used to separate the traffic from the different customers.

L2 protocol tunnelling may also be used to transport the L2 control protocols from the customers (e.g. STP).

Rate limiting is used to police the ingress Ethernet traffic from the different customers to make it possible to meet the agreed service level agreements (SLA). Non-conforming traffic is remarked with lower priority. The non-conforming traffic is dropped if there is congestion in the network. It is also possible to drop non-conforming traffic without remarking the packets.The full Ethernet rate limiting and remarking are supported in a later release.

Priority may also be used to make it possible for high priority packets to bypass low priority packets in the buffers.

Performance monitoring is available with the RMON counters for the Ethernet part and SDH performance monitoring for the SDH part.

The physical interface can be either a FE port or a GE port and the AXX 9100 CONNECT supports a number of different physical interfaces.

It is possible to have multiple EPLAN services active in AXX 9100 CONNECT. The number is limited by the total aggregate capacity, the number of mappers and the number of physical Ethernet interfaces. The different Ethernet services can be routed in different directions in the network.

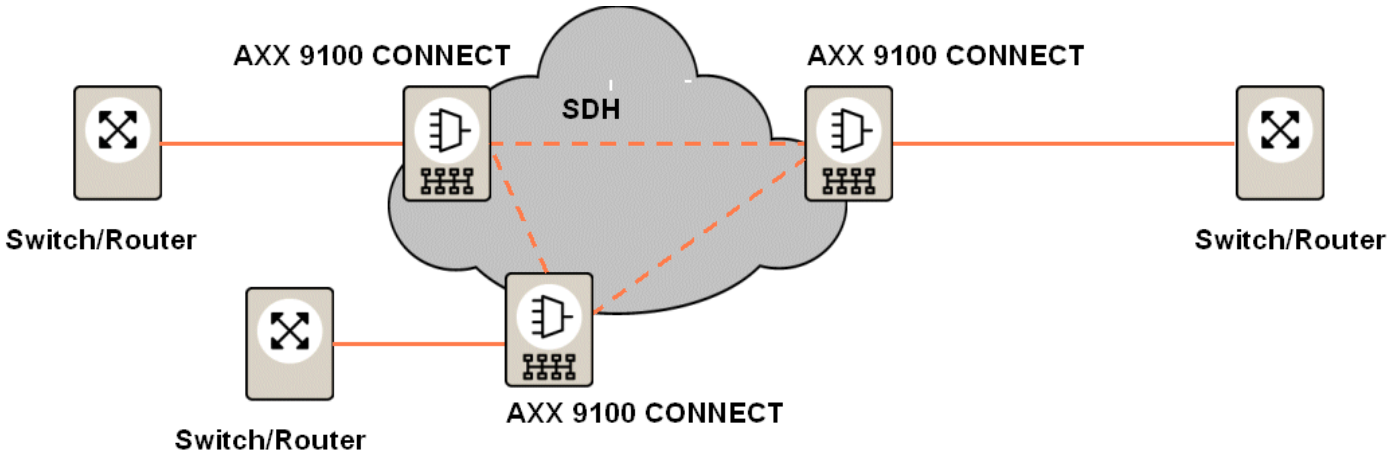

Figure 27 Ethernet Private LAN based on a meshed network topology

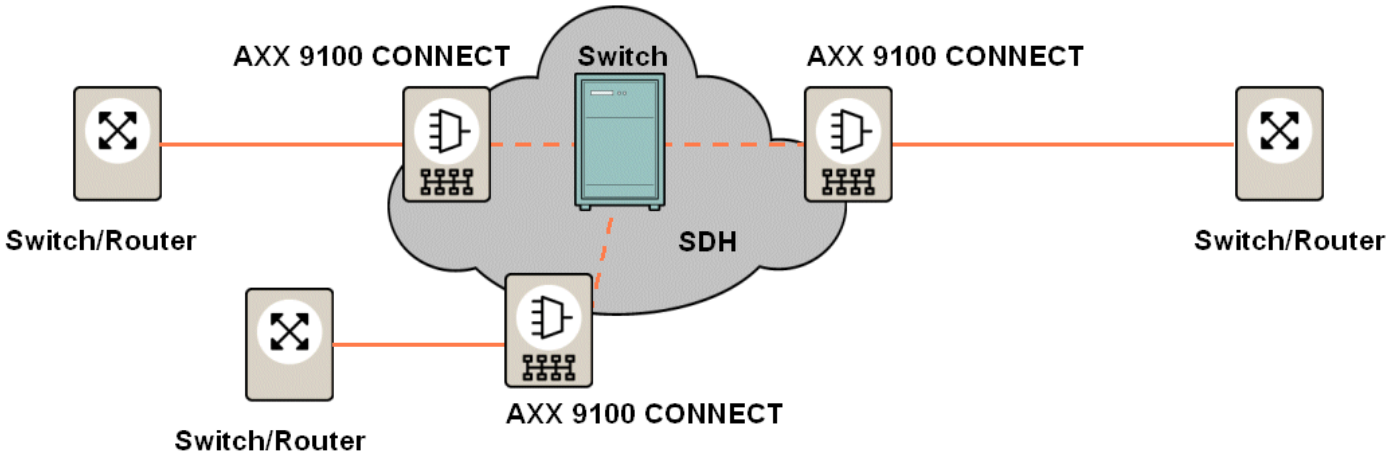

Figure 28 EPLAN based on a network topology with a centralised switch

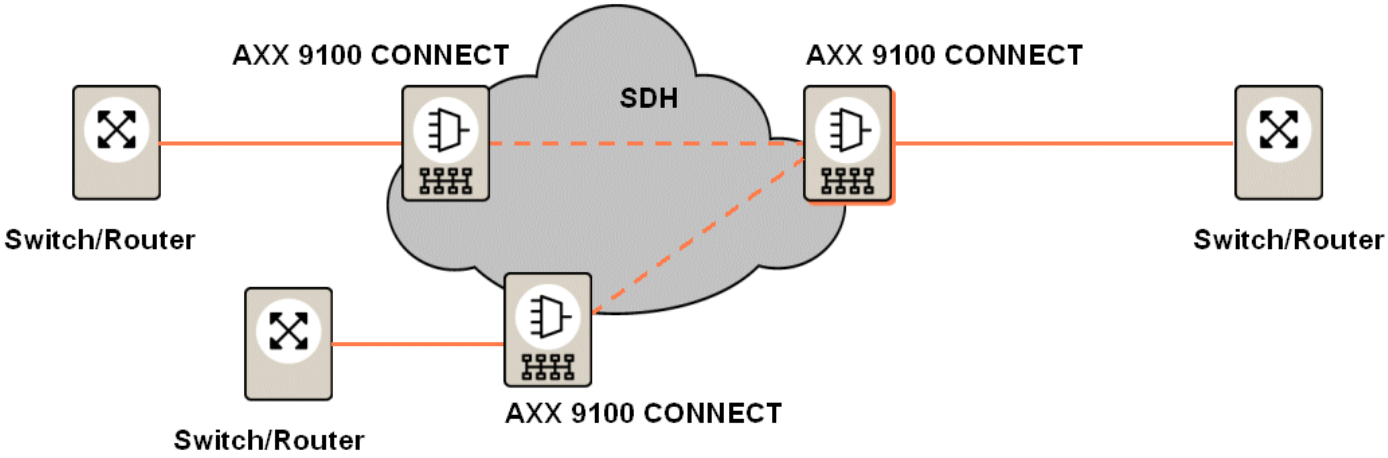

Figure 29 EPLAN based on a network topology with switching in an edge node

Ethernet Virtual Private LAN

EVPLAN is a combination of EVPL and EPLAN. The channel bandwidth is shared among different customers (as in Figure 24 - b), as are switches and/or routers in the carrier network. Ultimately, the sharing of bandwidth in the transmission channels and switch fabrics give EVPLAN the potential for very cost-effective carrier

network resource use. Clearly, however, EVPLAN is the most complicate network architecture to manage.

The functionality is more or less equal to EPLAN. The major difference is that double tagging and L2 protocol tunnelling must be used to separate the traffic from the different customers.

The WAN capacity must be higher than the sum of guaranteed traffic from all customers.

Rate limiting is used to police the ingress Ethernet traffic from the different customers to make is possible to meet the agreed service level agreements (SLA). Non-conforming traffic is remarked with lower priority. The non-conforming traffic is dropped if there is congestion in the network. It is also possible to drop non-conforming traffic without remarking the packets.The full Ethernet rate limiting and remarking are supported in a later release.

Priority may also be used to make it possible for high priority packets to bypass low priority packets in the buffers.

Performance monitoring is available with the RMON counters for the Ethernet part and SDH performance monitoring for the SDH part.

The physical interface can be either a FE port or a GE port (in a later release)and the AXX 9100 CONNECT supports a number of different physical interfaces (See module description chapter and interface description chapter). It is possible to have multiple EVPLAN services active in AXX 9100 CONNECT. The number is limited by the total aggregate capacity, the number of mappers and the number of physical Ethernet interfaces. The different Ethernet services can be routed in different directions in the network.

2.3.3 Ethernet functionality

2.3.3.1 Physical interface

Auto-negotiation and flow control

The LAN Ethernet ports on the AXX 9100 CONNECT can operate at the traditional 10 Mbps Ethernet (E) speed, at the 100 Mbps Fast Ethernet (FE) speed.

NOTE! GE is not supported in the first release of AXX 9100 CONNECT.

The FE copper ports support 10 Mbps and 100 Mbps line rates . Each LANx port can operate in half duplex or full duplex mode. Half duplex means that transmission of traffic can occur in both directions on the wire, but only one direction at the time (the communicating parties take turns in sending in the cable). In full duplex, both parties can send and receive at the same time.

Each LANx port can use backpressure and flow control to deal with overflow, so that frames do not get lost. Flow control is used on ports operating in full duplex mode. Backpressure is used on ports in half duplex mode.

Ports operating in half duplex mode do not use flow control. In stead they use backpressure to deal with overflow situations. A port that is experiencing overflow does not send pause frames upstream. Instead it sends a dedicated pattern upstream (JAM pattern), indicating a collision on the Ethernet medium. The pattern is sent continuously until the port is ready to receive more traffic. Other ports refrain from sending downstream traffic as long as the dedicated pattern endures.

The actual port parameters used are determined in one of two ways:

- Administratively - that is, an operator sets the port parameters to use, by means of the management system
- By auto-negotiation - that is, the AXX 9100 CONNECT negotiates the port parameters to use with the equipment connected to the Ethernet port in question, according to the IEEE 802.3 specification

All features may not be supported on a single LANx interface. Check with the relevant module descriptions.

Auto-negotiation is active on all LANx ports as a default.

The WANx ports are always set to 100 Mbps (FE mapper).

The WANx ports are always be set to Full Duplex.

Flow control can be symmetric or asymmetric. AXX 9100 CONNECT supports symmetric flow control. This means that it can both originate pause frames when overflow is about to occur, and receive pause frames from other switches, and act accordingly.

AXX 9100 CONNECT does not support asymmetric flow control.

Auto crossover

An Ethernet switch can be directly connected to a host with an ordinary Ethernet cable (e.g. UTP-5). If the switch is connected to another switch or a router a crossover cable must be used. AXX 9100 CONNECT supports auto crossover function that makes it possible to use either the crossover cable or the ordinary cable to hosts, switches or routers.

The auto crossover functionality in the Ethernet physical interface swaps the input signal with the output signal if a crossover cable is used.

The auto crossover feature is always enabled.

Ethernet frame size

The maximum frame size for L1 traffic is 9k octets.

The maximum frame size for Ethernet is 1522 octets. The size of the packets can be increase above this limit if a double tagging scheme such as Q in Q is used or if MPLS tags are added to the Ethernet frame.

The AXX 9100 CONNECT supports oversized frames with sizes up to 6144 octets for L2 traffic. The default maximum frame size is 1536 octets.

NOTE! In order to provide transport of Ethernet frame sizes above 1536 bytes, Jumbo Frames needs to be enabled for the LANx-port.

MAC address

The physical ports have allocated a MAC address to each port. It is possible to select if this address shall be a default address, which is the same as for the management port of the AXX 9100 CONNECT, or a unique address for the specified port or VLAN.

LED indicators

The Ethernet copper interfaces (FE) have two LED's to indicate the link status and speed of the link.

The link status LED indicates the following:

- The link is down if the LED is extinguished
- The link is up if the LED is green

- The link is up and receiving or transmitting traffic when the LED is blinking green

The speed LED indicates the following:

- The link speed is 10 Mbps when the LED is yellow
- The link speed is 100 Mbps when the LED is green

The Ethernet copper and optical interfaces (GE) have only one LED. This is the link status LED. There is no link speed LED since the modules only support one link speed.

The link status LED indicates the following:

- The link is down if the LED is extinguished
- The link is up if the LED is green
- The link is up and receiving or transmitting traffic when the LED is blinking green

Summary - for the physical interface

Description	Specification
All Ethernetports can be enabled and disabled	
Alarms are not reported from a disabled port	
Link status is reported for an enabled port	
Auto-Negotiation is supported	802.3 ch.28 02/2003
Possible to enable/disable Auto-Negotiation	802.3 ch.28 02/2003
Auto-Negotiation is on by default	802.3 ch.28 02/2003
Possible to manually set link speed to 10 Mbps	802.3 ch.28 02/2003
Possible to manually set link speed to 100 Mbps	802.3 ch.28 02/2003
Possible to manually set to half duplex	802.3 ch.28 02/2003
Possible to manually set link to full duplex	802.3 ch.28 02/2003
Symmetrical flow control is supported	802.3 ch.28 02/2003
Possible to manually enable/disable flow control	802.3 ch.28 02/2003
Possible to manually enable/disable back pressure	
Flow control only supported in full duplex operation	802.3 ch.28 02/2003
Back pressure only supported in half duplex operation	
WANx port only support full duplex operation	
Only 100 Mbps supported for a FE WANx port	
Flow control can be enabled/disabled for FE WANx port	
Auto-Crossover is supported on the ports	802.3 ch.40 02/2003
Auto-Crossover is always enabled	802.3 ch.40 02/2003
The maximum frame size is 9K octets for L1	
The maximum frame size is 6144 octets for L2	
The default maximum frame size is 1536 octets.	
The maximum frame size can be configured from the TMN system	
All ports have an MAC address allocated	
By default all ports share the same address as the management port	

Description	Specification
All port can be allocated a unique port	
All copper ports have two status LED's	
The link status LED indicates the status of the link	
The link is down if the link status LED is extinguished	
The link is up if the link status LED is green	
The link is up and receiving or transmitting traffic when the link status LED is blinking green	
The speed LED indicates the speed of the link	
The link speed is 10 Mbps when the speed LED is yellow	
The link speed is 100 Mbps when the speed LED is green	

Table 11 Feature summary Ethernet physical interface

2.3.3.2 MAC switching

AXX 9100 CONNECT includes a transparent bridge, which means that it has the following features:

- Promiscuous listening on all its ports and store and forwarding between ports
- Self-learning
- Rapid spanning tree protocol (RSTP)

2.3.3.3 Promiscuous Listening and Store and Forward

Promiscuous listening means that the bridge listens to all traffic sent on all its ports, so that it can pick up any frames that should be sent on to other ports, and do so as appropriate.

The store and forward capability means the raw bits received on a port, are not sent out on other ports immediately as they arrive, thoughtlessly. Instead, the transparent bridge just picks up frames that should be sent to other segments. No forwarding to other ports is done until an entire, valid Ethernet frame has been collected. When forwarding on another segment, the bridge also applies to the medium access control on the segment.

2.3.3.4 Self-Learning

Self-learning means that the bridge is able to learn MAC addresses, so that the bridge knows which segment a frame destined for a given MAC address should be forwarded to. The MAC address is stored in the table of MAC addresses, together with information about which port the segment in question is connected to. This information can be used later, when a frame with the MAC address

as destination address arrives at a different port. The bridge knows that the destination is reached through the registered port (directly or indirectly). Therefore, the bridge needs to forward the frame on that port only. Broadcast on all ports is avoided.

2.3.3.5 Static MAC addresses

Note that it is also possible to use static MAC addresses in AXX 9100 CONNECT. The MAC address and the port number are added by a command from the TMN system. The static addresses are permanently placed in the MAC address table and the ageing algorithm does not affect them. The static addresses can be deleted by a command from the TMN system.

2.3.3.6 Administration of forwarding Cache

As seen in the previous sub-section, the transparent bridge capability implies that the AXX 9100 CONNECT is able to learn MAC addresses and maintain them in a forwarding cache. If the cache gets full, existing entries will be overwritten by new MAC addresses learned.

To avoid that the cache is filled up with irrelevant MAC addresses, the AXX 9100 CONNECT applies ageing to the entries in the cache. To ensure that the table gives as correct and efficient forwarding as possible, with limited superfluous broadcasting, MAC addresses that have been unused for a given time, are removed from the cache.

Manual administration of the forwarding cache is also possible on the AXX 9100 CONNECT. The management system offers commands for viewing the entire cache, viewing the size of the cache (that is the number of entries at any time), adding entries explicitly (static MAC addresses), editing entries and removing entries. Entries entered manually are not removed automatically by the system.

Through the TMN system it is also possible to configure the ageing time to be used and to set a maximum size for the forwarding cache. For the latter, sizes up to 32K(32x1024) entries can be selected. The default size is 8K.

2.3.3.7 Head of Line Blocking prevention

The AXX 9100 CONNECT switch has no head of line blocking (HOLB). The HOLB problem is described below.

A number of frames arrive in sequence at a port in a switch. Some are destined for a congested port and some for other non-congested ports. The switch with the HOLB problem processes incoming frames according to the FIFO (First In First Out) policy. The frames destined for the congested port wait in the buffer for access. Frames destined for non-congested port that arrive afterwards must also wait in the buffer until the congestion is removed. This introduces additional latency in the switch for the frames destined for the non-congested port.

If the congestion is not removed the buffer fills up and the switch starts dropping frames. The frame dropping affects frames for both congested and non-congested ports. Dropping frames destined for the congested port is acceptable, but dropping frames for the non-congested ports is not acceptable.

Summary - MAC switching

Description	Specification
Support bridging/switching for L2 solution	IEEE 802.3
Support self learning	IEEE 802.3
Support static MAC addresses	IEEE 802.3
MAC address ageing supported	IEEE 802.3
The ageing time can be configured from the TMN system	IEEE 802.3
The MAC address forwarding table can be displayed in the TMN system	
Static MAC addresses can be added/deleted by command from TMN system	
The size of the MAC address table is configurable from 20 to 32K	
The default MAC address table size is 8K	
The AXX 9100 CONNECT does not have head of line blocking	

Table 12 Feature summary - Ethernet MAC switching

2.3.3.8 VLAN

Overview

The Virtual LAN (VLAN) mechanism makes it possible to create several logical LANs on one physical LAN.

The VLAN is defined by a set of members. Members can be specified in a number of ways.

The most common way is the one used in port-based VLANs. In a port-based VLAN, a set of ports constitutes the members of the VLAN. Each member is specified by the device (switch, hub, host) it belongs to and a port number on the device. A frame originated from the VLAN, is communicated only on the ports that are members of that VLAN.

Communication between parties in a physical Ethernet is confined by the VLANs defined on the physical Ethernet. A frame sent on a VLAN, is only distributed to members of the VLAN. The communication is confined to the members of the VLAN.

2.3.3.9 VLAN Access Links and VLAN Trunks

Because several VLANs can be defined on a single physical Ethernet, some physical links in the physical Ethernet may be used for traffic of several VLANs. Other links carry traffic from a single VLAN only as shown in Figure 30

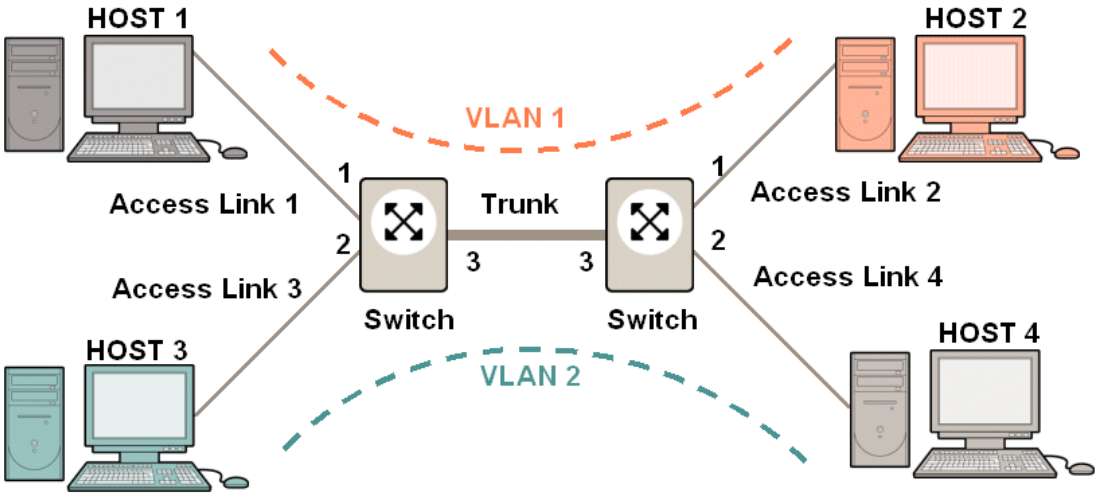

Figure 30 Small Ethernet with two VLANs, four access links and one trunk

The figure shows an Ethernet with two switches interconnecting four hosts. Two port-based VLAN's have been defined:

- VLAN 1: defined by specifying port 1 and 3 of switch 1 and port 1 and 3 of switch 2 as members.
- VLAN 2: defined by specifying port 2 and 3 of switch 1 and port 2 and 3 of switch 2 as members.

The link between Host 1 and Switch 1 is called an access link. On an access link, the VLAN an arriving frame belongs to, can be uniquely identified, without the use of tagging of frames on the link. In a port-based VLAN for instance, the VLAN of a frame on an access link can be decided implicitly from the switch port the link is attached to. For a port- and protocol-based VLAN, the VLAN for a frame on an access link can be decided from the switch port the link is attached to, and the protocol number found in the Frame Type field of the frame header.

Access links connect VLAN unaware devices to the port of a VLAN aware switch. A VLAN unaware device is a device not able to handle VLAN tags.

The link between port 3 of the two switches is called a trunk, because it carries traffic from more than one VLAN, and because tagging of frames is used on the port as needed, to uniquely identify the VLANs of frames coming in on a port attached to the link.

2.3.3.10 Implemented features

The AXX 9100 CONNECT supports VLANs according to the standard IEEE 802.1Q. Both access links and trunks are supported. The AXX 9100 CONNECT can also handle trunks where one VLAN is untagged and the others are tagged. Kinds of VLANs supported are:

- Port-based

The maximum number of VLANs is 4000, but it is possible to configure the maximum number to any value less than or equal 4000.

Note that at least one VLAN (the default one or a similar one) must be installed on the device, to make the device operate as a transparent bridge with learning and ageing. With no VLANs on the device (and GVRP inactive), forwarding at the Ethernet layer between the ports will not occur.

As with port-based VLANs, an Ethernet frame belongs to one and only one VLAN. In case a frame arrives at the switch, and the device has no VLAN for which the frame is a member, the frame is discarded.

When a VLAN-tagged frame arrives at the switch, the AXX 9100 CONNECT just looks up the VLAN on the device with the same tag as the tag found in the frame. Note that both the MAC address and VLAN tag are used in the lookup process. If such a VLAN is not found, the frame is discarded.

When the AXX 9100 CONNECT has received an Ethernet frame on a port, and decided which VLAN the frame belongs to, the AXX 9100 CONNECT sends the frame out on the ports listed as members of the identified VLAN (provided the ports satisfies the other basic Ethernet criteria for sending on the port).

2.3.3.11 GARP VLAN Registration Protocol

The Generic Attribute Registration Protocol (GARP) protocol is a general-purpose protocol specified in IEEE 802.1D that is used by participants in GARP Applications (GARP participants) to register and de-register attribute values with other GARP Participants within a Bridged LAN. GARP defines a set of devices interested in a given network attribute, such as VLAN or multicast address.

GARP VLAN Registration Protocol (GVRP) protocol is specifically provided for automatic distribution of VLAN membership information among VLAN-aware bridges. GVRP allows VLAN-aware bridges to automatically learn VLAN to bridge ports mapping, without having to individually configure each bridge, and to register VLAN membership.

GVRP allows both end stations and Bridges in a Bridged LAN to issue and revoke declarations relating to membership of VLANs. The effect of issuing such a declaration is that each GVRP Participant that receives the declaration creates or updates a Dynamic VLAN Registration Entry in the Filtering Database to indicate that VLAN is registered on the reception port. Subsequently, if all Participants on a segment that had an interest in a given VID revoke their declarations, the port attached to that segment is set to Unregistered in the Dynamic VLAN Registration Entry for that VLAN by each GVRP Participant attached to that segment.

Use of static configuration of VLANs may be appropriate on ports where the configuration of the attached devices is fixed, or where the network administrator wishes to establish an administrative boundary outside of which any GVRP registration information is to be ignored. For example, it might be desirable for all ports serving end user devices to be statically configured in order to ensure that particular end users have access only to particular VLANs.

Use of dynamic configuration of VLANs may be appropriate on ports where the VLAN configuration is inherently dynamic; where users of particular VLANs can connect to the network via different ports on an ad hoc basis, or where it is desirable to allow dynamic reconfiguration in the face of Spanning Tree topology changes. In particular, if the "core" of the Virtual Bridged LAN contains redundant paths that are pruned by the operation of Spanning Tree, then it is desirable for Bridge ports that form the core network to be dynamically configured.

Use of both static and dynamic configuration of VLANs may be appropriate on ports where it is desirable to place restrictions on the configuration of some VLANs, while maintaining the flexibility of dynamic registration for others. For example, on ports serving mobile end user devices, this would maintain the benefits of dynamic VLAN registration from the point of view of traffic reduction, while still allowing administrative control over access to some VLANs via that port.

Summary - Ethernet VLAN

Description	Specification
Support port based VLAN	802.1Q 2003
Support up to 4000 VLANs	
The maximum number of VLANs is configurable from the TMN system (0-4000)	
VLANs is default not active	
At least one VLAN must be active to make the AXX 9100 CONNECT start forwarding	
Supports tagged VLAN	
Supports untagged VLAN	
Able to add a tag to an untagged frame	
Able to remove a tag from a tagged frame	
Possible to use the VLAN identifiers from 1 to 4000	
Supports GVRP	
GVRP can be enable/disabled on a per port basis	
GVRP is disabled by default	
Possible to set the maximum number of GVRP VLAN from the TMN system	
Possible to set the relevant timers for GVRP	

Table 13 Feature summary - Ethernet VLAN

2.3.3.12 Multicast traffic

Overview

Multicast is a method of sending one packet to multiple destinations. Multicasting is used for applications such as video conferencing, and for distribution of certain information like some routing protocols. A standard IEEE 802.1D bridge forwards multicast frames on all ports that are members of the same VLAN as the port receiving such frames. This might not be desirable if the there is a lot of multicast traffic being transported through a multi-port bridge where the recipients are connected on only one (or a few) of the bridge port.

To alleviate unnecessary bandwidth consumption, the AXX 9100 CONNECT supports specific tables to control the forwarding of Multicast traffic if desired.

AXX 9100 CONNECT supports both static and dynamic configuration of MAC multicast addresses.

The static entries are configured from the TMN system. Entries may be added or deleted. The deletion may be performed immediately, after reset or dynamically aged out. It is possible to configure which ports are used or which ports that are not used.

The AXX 9100 CONNECT also supports IGMP (Internet Group Management Protocol) snooping which is used to dynamically update the dynamic multicast table based on the IGMP messaging between end nodes and IP multicast routers.

The AXX 9100 CONNECT contains a MAC Multicast forwarding table that includes static entries and dynamic entries. This table can be accessed from the TMN system

Note that multicast traffic is forwarded as usual if the MAC multicast feature is not enabled.

It is possible to specify ports that forward all multicast traffic in the Multicast Forward All table. It is also possible to specify what happens with unspecified multicast traffic in the Multicast Forward Unregistered table.

The internal resources of the AXX 9100 CONNECT used for the multicast tables are shared with the VLAN tables. The total of VLAN entries and multicast groups registered are 4000, and both types of entries occupy the same amount of resources. Hence, to enable the Multicast feature, ensure that the maximum amount of VLANs is less than 4000 according to how many multicast groups are anticipated.

2.3.3.13 Internet Group Management Protocol (IGMP) snooping

IGMP is a protocol used between hosts and routers. It makes it possible for hosts to specify their participation in a particular multicast group.

IGMP snooping, as implied by the name, is a feature that allows the switch to "listen in" on the IGMP conversation between hosts and routers. When a switch hears an IGMP report from a host for a given multicast group, the switch adds the host's port number to the Multicast Forwarding Table list for that group.

The number of active hosts is listed in the MAC Multicast Group table, and the number of active routers is listed in the MAC Multicast Router table.

It is possible to configure the IGMP timers from the TMN system.

Summary - Ethernet Multicast

Description	Specification
Support MAC multicast	802.1D 2004
MAC multicast is disabled by default	
Multicast frames are broadcasted when MAC multicast is disabled	
Support static MAC multicast	
Static MAC multicast must be configured from the TMN system	
Static entries can be added or deleted from TMN system	
Deleted entries can be removed immediately, after reset or dynamical after a timeout	
Possible to specify forbidden ports	
Possible to specify static ports	
Support dynamic multicast entries based on IGMP snooping	
IGMP snooping is disabled by default	
It is possible to configure host and router ageing timers	
The active host is available in the MAC multicast Group table	
The active routers is available in the MAC multicast Router table	

Table 14 Feature summary - Ethernet multicast

2.3.3.14 Ethernet protection

Overview of Spanning Tree Protocol

Spanning Tree Protocol (STP) is a Layer 2 link management protocol that provides path redundancy while preventing loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. Spanning-tree operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

The spanning-tree algorithm calculates the best loop-free path throughout a switched Layer 2 network. Switches send and receive spanning-tree frames, called bridge protocol data units (BPDU), at regular intervals. Switches supporting STP do not forward these frames, but use the frames to construct a loop-free path. Each switch uses the STP information in its own tables to create the BPDU it sends on to its neighbours.

Spanning tree defines a tree with a root switch and a loop-free path from the root to all switches in the Layer 2 network. Spanning tree forces redundant data paths into a standby (blocked) state.

When two interfaces on a switch are part of a loop, the spanning-tree port priority and path cost settings determine which interface is put in the forwarding state and which is put in the blocking state. The port priority value represents the location of an interface in the network topology and how well it is located to pass traffic. The path cost value represents the media speed.

Note that only a single instance of the spanning tree can be used regardless of VLAN configuration.

Rapid STP

The RSTP mechanism adapts to changes in physical network topology (that is, links going down and coming up) faster than the traditional STP variants. The STP variant may use in the order of a minute to adapt to a change, while the RSTP adapts in less than a second.

RSTP may be used together with its corresponding traditional (slow) variant.

NOTE! RSTP reverts to the STP algorithm on ports connected to equipment that only support STP.

AXX 9100 CONNECT supports RSTP in according to the standard IEEE 802.1w.

Summary - Ethernet protection

Description	Specification
Supports RSTP	802.1w 2001
RSTP can be enable/disabled from the TMN system	
RSTP is disabled by default	
Possible to configure the relevant parameters for RSTP from the TMN system	
Possible to add/remove ports under the control of RSTP	
Possible to configure Port Cost and Priority per port	

Table 15 Feature summary - Ethernet protection

2.3.3.15 Traffic priority

Overview

IEEE 802.1p traffic priorities constitute a generic mechanism that can be used to give different priorities to different kinds of traffic. The priorities influences the way switches treats traffic coming in on their ports.

In a switch without priorities, all traffic destined for the output port is treated according to the FIFO policy. When more traffic arrives at the output port than can be sent, traffic is queued. The queue has a certain size. When the queue is full, frames have to be discarded or the traffic destined for the output port will have to be reduced.

With priorities, traffic can be categorized, and each traffic category can be assigned a specific priority. Traffic with the same priority is served FIFO.

The IEEE 802.1p priority mechanism uses eight priority levels, numbered 0 - 7, inclusive. The relative ranking between these levels is not fixed by the standard. There is however a recommended relative ranking and priority assignment to traffic types, in the standard. This recommendation is found in Table 16

Priority Level	Traffic Type
7 (highest priority)	network management
6	voice
5	video
4	controlled load

Priority Level	Traffic Type
3	excellent effort
0	best effort
2	undefined
1 (lowest priority)	background

Table 16 Relative ranking of priority levels and assignment to traffic types

In the table, the priority levels are given in the order of descending relative priorities, from top to bottom. Note that the recommendation is to let priority level 0 (zero) have higher priority than 2 and 1.

Most switches do not implement 8 queues per output port. Two or four queues per output port is more common. Having recognized this, the standard contains recommendations for how switches with less than 8 queues per output port should behave. A number of classes of service should be defined in such switches - one per output queue supported.

Recommended mapping between priority levels and classes of service for such a switch is given in Table 17

Priority Level	Class of Service
6, 7	3
4, 5	2
0, 3	1
1, 2	0

Table 17 Recommended mapping for a switch with four output queues per port

The AXX 9100 CONNECT only support strict priority as a scheduling policy that is applied between the queues at an output port:

- Strict policy: no traffic is sent from a queue with a given priority, unless all queues of higher priority are empty

For strict policy, the most distinctive advantage is that critical traffic can be sent at the same rate as it arrives at the queue, with no traffic loss, as long as the arrival rate is less or equal to the total capacity of the output port.

The priority of traffic arriving at a port of a switch can be determined implicitly or explicitly. In explicit determination, an arriving frame contains a tag explicitly stating the priority of the frame. The tag is a 3 bit field, part of the same overall tag-field as the one used for VLANs. Even though priorities and VLANs share an overall field of the Ethernet frame, they are independent mechanisms.

In implicit determination of priority, the switch can tell the priority of an arriving frame, from the context the frame is received in. The priority may for instance be determined based on which port of the switch the frame arrives on. In implicit determination, no priority tag is needed in the Ethernet frame

Implemented features

The AXX 9100 CONNECT supports priorities according to IEEE 802.1p (Note that 802.1p was incorporated into the 802.1D). Four different classes of services are used - that is, four queues per output port. The classes of service are numbered from 0 through 3. Service class 0 has lowest priority. Priority increases with increasing service class number. The mapping from the 8 IEEE priority levels to the four classes of service is configurable through the management system. The default mapping used, is the one recommended in IEEE 802.1D (see Table 14 above).

The scheduling used by the AXX 9100 CONNECT between output queues at a port, is strict policy. Both implicit and explicit (tagged) priority determination are used by the device. Tagging of outgoing frames with correct priority value is also supported, as is tag removal for outgoing frames (where appropriate).

The packet parts of the AXX 9100 CONNECT include an Ethernet switch with selectable number of ports. This decided by how many Ethernet modules are present in the system. The traffic priorities on the device, work across all ports, as it would on a traditional Ethernet switch.

Summary - Traffic priority

Description	Specification
Supports Ethernet priorities	802.1D 2004
Disabled by default	
AXX 9100 CONNECT have four queues per port	
The eight COS level is mapped into 4 queues	
The default mapping is according to Table 14	
The mapping can be changed from the TMN system	
Strict priority scheduling is supported	
Support implicit and explicit priority determination	

Table 18 Feature summary - Ethernet traffic priority

2.3.3.16 Rate limiting

Ethernet rate limiting

Ethernet rate limiting is not supported in this release.

SDH rate limiting

The rate limiting features for SDH are performed in the EOS mapper. The WAN capacity is used to set the maximum rate of the input port and the following step sizes are used.

- NxVC-12 for N is from 1 to 50
- NxVC-3 for N is from 1 to 3
- NxVC-4 for N is 1

It is possible to map 2.24 Mbps into a VC-12 container 48.38 Mbps for a VC-3 container and 149.76 Mbps for a VC-4 container.

Summary - Rate limiting

Description
Rate limiting in EOS mapper supported
Bandwidth can be configured from 2.2 Mbps to 100 Mbps in steps of 2.2Mbps with VC-12 mapping
Bandwidth can be configured from 48 Mbps to 100 Mbps in steps of 48 Mbps with VC-3 mapping
Bandwidth can be configured for 100 Mbps with VC-4 mapping

Table 19 Feature summary - Ethernet rate limiting

2.3.3.17 Provider bridging

The CONNECT provides provider bridging functionality. It is important for a network provider to be able to deliver a transparent service to the end customer. Therefore it must be possible to tunnel the end customer traffic through the providers network without setting any requirements about the content of the end customer Ethernet traffic. The basic Ethernet format must of course be according to the Ethernet standards, but the end customer does not have any limitation on the VLAN information.

It is equally important to tunnel the user traffic to prevent the L2 control protocols from the end customer to interact with the operators network. Therefore it must be possible to remove or to tunnel the relevant control protocols through the providers network.

Provider VLAN also make the providers network more scalable by removing the 4K VLAN limitation and the size limitation of the spanning tree since the number of hops in the provider network is not a part of the calculation by the user spanning tree.

Tunnelling of user traffic

Tunnelling of user traffic is supported with a Q in Q or double tagging solution. An additional VLAN tag is inserted in the ingress traffic when the Ethernet frame enters the providers network. The VLAN tag is removed from the egress traffic when the Ethernet frame leaves the provider network. Internally in the providers network it is treated as an ordinary VLAN Ethernet frame. The only difference is that the size of the Ethernet frame is increased with four bytes. This is shown in Figure 31

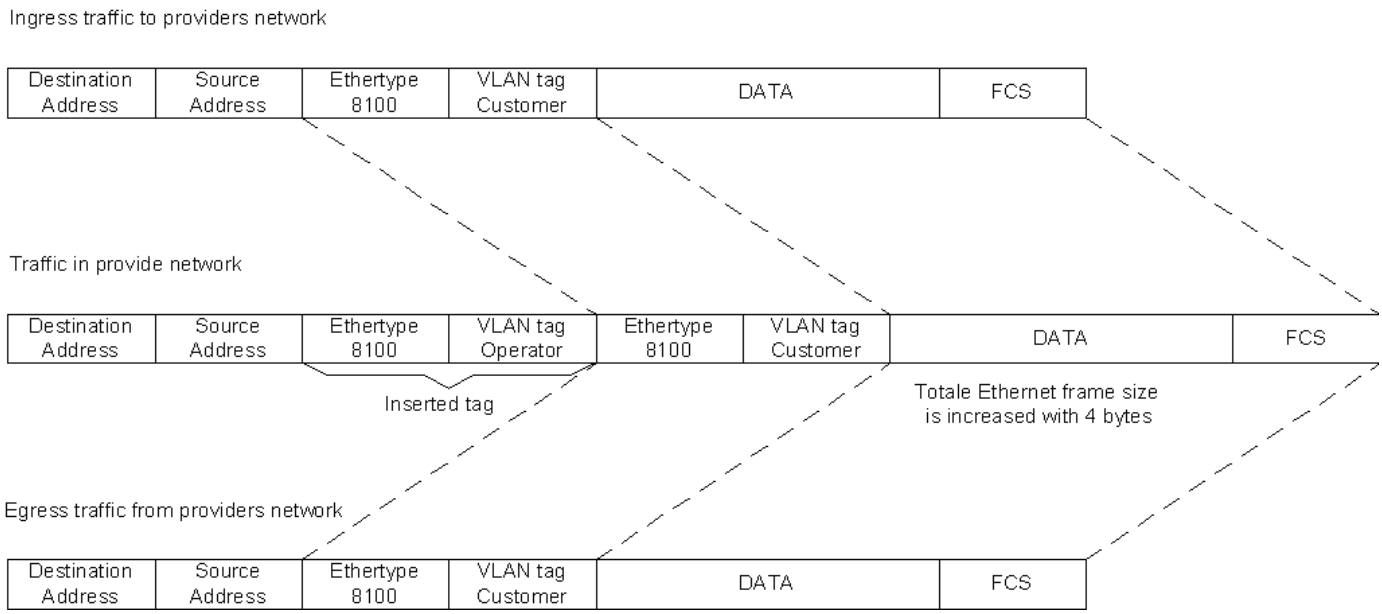

Figure 31 User traffic tunnelling

The AXX 9100 CONNECT supports two Ethertype values (8100 and FFFF). The value is configurable from the TMN system.

The priority field in the provider tag can be set to a fixed value for a port or copied from the ingress customer traffic. This is selectable per port and controlled by the TMN system. The default setting is to copy it from the ingress customer traffic.

Tunnelling of user protocols

It is highly disadvantageous to mix L2 control frames (e.g. STP BPDUs) from the customer with the L2 control frames from the network provider.

The AXX 9100 CONNECT can also tunnel user L2 control protocols through the provider network. The destination address for the protocol is replaced with a new multicast address (0180C2xxxxxx is replaced by 01047Axxxxxx) from the Ericsson AXXESSIT address range. The tunnelling is performed between the ingress and egress of the provider's network.

The following multicast addresses in the range from 0180C2000000 to 0180C20000FF, except for 0180C2000001 are tunneled (PAUSE packet are dropped).

This includes the following protocols:

- Spanning Tree Protocols (STP, RSTP and MSTP)

- Link OAM (802.3ah)
- IEEE 802.1x Port Authentication protocol
- Generic Attribute Registration Protocol (GARP)
- GARP VLAN Registration Protocol (GVRP)
- GARP Multicast Registration Protocol (GMRP)
- Multicast to all bridges in a bridged LAN on standard address

It is possible to select from the TMN system if all of the above mentioned control protocols are processed or tunnelled through the provider network.

Summary - Provider bridging

Description	Specification
User traffic tunnelling supported	
User traffic tunnelling is off default	
Q in Q is used for user traffic tunnelling	
The standard Ethertype is used for Q in Q frames	
Protocol tunnelling supported	
All protocols terminated by default	
All protocols in the range in range from 0180C2000000 to 0180C20000FF, except for 0180C2000001 are tunneled	
PAUSE packets are dropped	
A multicast address (01047Axxxxxx) is used as the tunnelling address	
Traffic classified per port	
Ethertype for Q in Q can be configured as 8100 and FFFF from the TMN system	

Table 20 Feature summary - Ethernet provider bridging

2.3.3.18 Link aggregation

Link aggregation technology, also called trunking or bonding, is essentially to combine multiple physical links between two devices into one logical path as shown in Figure 32 This group of links is called a link aggregation group (LAG). The physical links between switches, namely Link 1, Link 2 and Link 3 consist of LAG, which is an integrated one in logic, and its internal details are invisible to upper layer entity.

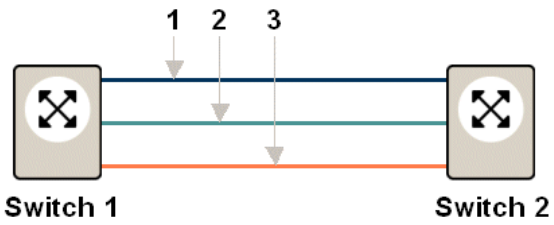

Figure 32 Link aggregation

The physical members of the LAG cooperate to finish data forwarding and backup each other. As long as one link remains active in spite of failure of others, the connection between two switches will not break. For instance, provided Link1 fails, its tasks will be moved to Link 2 and Link 3 quickly, keeping the connection between the switches in working.

An advantage brought by aggregation technology is to increase bandwidth of lines economically. Bonding together, many physical lines form a data path of higher capacity equaling to the sum of that of all physical lines. Users need not to upgrade equipments. According to certain algorithm, the traffic is distributed across aggregate members inside to share the load.

Note that traffic for one source will always use one link to prevent that the frames are mis-ordered. Multicast traffic and broadcast traffic will always be allocated for only one of the links.

The AXX 9100 CONNECT use a load-balancing scheme based on the combination of destination MAC address and VLAN id.

Note that the load-balancing scheme limits the maximum throughput over the logical link. The worst-case maximum throughput is limited to the capacity of one of the links if all the traffic over the logical link sent to one source. The best-case maximum throughput is the capacity of the links when the traffic is sent to many different sources.

In an aggregation group, the link members backup for each other dynamically; once one breaks down, the rest can take over its work fast. Contrary to STP, this procedure of replacement is independent and transparent for the outside and can be finished in on the order of 1 second or less.

The allocation of link for a LAG can be done statically or automatically.

The operator can from the TMN system statically configure which links that are a part of the LAG.

AXX 9100 CONNECT supports only link aggregation on the L2 FE module. It is not supported for the L1 FE module.

The member of a LAG must be on the same module. It is not possible to have a LAG with interfaces on two modules.

Summary - Link aggregation

Description	Specification
Link aggregation supported	802.3 2002
Link aggregation off by default	
Available on all L2 Ethernet ports (FE)	
A LAG only use interfaces from the same module	
Only support one LAG per module	
The maximum number of link in a LAG is 4	
Only support static configuration of LAG from the TMN system	

Table 21 Feature summary - Link aggregation

2.3.3.19 Performance monitoring

AXX 9100 CONNECT provides performance monitoring based RMON statistic as described in IETF RFC 2819.

The following groups are supported:

- Ethernet statistic group
- History control group
- Alarm group
- Event group

The RMON functionality is available for all LANx and WANx ports.

Summary - Performance monitoring

Description	Specification
RMON performance monitoring is supported	
RMON is off by default	
Available on all Ethernet ports	
The Ethernet statistic group supported	
The History control group supported	
The Alarm group supported	
The Event group supported	

Table 22 Feature summary - Ethernet performance monitoring

2.3.3.20 Port mirroring

AXX 9100 CONNECT provides the possibility to monitor traffic on a port. Both the received traffic and the transmitted traffic are forwarded to a user-selected port. A network traffic analyser would typical be connected to this port, see Figure 33 Another name for port mirroring is sniffing.

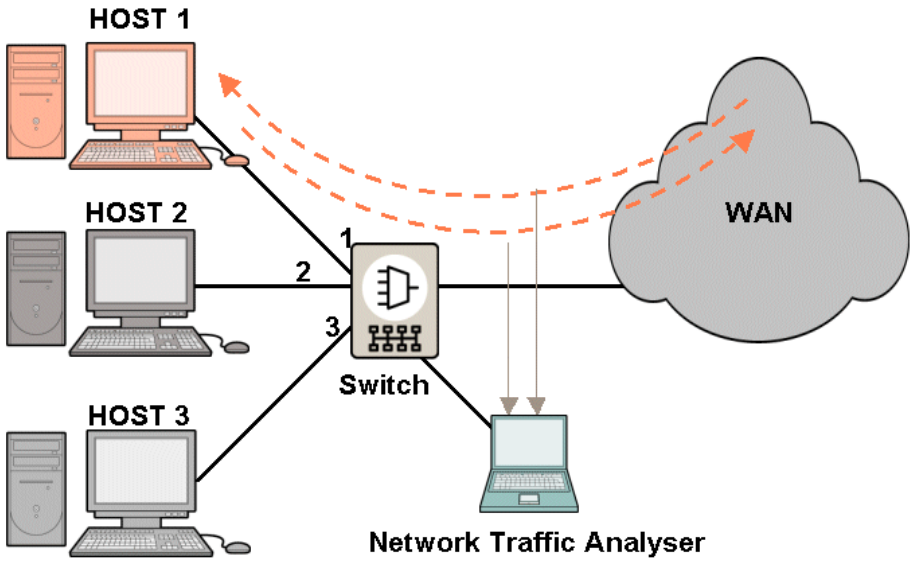

Figure 33 Port mirroring

The implementation has a limitation if the monitored port is running in full duplex mode. Frames will be lost if both the port is transmitting and receiving data at full speed over a period.

Summary - Port mirroring

Description
Port mirroring supported
Port mirroring switched off by default
No restrictions for selection of the port that shall be monitored
No restrictions for selection of the monitor port

Table 23 Feature summary - Port mirroring

2.4 PDH features

2.4.1 E1 features

General information

AXX 9100 CONNECT supports a number of E1 interfaces that is mapped into SDH VC-12 containers. The SDH mapping features is described in “SDH features” on page 17.

The E1 interfaces provide a number of different services as shown below:

- Transparent leased line (TRA)
- Framed leased line (FRA)
- ISDN primary rate access (PRA)

It is possible to configure the E1 interfaces individually to support the different services.

AXX 9100 CONNECT include a special feature to reduce jitter and wander. The pointer processing for the interface is switched off and controlled frame slips are performed if the frequency of the SDH timing is not synchronised to the frequency of the PDH interface.

No frame loss, multiframe loss or CRC-4 errors are generated when controlled frame slips are performed.

This feature is only supported in the framed leased line and the ISDN PRA modes. The operational modes are shown below:

Mode	**Description**
PRA	ISDN PRA lease line
TRA	Transparent leased line
PRA-FIXED	ISDN PRA with fixed pointer
FRA-ONES	All ones SA-bits, CRC4E term
FRA-TRANSP	Transparent SA-bits, CRC4E term
FRA-FIXED-ONES	All ones SA-bits, CRC4E term
FRA-FIXED-TRANSP	Transparent SA-bits, CRC4E term
FRA-MONITOR	Monitor only

Table 24 Operational modes

2.4.1.1 Transparent leased line

The transparent or unstructured leased line service delivers a full digital bit rate of 2048 kbps with no restriction on the binary content.

The service is symmetrical in both directions and only supports point-to-point connections. The service is specified in EN 300 247 and the network interface is specified in EN 300 418.

An alarm indication signal (AIS) is inserted toward the network if loss of signal (LOS) is detected from the customer.

AIS is also inserted towards the customer if LOS or other major alarms are detected from the networks.

2.4.1.2 Framed leased line

The framed or structured leased line service operates at a bit rate of 2048 kbps and provides an information transmissions capacity, with no restriction on the binary content, of 1984 kbps. The remaining 64 kbps provides an 8 kHz framing structure in accordance to G.704 and G.706.

The service is symmetrical in both directions and only supports point-to-point connections. The service is specified in EN 300 419 and the network interface is specified in EN 300 418.

It is possible to configure the service to run in both basic frame and multiframe modes. Note that performance monitoring is only available in the multiframe mode.

It is possible to terminate the CRC-4 segments in both directions, but it is also possible monitor the CRC-4 segments the CRC-4 bits and E-bits in both directions.

The SA bits and the A bit is not processed and is undefined.

An alarm indication signal (AIS) is inserted toward the network if LOS, loss of basic frame alignment or loss of multiframe alignment is detected from the customer.

AIS is also inserted towards the customer if LOS, loss of basic frame alignment, loss of multiframe alignment or other major alarms are detected from the networks.

2.4.1.3 ISDN Primary rate access

Basic Configuration

ISDN Primary rate access (PRA) is used to provide ISDN access for the end customers of an operator. A block diagram describing the digital line section for PRA is shown in Figure 34

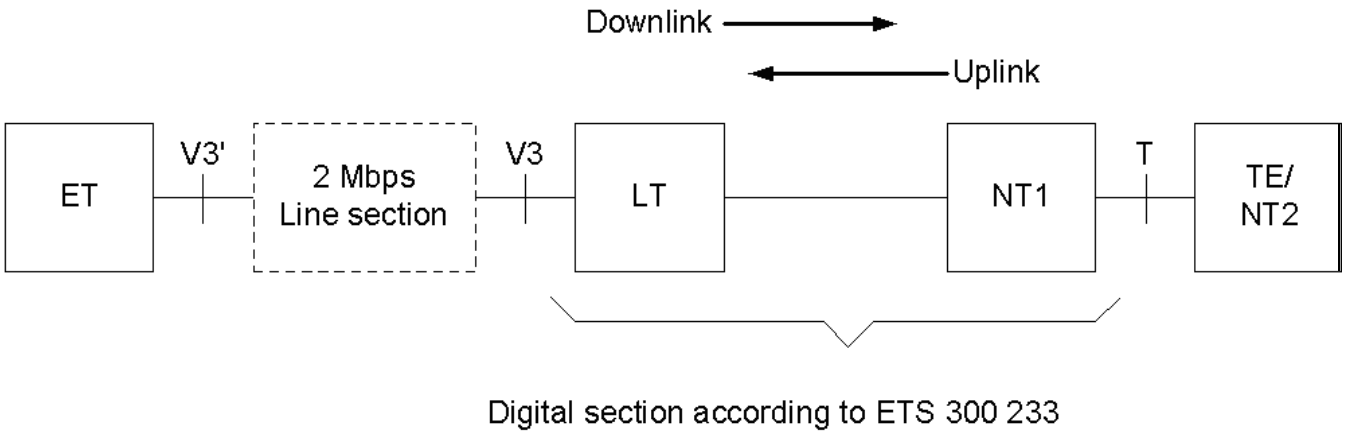

Figure 34 ISDN PRA

ET -Exchange Terminal

LT- Line Terminal

NT1. Network Terminal

TE/NT2- Terminal Equipment/Network Terminal 2 (users equipment)

T- Network Interface to user (ETS 300 011)

V3- LT interface to ET (ETS 300 233). If a 2 Mbps Line Section is inserted between LT and ET, the interface at the ET side is named V3`

The interfaces related to the transmission between LT and NT1 are not specified, neither the transmission medium.

- Transmission rate at V3 (V3`) and T is 2.048 kbps +/- 50 ppm with independent clocks for two directions of transmission
- Transmission format is according to G.704 and electrical interface according to G. 703 120 ohm balanced T interface.

The ET is responsible for management of the PRA access section. This is embedded in the functional specification of interface V3 comprising uplink reporting of failure conditions and detected bit errors, and downlink provision of loopback commands.

The LT does not have any function related to supervision of transmission quality. Note that no LT1 functionality is implemented in AXX 9100 CONNECT.

The NT1 performs the following functions related to supervision of transmission quality:

- CRC-4 errors are detected and reported for the ET-NT1 CRC-4 segment using E-bits.
- CRC-4 errors are detected and reported for the NT1-TE CRC-4 segment using SA6 codes.
- Failure conditions are also reported using Sa6 codes.
- The NT1 is transparent to the following TS0 bits in both directions: A(RA1), SA4, SA7 and SA8.
- Bits SA5 and SA6 are utilised between NT1 and ET only, and are not interpreted by the TE

Loopback point 2 in the NT1 is specified towards the ET. Loopback commands are given from the ET by codes in TS0 bit SA6.

2.4.1.4 Loopbacks

Two types of loopbacks are supported for the interface; Line loopback and terminal loopback.

The PDH line loopback has the following characteristics:

- The entire PDH E1 signal is looped back
- The loopback is performed after the clock extraction
- AIS is inserted towards the network element itself

The PDH Terminal loopback has the following characteristics:

- The entire PDH E1 signal is looped back towards the network element itself
- AIS is transmitted towards the line

The loops can be activated from the craft terminal or from the TMN system. The network loop can also be activated in band from the ET in ISDN PRA mode.

NOTE! It is not possible to activate the loops from the craft terminal or the TMN system while in ISDN PRA mode.

2.4.1.5 Performance monitoring

AXX 9100 CONNECT measures and calculates performance-monitoring data for bit errors in a G.704 framed signal.

A block of 2048 bits is used for detection of bit errors (one SMF). The embedded CRC-4 bits or the remote E-bits are used to detect bit errors in the block.

Three types of defects are defined in the specification:

- Loss of signal
- Detection of AIS
- Loss of frame alignment

Two type of anomalies are also defined:

- Error in frame alignment word
- Bit errors in the block

The following parameters are calculated according to G.826:

- Errored second (ES).A one second period with one or more errored blocks or at least one defect.
- Severely errored second (SES).A one second period which contains >= 30% errored blocks or at least one defect
- Background block error (BBE).An errored block not occurring as a part of an SES
- Unavailable seconds (UAS).A period of unavailable time begins at the onset of ten consecutive SES events. These ten seconds are considered to be part of unavailable time. A new period of available time begins at the onset of 10 consecutive non-SES events. These ten seconds are considered to be part of available time. UAS is the number of second of unavailable time.

AXX 9100 CONNECT provides performance data for both CRC-4 segments and provides performance data for both CRC-4 errors and E-bits (remote CRC-4 errors).

Note that the segment between AXX 9100 CONNECT and the network is equal to the performance data for the VC-12 connection as long as the whole network is SDH based. It may differ if part of the network is running over PDH links.

Summary - E1 interface

Description	Specification
Support E1 interfaces	
Support transparent leased lines	EN 300247 V1.2.1
Support framed leased lines	EN 300419 V1.2.1
Support NNI interface for transparent leased line	EN 300418 V1.2.1
Support ISDN PRA	ETS 300233 05/1994
Only support NT1 functionality in ISDN PRA	ETS 300233 05/1994
Support the error detection capability in ISDN PRA	ETS 300233 05/1994
Support alarm reporting functionality in ISDN PRA	ETS 300233 05/1994
Dying gasp in ISDN PRA not supported	ETS 300233 05/1994
Support in-band looping commands in ISDN PRA	ETS 300233 05/1994
Power feeding for ISDN PRA not supported	ETS 300233 05/1994
Support the UNI for ISDN PRA	ETS 300011-2 03/1998
The modes for the E1 interface are individually configurable	
The E1 interface support 75 ohm unbalanced interface with an external balun	
The E1 interface support 120 ohm balanced interface	
LOS detection	G.775 10/1998 ch.4
Basic frame structure	G.704 10/1998 ch. 2.3
Multiframe structure	G.704 10/1998 ch. 2.3
A bit support	G.704 10/1998 ch. 2.3
SA bit shall be transparent except for ISDN PRA	G.704 10/1998 ch. 2.3
Basic frame alignment	G.706 04/1991 ch.4
Multiframe alignment	G.704 10/1998 ch. 2.3
Termination of CRC-4 segments	G.704 10/1998 ch. 2.3
Monitoring of CRC-4 segment without termination	G.704 10/1998 ch. 2.3

Description	Specification
Loopback supported	
Both line and terminal loopbacks supported	
AIS generated towards the matrix for the line loopback	
AIS generated towards the line for the terminal loopback	
All loopbacks removed by a system restart	
Performance monitoring according to G.826	G.826 02/1999
Support PM data for both CRC-4 segments	G.826 02/1999
Support PM data for CRC-4 errors	G.826 02/1999
Support PM data for remote CRC-4 errors (E-bits)	G.826 02/1999

Table 25 Feature summary - E1

2.4.2 E3 features

General information

AXX 9100 CONNECT supports a number of E3 interfaces that is mapped into SDH VC-3 containers. The SDH mapping features is described in SDH features chapter.

The E3 interfaces provide the following service as shown below:

- E3 Transparent leased line

E3 transparent leased line

The transparent or unstructured leased line service delivers a full digital bit rate of 34.368 Mbps with no restriction on the binary content.

The service is symmetrical in both directions and only supports point-to-point connections.

An alarm indication signal (AIS) is inserted toward the network if loss of signal (LOS) is detected from the customer.

AIS is also inserted towards the customer if LOS or other major alarms are detected from the networks.

Loopbacks

Two types of loopbacks are supported for the interface; Line loopback and terminal loopback.

The PDH line loopback has the following characteristics:

- The entire PDH E3 signal is looped back
- The loopback is performed after the clock extraction
- AIS is inserted towards the network element itself

The PDH Terminal loopback has the following characteristics:

- The entire PDH E3 signal is looped back towards the network element itself

AIS is transmitted towards the line

The loops can be activated from the craft terminal or from the TMN system

Summary - E3 interface

Description	Specification
Support E3 interfaces	
Support E3 transparent leased lines	
The E3 interface is individually configurable	
The E3 interface support 75 ohm unbalanced interface	
LOS detection	G.775 10/1998 ch.4
AIS generation towards network while customer loop is active	
AIS generation towards customer while network loop is active	
Loopback supported	
Both line and terminal loopbacks supported	
Loopback switched of by default	
AIS generated towards the matrix for the line loopback	
AIS generated towards the line for the terminal loopback	
All loopbacks are removed by a system restart	

Table 26 Feature summary - E3

2.4.3 T3 features

General information

AXX 9100 CONNECT supports a number of T3 interfaces that is mapped into SDH VC-3 containers. The SDH mapping features is described in “SDH features” on page 17.

The T3 interfaces provide one service as shown below:

- T3 Transparent leased line

T3 transparent leased line

The transparent or unstructured leased line service delivers a full digital bit rate of 44.736 Mbps with no restriction on the binary content.

The service is symmetrical in both directions and only supports point-to-point connections.

An alarm indication signal (AIS) is inserted toward the network if loss of signal (LOS) is detected from the customer.

AIS is also inserted towards the customer if LOS or other major alarms are detected from the networks.

Loopbacks

Two types of loopbacks are supported for the interface; Line loopback and terminal loopback.

The PDH line loopback has the following characteristics:

- The entire PDH T3 signal is looped back
- The loopback is performed after the clock extraction
- AIS is inserted towards the network element itself

The PDH Terminal loopback has the following characteristics:

- The entire PDH T3 signal is looped back towards the network element itself
- AIS is transmitted towards the line

Note that AIS for T3 is the same as all ones.

The loops can be activated from the craft terminal or from the TMN system.

Summary - T3 interface

Description	Specification
Support T3 interfaces	
Support T3 transparent leased lines	
The T3 interface is individually configurable	
The T3 interface support 75 ohm unbalanced interface	
LOS detection	G.775 10/1998 ch.4
AIS (all ones) generation towards network while customer loop is active	
AIS (all ones) generation towards customer while network loop is active	
Loopback supported	
Both line and terminal loopbacks supported	
Loopback switched of by default	
AIS s generated towards the matrix for the line loopback	
AIS generated towards the line for the terminal loopback	
All loopbacks removed by a system restart	

Table 27 Feature summary - T3

2.5 DCN features

2.5.1 Introduction

In this context the term "DCN" (Data Communication Network) is used to denote the network that transports management information between a management station and the NE. This definition of DCN is sometimes referred to as MCN (Management Communication Network). The DCN is usually physically or logically separated from the customer network.

The AXX 9100 CONNECT management solution is based on SNMP over IP. The main purpose of the DCN implementation is to provide connectivity to the SNMP Agent inside the AXX 9100 CONNECT via different DCN topologies. The DCN implementation, however, also support transport of management traffic between other Ericsson AXXESSIT or third party nodes.

Although the management application is IP-based, the DCN solution must also support OSI-only and mixed IP/OSI-networks at layer 2 and 3. The various options and features related to different DCN topologies are specified throughout this section.

In general, the term "OSI" in this document is used to denote a CLNP-routed network, i.e. it is only used for L3. Higher level OSI-protocols are not considered. At L2 different protocols are supported, including LAP-D. The AXX 9100 CONNECT OSI-implementation supports CLNP, IS-IS Level 1 and Level 2 and ES-IS.

For the "IP In-band" L2 topology (see page 2-104) the management traffic carried in a VLAN is switched between LANx/WANx ports at wire-speed along with the user traffic. For all other cases, the following applies: The DCN traffic is always routed (IP or OSI) between the management interfaces. The DCN routers are implemented in software.

Most topologies in the following sections assume standard numbered IP interfaces, i.e. every interface connected to the router takes an IP address and a subnet. However, AXX 9100 CONNECT will also support "IP Unnumbered Interfaces".

With this feature the device will need only one IP address (see “IP Numbered and IP Unnumbered DCN system mode” on page 102).

2.5.2 Management Interfaces

The following interfaces may be used to carry management traffic:

- **Management port**. The AXX 9100 CONNECT has a dedicated Ethernet port for management, called the "Management Port". This port can be used for local management, e.g. connecting a craft terminal. It can also be used for connecting to a separate external management network. The management port can be turned off to avoid unauthorised local access. The management port cannot be member of a VLAN.
- **LANx ports**. The LANx ports can be used to carry management traffic both when they are in L1 mode, i.e. internally connected to an EOS mapper for L1 functions, and when they are in L2 mode, i.e. internally connected to a port on the internal Ethernet switch for L2 functions.
- **WANx ports**. The WANx ports can be used to carry management traffic.
- **DCC channels**. The SDH architecture defines data communication channels (DCC) for transport of management traffic in the regenerator section (DCC_R - 192 kbps) and in the multiplexer section (DCC_M - 576 kbps).
  DCN can use 2 DCC_R from the aggregate interfaces, 2 DCC_M from the aggregate interfaces, and 8 DCC_R from the tributary modules. For one SDH-port, both DCC channels may be active simultaneously. Activation and deactivation of DCC channels is configurable on a per port basis.
- **Local VT-100 serial port**. Also this RS-232 interface is regarded as a management interface, although it does not relate to the various DCN topologies described throughout the rest of this section. Only a few basic CLI-commands are provided via this interface.

2.5.3 IP Numbered and IP Unnumbered DCN system mode

The AXX 9100 CONNECT DCN solution supports two main modes, referred to as system modes: IP numbered mode and IP unnumbered mode. Numbered mode means that all management interfaces are allocated an IP address. Unnumbered mode means that point-to-point management interfaces have no IP address.

The IP Unnumbered concept allows the system to provide IP processing on a serial interface or in general a point-to-point without assigning it an explicit IP address. The IP unnumbered interface borrows the IP address of another interface already configured on the system (i.e. the Management Port), thereby conserving network and address space, and making the system easier to configure, manage and maintain.

With IP Unnumbered, all nodes connected via PPP-links may be on the same IP subnet. An essential part of the implementation is the DCN ARP Proxy Agent, which makes sure that connectivity between the nodes is obtained without having to provision static routes. The Proxy Agent builds entries for all the DCN IP destinations, and will reply to ARP requests on behalf of them.

The configuration of the system mode (numbered or unnumbered) applies to the whole Network Element, i.e. either all point-to-point management interfaces are numbered, or all are unnumbered.

Some of the DCN modes presented in the remaining of this chapter require an IP address (for example OSI mode and L2 IP Inband mode), and therefore cannot be used when the system mode is set to IP unnumbered. Table 28 presents an overview of which DCN modes are available for the IP numbered and IP Unnumbered system modes.

	System Mode: IP Numbered	**System Mode: IP Unnumbered**
External DCN / Management Port	x	x
L1 IP Inband	x	x
L2 IP Inband	x	not available
OSI	x	not available
PPP/DCC	x	x
Transparent DCC	x	x

Table 28 DCN modes versus System Mode (IP Numbered or IP Unnumbered)

2.5.4 External DCN

Description

"External DCN" means that the management station connects to the AXX 9100 CONNECT via a separate DCN. The physical connection to the AXX 9100 CONNECT is the Management Port.

Both IP/Ethernet and CLNP/802.x are supported. The AXX 9100 CONNECT can run both stacks on the Management Port simultaneously.

The AXX 9100 CONNECT may also serve as a gateway from an External DCN to other Ericsson AXXESSIT-nodes in the SDH network, i.e. the External DCN topology may be combined with other topologies described in the next subsections. If External DCN (in OSI mode) is combined with OSI/DCC, the AXX 9100 CONNECT implements a Gateway Network Element (GNE) as defined in ITU-T G.784.

The direct connection of a craft terminal to the Management Port may be regarded as a special case of the External DCN topology.

Example

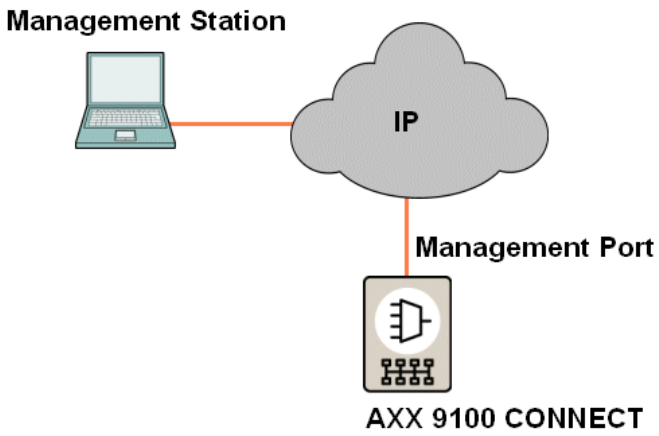

Figure 35 External DCN

2.5.5 IP In-band DCN

Description

"IP-In-band" means that LANx and WANx ports are carrying management traffic together with customer traffic. This is useful in

topologies where (parts of) the SDH-network is owned by a different operator that does not allow a third party to use the DCC capacity.

With IP-In-band it is possible to build tunnels between "islands" that have other DCN solutions.

This feature has different restrictions and options depending on whether the LANx ports are in L1 or L2 mode:

L2 Mode:

A LANx port in L2 mode is connected to the switch. Such a port may carry in-band management traffic if an IP-address is assigned to the port, or to the VLAN it belongs to.

Between LANx ports in L2 mode and WANx ports members of the same VLAN, the switching is always at wire-speed. Routing between LANx ports in L2 mode, WANx ports, and the other management interfaces is always performed by the CPU.

It is possible to split management traffic from user traffic by assigning dedicated LANx/WANx ports or dedicated VLANs to management traffic.

L1 Mode:

In AXX 9100 CONNECT, LANx ports can also be in L1 mode in order to support Ethernet L1 services. In this case the ports are not connected to the switch.

LANx ports in L1 mode can carry in-band management traffic. The management traffic is identified by means of a proprietary Ericsson AXXESSIT MAC-address and can only be used over point-to-point links between Ericsson AXXESSIT nodes. This feature can be enabled or disabled per L1 LANx port.

From a system point of view this feature is similar to the PPP/DCC case (see “PPP/DCC DCN” on page 109).

Example

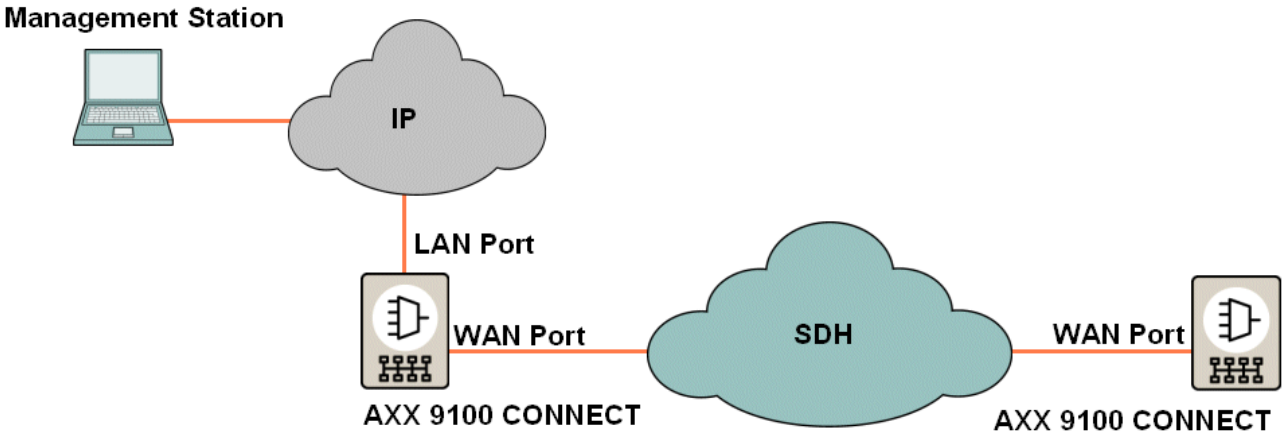

Figure 36 IP Inband DCN

2.5.6 OSI/DCC DCN

Description

This option is useful if the AXX 9100 CONNECT is connected to or part of an OSI-based DCN. The AXX 9100 CONNECT IP-based management traffic will be transported through the DCC-channels of a general (multi-vendor) SDH network by means of standard OSI-protocols at layer L2 and L3.

L3 protocols supported are CLNP, IS-IS Level 1 and Level 2 and ES-IS. The L2-protocol in the DCC-channels in OSI-mode is LAP-D.

All the interfaces that have the OSI option enabled will be connected to the internal CLNP router. This implies that also third-party DCC-traffic can be routed across the AXX 9100 CONNECT CLNP router.

A CLNP tunnelling mechanism is provided for transport of IP datagrams between the management station and the AXX 9100 CONNECT SNMP Agent over an OSI-based network. One Ericsson AXXESSIT node (AXX 9100 CONNECT or other) must be configured to act as a gateway (GW) to an IP-based network for a number of NE's. The NE's must know the NSAP address of its GW. Both ends will encapsulate the IP datagrams in CLNP-frames and transmit them across the OSI network. The encapsulation methods used are mostly in accordance with RFC 3147 Generic Routing Encapsulation over CLNS Networks and RFC 2784 Generic Routing Encapsulation.

The DCC channels connect to CLNP individually, and CLNP is connected to the IP router via one router port. In OSI/DCC mode the AXX 9100 CONNECT must have both an NSAP address and (at least) one IP address. From an IP perspective the GW is a router between OSI and the Management port.

The GW maintains an Address Mapping Table between the NE's IP and NSAP addresses by means of a proprietary protocol.

All NE's associated with a GW are on the same IP subnet.

NOTE! The GW functionality described , should not be mixed up with the ITU-T G.784 Gateway Network Element (GNE) function, which is the gateway between the CLNP network on SDH-DCC, and another non-SDH based network.

Example

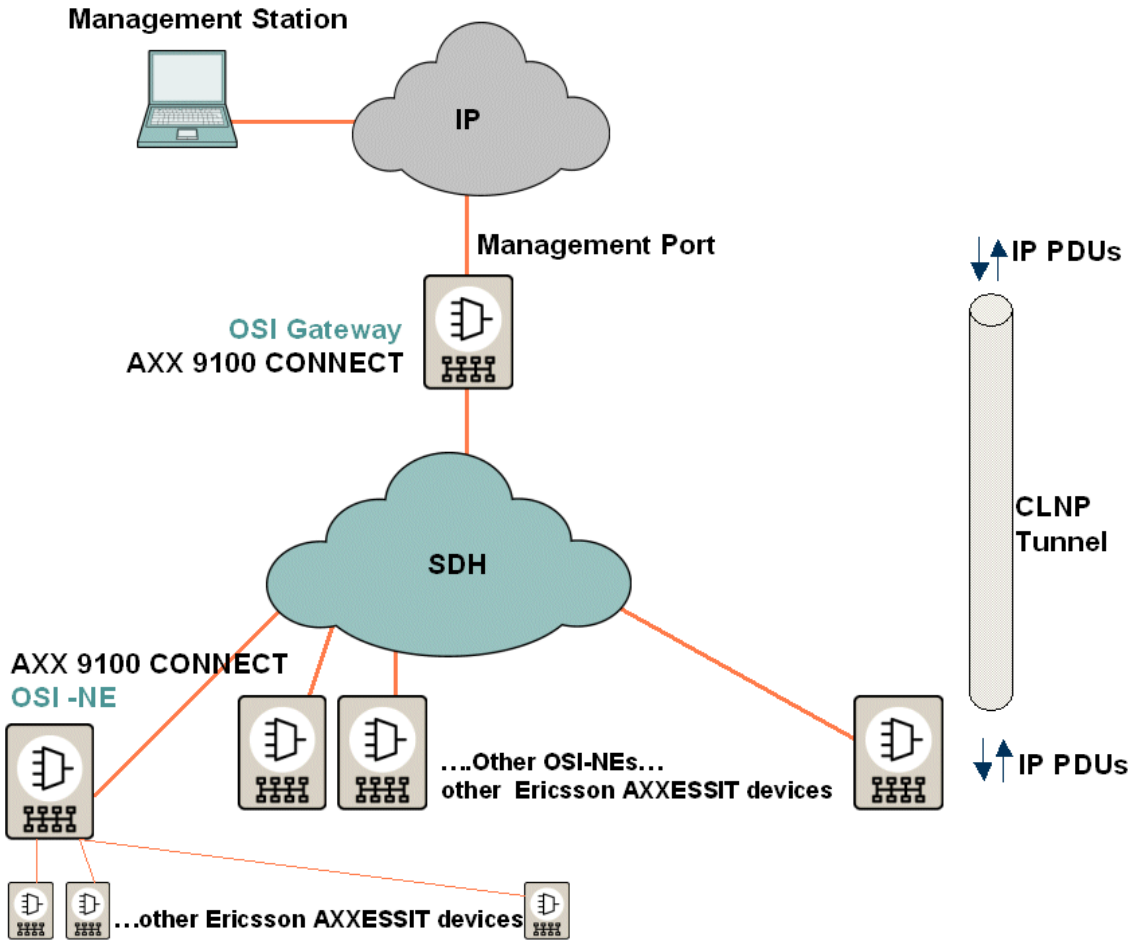

Figure 37 OSI/DCC DCN

2.5.6.1 Limitations

- Max number of NE's per GW: 32
- Max number of entries in the IS-IS L1/L2 routing-table: 200
- Max number of DCC channels in OSI-mode: 4
- Only available in IP numbered system mode

2.5.7 PPP/DCC DCN

Description

PPP/DCC means that the management IP-traffic is carried in PPP over the SDH DCC channels according to NSIF-DN-0101-001. The PPP implementation supports RFC1661 (PPP), RFC1662 (PPP in HDLC-like framing) and RFC1332 (IPCP).

Each PPP/DCC channel connects to the IP router individually.

Example

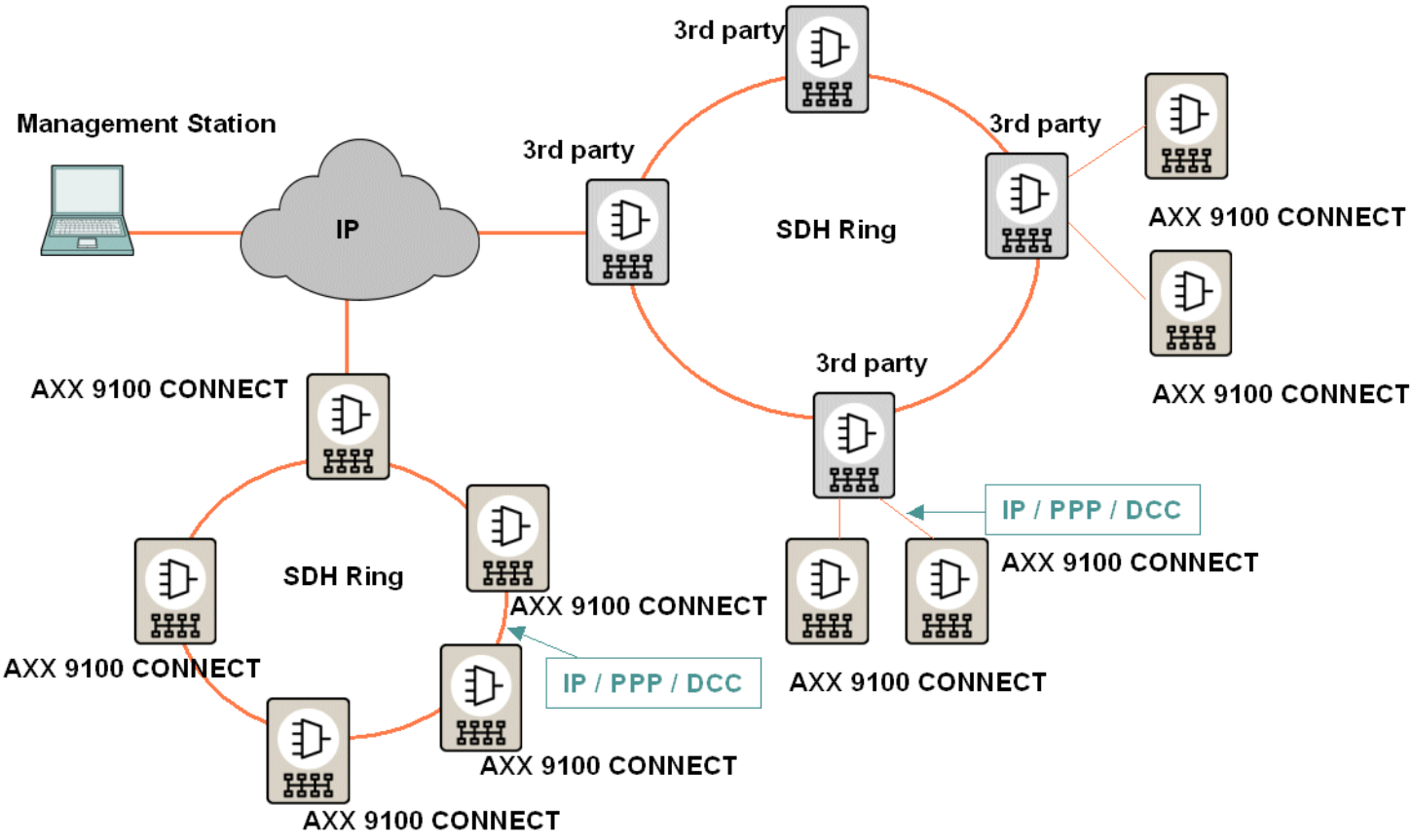

Figure 38 PPP/DCC DCN

2.5.8 Transparent DCC

This feature makes it possible to cross-connect DCC channels without any protocol processing (bit-transparent). Typically, it is used to interconnect two neighbour SDH node's DCC channels.

2.5.9 Compatibility Issues

PPP/DCC

AXX 9100 CONNECT must be able to provide DCN connectivity with all types of Ericsson AXXESSIT devices already deployed. Hence, the PPP/DCC mode is supported both for the IP numbered and the IP unnumbered system modes.

IP/DCC

IP/DCC is a non-standard mechanism used for conveying management information on the SDH DCC channels in a network of Ericsson AXXESSIT devices only. This transport mechanism was used by early Ericsson AXXESSIT devices.

The IP/DCC DCN option is not supported by AXX 9100 CONNECT.

2.5.10 Protection

The AXX 9100 CONNECT supports two different SDH protection schemes: MSP (1+1 link protection) and SNCP (inherent or non-intrusive path protection). SNCP and DCN are fully independent. If the IP Inband DCN option is used on a protected path, the switchover will be transparent for the higher levels.

For MSP protected links, the DCN behaviour depends on the DCN mode:

- If the mode is PPP/DCC (numbered or unnumbered) the management traffic over DCC follows the user traffic, i.e. traffic is sent over both links (working and protecting), but received only from the active link.
- In all other modes, the two DCC channels will be individual interfaces to the router (CLNP and/or IP), and switchover will be handled at routing level.

2.5.11 Security

In order to prevent unauthorized access to the SNMP Agent, the following security and traffic control features are supported:

2.5.11.1 Management Port on/off

The Management Port can be turned on and off, thereby preventing unauthorized local access to the management network.

2.5.11.2 SNMPv1 Community

The SNMPv1 packet contains a password (called community string) that must be known by both the manager and the agent. Different community names can be defined for read and read/write access. The community string is, however, transferred unencrypted.

2.5.11.3 SNMP Manager Identity

This is an enhancement of the SNMPv1 Community feature. Here, the SNMP manager's IP address must be configured in the Ericsson AXXESSIT device subject to management. Only legal combinations of community name and source IP address in SNMP requests are accepted.

2.5.11.4 SNMP read/write control

The access rights of the registered management systems can be set to read/write or read only.

2.5.11.5 VLAN (802.1Q)

This security mechanism relates to the L2 IP in-band option only: By configuring a separate VLAN for the management traffic and assigning an IP address to it, the end-users will not be able to access the device or generate traffic into the management VLAN.

2.5.11.6 CLI Access Control

CLI is protected by user name and password. CLI is by default a superuser and can block all remote SNMP users by changing the access rights and passwords. Remote CLI access via Telnet must in addition have a Telnet password.

2.5.12 Routing Protocols

The AXX 9100 CONNECT supports IP routing for DCN purposes. Routing tables can be statically configured or automatically updated by dynamic routing protocols. Both RIP and OSPF are supported by AXX 9100 CONNECT. Notice that the availability for these routing protocols depends on the selected router system mode, i.e. IP unnumbered or IP numbered.

IP numbered is the default system mode. In this system mode all interface (IF) indices (DCC, LAN- and WAN-ports, VLAN(s), OSI IF) may be assigned an IP address for routing purpose. When the system mode is IP unnumbered only one IP address can be assigned to AXX 9100 CONNECT and only P-t-P channels may be used for DCN purposes. P-t-P channels are DCC and/or L1 Ethernet INBAND channels (L1CC - 192kbit/s). Selecting the desired system mode for routing is a strategically choice, which should be performed before doing any other parameter settings, i.e. make sure that the device has an empty CDB (configuration database). For more information refer the Quick Reference Guide for AXX 9100 CONNECT. The subsequent sections provide an overview for the implementation of routing protocols in AXX 9100 CONNECT.

RIPv1/v2

RIPv1/v2 is only supported for system mode IP **n**umbered. The implementation is acc. to RFC 2453. The following parameters may be configured or read through management configuration tools:

RIP - enable/disable (global)

Leak Ospf Routes - enable/disable

Leak Static Routes - enable/disable

RIP Global Filter

- Type - input/output
- Filter action - deny/permit
- Number of Match Bits - Range 0-32

- Network Address - 32bit IP

RIP Statistics

- Global route change count (readOnly)
- RIP response count (readOnly)

RIP Interface Parameters

- Outgoing RIP version - doNotSend, RIPv1 or RIPv2
- Incoming RIP version - doNotReceive, RIPv1 or RIPv2
- Virtual Distance - Range 1- 15
- Default Route Metric - Range 0-15
- Autosend - disabled/enabled
- RIP Interface filter
  - Type - input/output
  - Filter action - deny/permit
  - Number of Match Bits - Range 0-32
  - Network Address - 32bit IP
  - RIP Interface statistics
  - Receive Bad Packet Count (readOnly)
  - Receive Bad Route Count (readOnly)
  - Sent Update Count (readOnly)

OSPF II

OSPF can be used, independent of selected system mode, though minor differences apply for the availability of OSPF features in IP **n**umbered and IP **u**nnumbered mode.

The OSPF feature support is listed for each system mode respectively.

OSPF - IP numbered

The OSPF implementation for system mode IP **n**umbered conforms to RFC 2328. The following parameters may be configured or read through management configuration tools:

OSPF - disable/enable (Global)

Leak External Direct Routes - enable/disable

Leak RIP Routes - enable/disable

Leak Static Routes - enable/disable

Configurable Router ID

External LS Checksum Sum (ReadOnly)

Number of external LSA (ReadOnly)

OSPF Area

- Multiple areas supported
- Area ID - From 0.0.0.0 to 255.255.255.255
- Import as External - ImportExternal/ImportNoExternal
- Metric - 0 to 16777215
- Metric Type (ReadOnly)
- Area LSA Checksum (ReadOnly)
- Area Summary (ReadOnly)
- Area LSA Count (ReadOnly)
- AS Border Router Count (ReadOnly)
- Area Border Router Count (ReadOnly)
- Intra Area Route Table Calculation Runs (ReadOnly)

Neighbour

- Neighbour IP address (ReadOnly)
- Neighbour State (ReadOnly)
- Router ID (ReadOnly)
- Priority - configurable
- Permanence (ReadOnly)
- Options (ReadOnly)
- Retransmission Queue Length (ReadOnly)
- Events (ReadOnly)
- Hello Suppressed (ReadOnly)

OSPF Interface Parameters

- Interface IP address (ReadOnly)

- Area ID - configurable to any of the area's configured in the OSPF area table.
- OSPF Enable - disabled/enabled
- Interface Type (ReadOnly. Only broadcast is supported)
- Interface State (ReadOnly)
- Authentification type - None or simple password
- Authentification Key - Configurable string (octets)
- Designated Router (ReadOnly)
- Backup Designated Router (ReadOnly)
- Multicast Forwarding (ReadOnly)
- Priority - from 1 to 65535. Default 1.
- Router Dead Interval - from 0 to 2147483647. Default 40.
- Hello Interval - from 1 to 65535. Default 10.
- Transit Delay - from 0 to 3600. Default 1.
- Retransmission Interval - from 0 to 3600. Default 5.
- Poll Interval - from 0 to 2147483647. Default 0.
- Metric Value - from 1 to 65535. Default 10.
- Demand (ReadOnly)
- Events (ReadOnly)

OSPF statistics

- New LSA Originated (ReadOnly)
- New LSA Received (ReadOnly)

Link State Database Entry

- Link ID (ReadOnly)
- Area ID (ReadOnly)
- Router ID (ReadOnly)
- Link State Advertisement (ReadOnly)
- Sequence Number (ReadOnly)
- Link type (ReadOnly)
- Checksum (ReadOnly)
- Age (ReadOnly)

External Link State Database Entry

- Link ID (ReadOnly)
- Origin Router ID (ReadOnly)
- Link State Advertisement (ReadOnly)
- Sequence Number (ReadOnly)
- Link type (ReadOnly)
- Checksum (ReadOnly)
- Age (ReadOnly)

OSPF - IP unnumbered

The OSPF implementation for system mode IP **u**nnumbered conforms to RFC 2328. Notice that the OSPF algorithm for IP unnumbered includes network topology awareness by means of opaque LSAs. The following parameters may be configured or read through management configuration tools:

OSPF - disable/enable (Global)

Leak External Direct Routes - enable/disable

Leak Static Routes - enable/disable

OSPF Area

- Multiple transit areas supported
- Area ID - From 0.0.0.0 to 255.255.255.255
- Area Summary (ReadOnly)
- Import as External (ReadOnly)

OSPF Area Interface

- Interface IP address (ReadOnly)
- IF index (ReadOnly)
- Area ID - configurable to any of the area's configured in the OSPF area table.
- OSPF Enable - disabled/enabled

- Interface Type (ReadOnly. Broadcast for MNGT-port and pointToPoint for DCC and L1CC interfaces)
- Interface State (ReadOnly)
- Designated Router (ReadOnly)
- Backup Designated Router (ReadOnly)
- Router Priority - from 1 to 65535. Default 1.
- Router Dead Interval - from 0 to 2147483647. Default 40.
- Hello Interval - from 1 to 65535. Default 10.
- Transit Delay - from 0 to 3600. Default 1.
- Retransmission Interval - from 0 to 3600. Default 5.
- OSPF Events (ReadOnly)

2.6 Management

This chapter contains the features related to management of AXX 9100 CONNECT.

2.6.1 Features supported by AXX 9100 CONNECT

When connecting to AXX 9100 CONNECT with Craft terminal or AXX 9800 TMN system, the following Management features are supported.

2.6.1.1 Management protocols

The management protocol available is

- SNMPv1
  - Full management access

2.6.1.2 File transfer protocol

The network element supports file transfer using TFTP (Trivial File Transfer Protocol.)

2.6.1.3 Time protocol

The RFC868 TP (Time Protocol) is supported.

2.6.1.4 Notifications

The network element reports 2 types of notifications

- Alarm notifications
- Event notifications

Alarms report failures on the network element. Alarms have a given severity.

Events report other situations in the network element that are not failures. An event has no severity, but a state.

2.6.1.5 Download support

The network element can download software, firmware, and licenses from a local or remote server. The download can be scheduled.

2.6.1.6 Configuration backup and restore

The network element can backup and restore configuration from a local or remote server. The management system can schedule the backup.

The network element will validate restored configuration before discarding old configuration. If the new configuration is discarded, an event notification is generated.

2.6.1.7 Connection status

The management system polls the network element to maintain connection status.

2.6.1.8 Topology knowledge

The network element has topology awareness. The topology is detected by use of OSPF opaque LSA. The management system collects the topology information, all LAN connections, all PTP connections, and all routes in the sub network, from the network element.OSPF opaque LSAs' are only supported when the system operates in unnumbered mode.

2.6.1.9 Security

Security is based on SNMPv1 security with community string and manager IP address.

Summary - Network Element Management

Description
Management protocols: SNMPv1
File are transferred using TFTP
Time protocol is TP
Reports 2 types of notifications ·Alarm notifications ·Event notifications
Download of software, firmware, and licenses from a local or remote server. The download can be scheduled.
Backup and restore configuration from a local or remote server.
Restored configuration is validated before discarding old configuration. If the new configuration is discarded, an event notification is generated.
Polling of network element for connection status.
SNMPv1 security with community string and manager IP address.

Table 29 Feature summary - Network Element management

2.6.2 Features supported by AXX 9800 TMN

Fault management

2.6.2.1 Notification performance

The management system can receive notifications at a rate of 20 notifications per second.

2.6.2.2 Alarm severity

The operator can assign a severity to alarm notifications. The severity levels are WARNING, MINOR, MAJOR and CRITICAL. Default values are assigned automatically.

2.6.2.3 Alarm ON-OFF state persistency

All SDH and PDH alarms are filtered through persistency filters that the management system can configure. This means that an alarm must stay on/off for a certain amount of time before being

raised/cleared respectively. Two values are associated with each persistency filter.

- T_{ON} - The number of consecutive faulty seconds before declaring a failure condition (alarm)
- T_{OFF}-The number of consecutive non-faulty seconds before declaring the alarm deactivated

2.6.2.4 Network element reset

It is possible to reset (reboot) the network element with or without resetting the current configuration. Reboot have minimal impact on traffic processing. The following situations will affect Ethernet/IP traffic and require a network element reset to become operative:

- After configuration and changes of OSI (CLNP) related parameters (Ethernet/IP traffic affecting)
- When decreasing/increasing entries in tuneable tables
- Software upgrade without FPGA fix (Ethernet/IP traffic affecting)
- Software upgrade with FPGA fix (All traffic affected)
- Change of router id (OSPF) for the IP numbered router
- OSPF configuration and/or parameter changes for the IP unnumbered router

The period of time from the restart was triggered to the network element is up and running is dependent on modules and software configuration of the network element.

Module management

An AXX 9100 CONNECT module's configuration is maintained in AXX 9100 CONNECT. If a module is replaced with a new one of the same type, it is initialised with the right configuration automatically.

If a module is replaced with a new one of another type, an alarm notification is generated.

If a module is removed or communication with the module is lost, an alarm notification is generated.

Configuration management

Configuration of AXX 9100 CONNECT is a complex task and specific workflow support is therefore part of the management system.

2.6.2.5 DCN configuration

The management system must configure the DCN features. Details about the DCN features are found in the chapter “DCN features”. The management system has workflow support for this configuration. Default values are applied when possible.

2.6.2.6 Download support

The download process has workflow support in the management system.

2.6.2.7 Configuration backup and restore

The network element can backup its configuration to a local or remote server immediately or at a scheduled time. The management system must specify:

- server name
- file location
- schedule time

Default values are applied when possible.

SDH configuration

The management system configures the synchronisation setup (see “Synchronisation” on page 40). Default values are applied when possible.

The management system configures the protection schemes setup on the network element and prevents the user from setting up illegal protection configurations. A protections switch triggers the network element to generate a protection switch notification.

Configurations of concatenation as described in “Concatenation schemes” on page 27 are supported.

PDH configuration

The management system configures the E1, E3, and T3 interfaces and the services offered by these interfaces as described in “PDH features” on page 90.

2.6.2.8 Ethernet configuration

The management system configures Ethernet interfaces and the services offered by theses interfaces as described in “Ethernet features” on page 51. Only configurations relevant to the installed modules are available for the management system. Cross connections configuration

The management system creates the cross connections in the network element. Cross connection features are described in “Cross-connect support” on page 28.

The management system has specific workflow support for the cross connections configuration.

Ethernet over SDH mapping

The management system supports two different mapping modes for Ethernet over SDH

- Ericsson AXXESSIT proprietary mapping
- GFP-F mapping combined with VCAT with or without LCAS

The management system has workflow support for the configuration of both mapping modes and supports all possible choices as described in “Ethernet over SDH mapping” on page 44.

Performance management

Performance management data collection can be turned on and off from the management system. The management system can clear all performance data on the network element. For details about performance management support, see “Performance monitoring” on page 35.

2.6.2.9 G.826 and NIM

The management system collects the performance data from the network element for real time presentation. .

The historical performance data stored on the network element is limited to 16 x 15 minutes periods and 1 x 24 hours period. It can collect the data from the network element for persistent storage of unlimited number of periods.

2.6.2.10 MSP 1+1, SNCP, and pointer justification performance parameters

The management system collects the performance parameters from the network element for real time presentation of the data. It can collect the performance parameters from the network element for persistent storage.

2.6.2.11 RMON

Performance based RMON statistics are supported on all Ethernet ports. The RMON monitoring can be turned on and off from the management system. The management system collects the RMON statistics from the network element for real time presentation. It can collect the statistics from the network element for persistent storage.

Summary - AXX 9100 CONNECT management

Description
Configuration of severities of alarm notifications generated by specific managed object classes. Default values are assigned automatically. Alarm notification severity levels are WARNING, MINOR, MAJOR, and CRITICAL.
All SDH and PDH alarm notifications are filtered through persistency filters. The management system configures persistency filters. Two values are associated with each persistency filter: T_{ON} and T_{OFF}
Network element reset with or without resetting the current configuration.
Module replacement Same type -> initialised with the right configuration automatically Another type -> alarm notification generated
Module removal -> alarm notification generated
Communication with module lost -> alarm notification generated
DCN configuration workflow support. Applying default values when possible.
Download process has workflow support.
Backup configuration to a local or remote server immediately or at a scheduled time. The management system must specify ·server name ·file location ·schedule time Applying default values when possible.
Prevent the user from setting up illegal protection configurations.
Configurations of contiguous and virtual concatenation.
Configure E1 and E3 interfaces and the services offered by these interfaces
Configure Ethernet interfaces and the services offered by theses interfaces. Only configurations relevant to the installed modules are available.Workflow support.
Create cross connections in the network element.Specific workflow support for the cross connections configuration.
Support two different mapping modes for Ethernet over SDH ·Ericsson AXXESSIT proprietary mapping ·GFP-F mapping combined with VCAT with or without LCAS. Workflow support for the configuration of both mapping modes.
Turn on and off performance management data collection.
Clear performance management data on the network element.
Collect G.826 and NIM performance data for real time presentation.
Collect G.826 and NIM data for persistent storage of unlimited number of periods.
Collect MSP 1+1, SNCP, and pointer justification performance parameters for real time presentation.

Description
Collect MSP 1+1, SNCP, and pointer justification performance parameters for persistent storage.
Turn on and off RMON monitoring.
Collect RMON statistics for real time presentation
Collect RMON statistics for persistent storage.
A filter is applied to a managed object class to avoid alarm flooding. Filters can be enabled and disabled.
Interface module alarm notifications are ·"InterfaceModuleNotProvisoned" ·"InterfaceModuleMissing" ·"InterfaceModuleMismatch" ·"InterfaceModuleNotApproved"
Interface module provisioning is independent of MSP/SNCP protection configuration, cross-connections, synchronization settings, port structuring, DCC configuration, AUX configuration, etc.

Table 30 Feature summary - AXX 9100 CONNECT management

3 Physical Interfaces

3.1 STM-1 short haul interface (S-1.1)

The interface is an optical STM-1 short haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	155 520 kbps
Wavelength range	1261 - 1360 nm
Transmitter at reference point S	
Source type	MLM
Spectral characteristics (max. RMS width)	7.7 nm
Mean launched power (max.)	-8 dB
Mean launched power (min.)	-15 dB
Minimum extinction ratio	8.2 dB
Optical path between S and R	
Attenuation range	0 - 12 dB
Maximum tolerable dispersion	96 ps/nm
Minimum optical return loss	NA
Maximum discrete reflectance between S and R	NA
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 10^{10})	-28 dB
Minimum overload	-8 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	NA

Table 31 Optical budget S-1.1 interface

Compliance

Description	Specification
Based on an SFP module	
Only accepts qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
Type of optical fibre	G.652 03/2003
Format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 2
Optical output power	G.957 06/1999 Table 2
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 2
Receiver sensitivity	G.957 06/1999 Table 2
Receiver overload	G.957 06/1999 Table 2
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 32 S-1.1 physical compliance

3.2 STM-1 medium haul interface (L-1.1)

The interface is an optical STM-1 medium haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	155 520 kbps
Wavelength range	1263- 1360nm
Transmitter at reference point S	
Source type	SLM
Spectral characteristics (max. RMS width)	NA
Maximum -20 dB width	1
Minimum side mode suppression ratio	30
Mean launched power (max.)	0 dB
Mean launched power (min.)	-5 dB
Minimum extinction ratio	10 dB
Optical path between S and R	
Attenuation range	10 - 28 dB
Maximum tolerable dispersion	NA
Minimum optical return loss	NA
Maximum discrete reflectance between S and R	NA
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 10^{10})	-34 dB
Minimum overload	-10 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	NA

Table 33 Optical budget L-1.1 interface

Compliance

Description	Specification
Based on an SFP module	
Only accepts qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
The type of optical fibre	G.652 03/2003
The format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 2
Optical output power	G.957 06/1999 Table 2
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 2
Receiver sensitivity	G.957 06/1999 Table 2
Receiver overload	G.957 06/1999 Table 2
Reflectance of receiver	G.957 06/1999 Table 2
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 34 L-1.1 physical compliance

3.3 STM-1 long haul interface (L-1.2)

The interface is an optical STM-1 long haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	155 520 kbps
Wavelength range	1480- 1580 nm
Transmitter at reference point S	
Source type	SLM
Spectral characteristics (max. RMS width)	NA
Maximum -20 dB width	1
Minimum side mode suppression ratio	30
Mean launched power (max.)	0 dB
Mean launched power (min.)	-5 dB
Minimum extinction ratio	10 dB
Optical path between S and R	
Attenuation range	10 - 28 dB
Maximum tolerable dispersion	NA
Minimum optical return loss	20
Maximum discrete reflectance between S and R	-25
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 1010)	-34 dB
Minimum overload	-10 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	-25 dB

Table 35 Optical budget L-1.2 interface

Compliance

Description	Specification
Based on an SFP module	
Only accept qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
The type of optical fibre	G.652 03/2003
The format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 2
Optical output power	G.957 06/1999 Table 2
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 2
Receiver sensitivity	G.957 06/1999 Table 2
Receiver overload	G.957 06/1999 Table 2
Reflectance of receiver	G.957 06/1999 Table 2
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 36 L-1.2 physical compliance

3.4 Electrical STM-1 (STM-1e)

The interface is a 155 Mbps STM-1e according to ITU-T G.703, 75 ohm coaxial interface.

Description	**Specification**
Frequency tolerance for STM-1	G.703 11/2001 ch.15.1
The format of the signal	G.707 10/2000
CMI signal coding	G.703 11/2001 ch.15.1
Output pulse shapes for 75 ohm for STM-1E	G.703 11/2001 ch.15.2
Output return loss for STM-1E	G.703 11/2001 ch.15.2
Cable attenuation for STM-1E	G.703 11/2001 ch.15.3
Input return loss for STM-1E	G.703 11/2001 ch.15.3
Interfering signal for STM-1E	G.703 11/2001 ch.15.3
Grounded input and output shield for STM-1E	G.703 11/2001 ch.15.5
Input jitter and wander for STM-1E	G.825 03/2000 ch 6.1.2.1
Output jitter for STM-1E	G.825 03/2000 ch 5.1
The physical connector is a 1.0/2.3 coaxial type	
The screen on the input and on the output connector is always DC coupled to ground.	
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998

Table 37 STM-1e physical compliance

3.5 STM-4 short haul interface (S-4.1)

The interface is an optical STM-4 short haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	622 080kbps
Wavelength range	1293 - 1334 nm/1274-1356nm
Transmitter at reference point S	
Source type	MLM
Spectral characteristics (max. RMS width)	4/2.5 nm
Mean launched power (max.)	-8 dB
Mean launched power (min.)	-15 dB
Minimum extinction ratio	8.2 dB
Optical path between S and R	
Attenuation range	0 - 12 dB
Maximum tolerable dispersion	46/74 ps/nm
Minimum optical return loss	NA
Maximum discrete reflectance between S and R	NA
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 1010)	-28 dB
Minimum overload	-8 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	NA

Table 38 Optical budget S-4.1 interface

Compliance

Description	Specification
Based on an SFP module	
Only accept qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
The type of optical fibre	G.652 03/2003
The format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 3
Optical output power	G.957 06/1999 Table 3
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 3
Receiver sensitivity	G.957 06/1999 Table 3
Receiver overload	G.957 06/1999 Table 3
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 39 S-4.1 physical compliance

3.6 STM-4 medium haul interface (L-4.1)

The interface is an optical STM-4 medium haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	622 080kbps
Wavelength range	1280 - 1355 nm
Transmitter at reference point S	
Source type	SLM
Spectral characteristics (max. RMS width)	NA
Maximum -20 dB width	<1
Minimum side mode suppression ratio	30
Mean launched power (max.)	+2 dB
Mean launched power (min.)	-3 dB
Minimum extinction ratio	10 dB
Optical path between S and R	
Attenuation range	10-24 dB
Maximum tolerable dispersion	NA
Minimum optical return loss	20 dB
Maximum discrete reflectance between S and R	-25 dB
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 1010)	-28 dB
Minimum overload	-8 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	-14 dB

Table 40 Optical budget L-4.1 interface

Compliance

Description	Specification
Based on an SFP module	
Only accepts qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
The type of optical fibre	G.652 03/2003
The format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 3
Optical output power	G.957 06/1999 Table 3
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 3
Receiver sensitivity	G.957 06/1999 Table 3
Receiver overload	G.957 06/1999 Table 3
Reflectance of receiver	G.957 06/1999 Table 3
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 41 L-4.1 physical compliance

3.7 STM-4 long haul interface (L-4.2)

The interface is an optical STM-4 long haul interface. The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Parameter	**Value**
Modulation rate on optical line	622 080kbps
Wavelength range	1480 - 1580 nm
Transmitter at reference point S	
Source type	MLM
Spectral characteristics (max. RMS width)	NA
Maximum -20 dB width	<1
Minimum side mode suppression ratio	30
Mean launched power (max.)	+2 dB
Mean launched power (min.)	-3 dB
Minimum extinction ratio	10 dB
Optical path between S and R	
Attenuation range	10-24 dB
Maximum tolerable dispersion	NA
Minimum optical return loss	24 dB
Maximum discrete reflectance between S and R	-27 dB
Receiver at reference point R	
Minimum sensitivity (BER < 1 in 1010)	-28 dB
Minimum overload	-8 dB
Maximum optical path penalty	1 dB
Maximum reflectance at R	-27 dB

Table 42 Optical budget L-4.2 interface

Compliance

Description	Specification
Based on an SFP module	
Only accept qualified optical modules from Ericsson AXXESSIT	
The physical connector is LC type	
The type of optical fibre	G.652 03/2003
The format of the signal	G.707 10/2000
RX pull-in and hold range	G.783 10/2000 ch 9.3.1.2
Optical output jitter	G.813 10/2000
Optical input jitter	G.825 03/2000 ch 6.1.2.1
Optical spectrum	G.957 06/1999 Table 3
Optical output power	G.957 06/1999 Table 3
Optical eye diagram	G.957 06/1999 ch 6.2.5
Optical extinction ratio	G.957 06/1999 Table 3
Receiver sensitivity	G.957 06/1999 Table 3
Receiver overload	G.957 06/1999 Table 3
Reflectance of receiver	G.957 06/1999 Table 3
Meets all safety requirements in specification	60825-1 08/2001
Optical safety CLASS I	60825-1 08/2001
Labelled according to specification	60825-1 08/2001
Meets all safety requirements in specification	60825-2 08/2001
Meets all safety requirements in specification	G.958 11/1994 ch 9.7
Meets all safety requirements in specification	G.664 03/2003

Table 43 L-4.2 physical compliance

3.8 10 Base-T

The interface is a 10 Base-T Ethernet interface according to the IEEE 802.3 specification.

The connectors are RJ-45 connectors, with the following pin-out:

Pin	**Signal**
1	TxD+
2	TxD-
3	RxD+
4	NC
5	NC
6	RxD-
7	NC
8	NC

Table 44 Pin-out 10 Base-T Ethernet port

Compliance

Description	Specification
The physical connector is a shielded RJ-45 type	
Pin-out according to specification	802.3 2002 ch 25.4.3
Support UTP-5 cabling	802.3 2002 ch 25.4.6
Minimum 100m of cable	802.3 2002 ch 25.4.6
Support STP-5 cabling	
Isolation requirement	802.3 2002 ch 14.3.1.1
Transmitter specifications	802.3 2002 ch 14.3.1.2
Differential output voltage	802.3 2002 ch 14.3.1.2.1
Transmitter differential output impedance	802.3 2002 ch 14.3.1.2.2
Output timing jitter	802.3 2002 ch 14.3.1.2.3
Transmitter impedance balance	802.3 2002 ch 14.3.1.2.4
Common-mode output voltage	802.3 2002 ch 14.3.1.2.5
Transmitter common-mode rejection	802.3 2002 ch 14.3.1.2.6
Transmitter fault tolerance	802.3 2002 ch 14.3.1.2.7
Receiver differential input signals	802.3 2002 ch 14.3.1.3.1
Receiver differential noise immunity	802.3 2002 ch 14.3.1.3.2
Idle input behavior	802.3 2002 ch 14.3.1.3.3
Receiver differential input impedance	802.3 2002 ch 14.3.1.3.4
Common-mode rejection	802.3 2002 ch 14.3.1.3.5
Receiver fault tolerance	802.3 2002 ch 14.3.1.3.6
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3

Description	Specification
Surge over voltage at shielded signal lines	K.41 05/1998
Surge over voltage at unshielded balanced signal lines	K.41 05/1998

Table 45 10 Base-T physical compliance

3.9 100 Base-TX

The interface is a 100Base-TX Ethernet interface according to the IEEE 802.3 specification.

The connectors are RJ-45 connectors, with the following pin-out:

Pin	**Signal**
1	TxD+
2	TxD-
3	RxD+
4	NC
5	NC
6	RxD-
7	NC
8	NC

Table 46 Pin-out Fast Ethernet port

Compliance

Description	Specification
The physical connector is a shielded RJ-45 type	
The pinout according to Table 46	802.3 2002 ch 25.4.3
Support UTP-5 cabling	802.3 2002 ch 25.4.6
Minimum 100m of cable	802.3 2002 ch 25.4.6
Support STP-5 cabling	
UTP test load	X3.263 1995 9.1.2.1
UTP differential output voltage	X3.263 1995 9.1.2.2
Waveform overshoot	X3.263 1995 9.1.3
Signal amplitude symmetry	X3.263 1995 9.1.4
Return loss	X3.263 1995 9.1.5
Rise/fall times	X3.263 1995 9.1.6
Worst case droop of transformer	X3.263 1995 9.1.7
Duty cycle distortion (DCD)	X3.263 1995 9.1.8
Jitter	X3.263 1995 9.1.9
Differential input impedance	X3.263 1995 9.2.2
Common-mode rejection	X3.263 1995 9.2.3
Signal Detect assertion threshold	X3.263 1995 10.1.1.1
Signal Detect deassertion threshold	X3.263 1995 10.1.1.2
Signal Detect timing requirements on assertion	X3.263 1995 10.1.2
Signal Detect timing requirements on deassertion	X3.263 1995 10.1.3
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998
Surge over voltage at unshielded balanced signal lines	K.41 05/1998

Table 47 Fast Ethernet physical compliance

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3.10 E1

The interface is a 2Mbps E1 interface according to ITU-T G.703, 120ohm differential pair.

The connector is a RJ-45 connector, with the following pin-out:

Pin	Signal
1	OUT+
2	OUT-
3	GND
4	IN+
5	IN-
6	Screen [1]
7	NC
8	NC

1. Pin 6 is always AC connected to ground. The outer screen is always direct connected to ground.

Table 48 Pin-out E1 interface

Compliance

Description	Specification
Frequency tolerance	G.703 11/01 ch.9.1
HDB3 signal coding	G.703 11/01 ch.9.1
Output pulse shapes for both 75 and 120 ohm	G.703 11/01 ch.9.2
Output return loss	G.703 11/01 ch.9.2
Cable attenuation	G.703 11/01 ch.9.3
Input return loss	G.703 11/01 ch.9.3
Interfering signal	G.703 11/01 ch.9.3
Grounded input and output shield	G.703 11/01 ch.9.4
120 ohm pinout	EN 300246 10/93 ch. 5.1.1
Impedance of interface	EN 300418 V1.2.1 ch.4.2.2.3
Impedance towards ground for output	EN 300418 V1.2.1ch 4.2.1.4
Tolerable longitudinal voltage	EN 300418 V1.2.1ch 4.2.2.5
Impedance towards ground for input	EN 300418 V1.2.1ch. 4.2.2.6
Input jitter and wander	G.823 03/00 ch 7.1.2
Input jitter	EN 300247 V1.2.2 ch. 4.1.7.1
Output jitter in the absence of input jitter	G.783 10/00 ch.15.2.3.1
Output combined jitter	G.783 10/00 ch. 15.2.3.3
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998

Table 49 E1 physical compliance

3.11 E3

The interface is a 34Mbps E3 according to ITU-T G.703, 75 ohm coaxial interface.

Compliance

Description	**Specification**
Frequency tolerance for E3	G.703 11/01 ch.11.1
HDB3 signal coding	G.703 11/01 ch.11.1
Output pulse shapes for 75 ohm for E3	G.703 11/01 ch.11.2
Output return loss for E3	G.703 11/01 ch.11.2
Cable attenuation for E3	G.703 11/01 ch.11.3
Input return loss for E3	G.703 11/01 ch.113
Interfering signal for E3	G.703 11/01 ch.11.3
Grounded input and output shield for E3	G.703 11/01 ch.11.4
Input jitter and wander for E3	G.823 03/00 ch 7.1.4
Output jitter in the absence of input jitter for E3	G.783 10/00 ch.15.2.3.1
Output combined jitter for E3	G.783 10/00 ch. 15.2.3.3
The physical connector is a 1.0/2.3 coaxial type	
The screen on the input and on the output connector is always DC coupled to ground.	
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998

Table 50 E3 physical compliance

3.12 T3

The interface is a 45Mbps T3 according to ITU-T G.703, 75 ohm coaxial interface.

Compliance

Description	Specification
Frequency tolerance for T3	G.703 11/01 ch.8
B3ZS signal coding	G.703 11/01 ch.8
Output pulse shapes for 75 ohm for T3	G.703 11/01 ch.8
Power level for T3	G.703 11/01 ch.8
Pulse imbalance for T3	G.703 11/01 ch.8
No DC power for T3	G.703 11/01 ch.8
Cable attenuation for T3 (0-137.2m of AT&T 728A cable)	GR-253 09/00 ch 2.1.1.1
Input return loss for T3	
Input jitter and wander for T3	G.824 03/00 ch 7.2.4
Output jitter for T3	G.824 03/00 ch 5.1
Output jitter in the absence of input jitter for T3	G.783 10/00 ch.15.2.3.1
Output combined jitter for T3	G.783 10/00 ch. 15.2.3.3
The physical connector is a 1.0/2.3 coaxial type	
The screen on the input and on the output connector is always DC coupled to ground.	
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998

Table 51 T3 physical compliance

3.13 Synchronisation

The interfaceis a 2 MHz clock interface according to ITU-T G.703, 120ohm differential pair.

The connector is a RJ-45 connector, with the following pin-out:

Pin	Signal
1	OUT+
2	OUT-
3	GND
4	IN+
5	IN-
6	Screen[1]
7	NC
8	NC

1. Pin 6 is always AC connected to ground. The outer screen is always direct connected to ground.

Table 52 Pin-out synchronisation interface

Compliance

Description	Specification
Frequency tolerance	G.703 11/01 ch.13.2
HDB3 signal coding for E1 mode	G.703 11/01 ch.9.1
Output pulse shapes for both 75 and 120 ohm (E1)	G.703 11/01 ch.9.2
Output pulse shapes for both 75 and 120 ohm (2 MHz)	G.703 11/01 ch.13.2
Maximum output voltage (2 MHz)	G.703 11/01 ch.13.2
Minimum output voltage (2 MHz)	G.703 11/01 ch.13.2
Output return loss	G.703 11/01 ch.9.2
Cable attenuation	G.703 11/01 ch.13.3
Input return loss	G.703 11/01 ch.13.3
Interfering signal	G.703 11/01 ch.9.3
Grounded input and output shield	G.703 11/01 ch.13.4
120 ohm pinout	EN 300246 10/93 ch. 5.1.1
Impedance of interface	EN 300418 V1.2.1 ch.4.2.2.3
Impedance towards ground for output	EN 300418 V1.2.1ch 4.2.1.4
Tolerable longitudinal voltage	EN 300418 V1.2.1ch 4.2.2.5
Impedance towards ground for input	EN 300418 V1.2.1ch. 4.2.2.6
Input jitter and wander	G.823 03/00 ch 7.1.2 G.823 03/00 ch 6.1
Output jitter	G.813 08/96 ch 7.1
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3
Surge over voltage at shielded signal lines	K.41 05/1998

Table 53 Synchronisation physical compliance

3.14 Power

The -48V DC supply input is provided via a 4-pin power connector (Molex Mini-fit 4x1), with the following pin-out:

Pin	**Signal**
1	0V
2	-48V (supply 1)
3	-48V (supply 2)
4	GND

Table 54 Pin-out DC connector

Compliance

Description	Specification
Physical connector is a 4-pin Minifit connector	
The pin out is according to Table 54	
3 A fuse	
Maximum power dissipation is 50W (20W for AM and 15W for each TM)	
Meets safety requirements for a SELV voltage when using -48V power	IEC 60950 10/2001
Meets safety requirements for a TNV-2 voltage when using -60V power	IEC 60950 10/2001
Meet nominal voltage of -48V	300132-2 V2.1.2 09/2003 ch 4.1
Normal service voltage range -48V	300132-2 V2.1.2 09/2003 ch 4.2
Abnormal service voltage range -48V	300132-2 V2.1.2 09/2003 ch 4.3.1
Recovery from abnormal service voltage range	300132-2 V2.1.2 09/2003 ch 4.3.2
Voltage transients	300132-2 V2.1.2 09/2003 ch 4.3.3
Recovery from voltage transients	300132-2 V2.1.2 09/2003 ch 4.3.4
Voltage changes due to regulation of the power supply	300132-2 V2.1.2 09/2003 ch 4.4
Supply protection	300132-2 V2.1.2 09/2003 ch 4.5
Maximum current drain following abnormal service	300132-2 V2.1.2 09/2003 ch 4.6
Surge currents (inrush current)	300132-2 V2.1.2 09/2003 ch 4.7
Immunity to narrowband noise	300132-2 V2.1.2 09/2003 ch 4.8.1
Immunity to wideband noise	300132-2 V2.1.2 09/2003 ch 4.8.2
Emission of narrowband noise	300132-2 V2.1.2 09/2003 ch 4.9.1
Emission of wideband noise	300132-2 V2.1.2 09/2003 ch 4.9.2
Meet nominal voltage of -60V	300132-2 V2.1.2 09/2003 Annex A
Normal service voltage range -60V	300132-2 V2.1.2 09/2003 Annex A

Description	Specification
Abnormal service voltage range -60V	300132-2 V2.1.2 09/2003 Annex A
Grounding and bonding	300253 V2.1.1 04/2002
Emission DC power port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.3
Immunity DC power port, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.5
Immunity DC power port, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.5
Surge over voltage at DC power port	K.41 05/1998

Table 55 Power supply physical compliance

3.15 CLI

The AXX 9100 CONNECT offers a VT-100 interface for connection of a Command Line Interface (CLI). The interface is in accordance with the specifications given in the Compliance chapter below.

The RS232 interface for AXX 9100 CONNECT is provided via a RJ-45 connector, with the following pin-out:

Pin	Signal
1	GND
2	TxD
3	RxD
4	DB-TxD[1]
5	NC
6	NC
7	DB_RxD[2]
8	NC

1. Only used for debug purposes
2. Only used for debug purposes

Table 56 Pin-out VT-100 connector

Compliance

Description	Specification
The physical connector is a RJ-45 connector	
The connector includes a CLI interface	
The connector includes a debug interface	
The pin out is as specified in Table 56	
The CLI interface is running at a data rate of 19.200 kbaud+/- 200ppm	
The CLI interface supports 8 bit asynchronous transmission	
The CLI interface supports 1 start bit and 1 stop bit	
The CLI interface emulates a VT-100 terminal	
The debug interface is running at a rate of 19.200 kbaud +/- 200ppm	
The debug interface supports 8 bit asynchronous transmission	
The debug interface supports 1 start bit and 1 stop bit	
The electrical interface meets the requirements in V.28	V.28 03/93
Load impedance	V.28 03/93 ch 3
Open circuit voltage	V.28 03/93 ch 3
Shunt capacitance	V.28 03/93 ch 3
Output voltage	V.28 03/93 ch 4
Open circuit and short circuit	V.28 03/93 ch 4
Driving capacitive loads	V.28 03/93 ch 4
Voltage levels ON	V.28 03/93 ch 5
Voltage levels OFF	V.28 03/93 ch 5
Signal characteristic	V.28 03/93 ch 6 and annex A

Table 57 CLI interface physical compliance

3.16 Alarm

The interface is an alarm interface with support of both alarm inputs and alarm outputs.

The connector is an 8 pins RJ-45 connector, with the following pin-out:

Pin	Signal
1	Alarm input 1
2	Alarm input 2
3	Alarm input 3
4	Alarm input 4
5	Alarm input return (1-4)
6	Alarm output return (1-2)
7	Alarm output 1
8	Alarm output 2

Table 58 Pin-out alarm connector

Electrical parameters alarm input

Parameter	Value
Nominal open contact voltage	+3.3 V
Nominal closed contact current	1 mA
Max. closed contact resistance	0.8 kohm
Min. open contact resistance	10 kohm
Common return to earth	0 V (No isolation)

Table 59 Electrical specification for alarm input

Electrical parameters alarm output

Parameter	Value
Maximum load bias referred to common return	+/-75 V
Maximum load current	50 mA
Isolation to earth	+/-250 V
Maximum contact resistance	50 ohm
Switching time	10 ms

Table 60 Electrical specification for alarm output

Compliance

Description	Specification
The physical connector is a female 15 pin DSUB	
The pin out is as specified in Table 58	
Minimum 4 alarm inputs	
Minimum 2 alarm outputs	
Individually enable and disable alarm inputs	
Individually set alarm to active high or active low	
Meet electrical requirements in Table 59 for input	
Meet electrical requirements in Table 60 for output	
Alarm output 1 is active without power	
Alarm output 2 is not active without power	
Alarm outputs may be configured to represent different alarms in AXX 9100 CONNECT	
Default configuration of Alarm output 1 is Critical alarm	
Default configuration of Alarm output 2 is Major alarm	
Emission telecommunication port, Conducted emission	300386 V1.3.2 12/2002 ch 7.1.4
Immunity ports for indoor signal lines, Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoor signal lines, Surges	300386 V1.3.2 12/2002 ch 7.2.2.3
Immunity ports for indoors signal lines, Radio frequency conducted continuous	300386 V1.3.2 12/2002 ch 7.2.2.3

Table 61 Alarm interface physical compliance

4 Mechanics & Characteristics

4.1 Redundancy and reliability

4.1.1 Hardware

Interface protection

It is possible to protect the optical aggregate interface on the aggregate module with 1+1 MSP, SNCP or LCAS protection.

Module details

The aggregate module has its own power supply that can be connected to two independent power supply sources. The power sources are connected together with wire-or diodes in the module. The aggregate module has an internal fuse to protect the external power sources against internal power failures. The internal power supply in a module generates a number of different voltages. The modules include a monitoring device for the power supply that generates an alarm if any of the internal voltages are outside the specification. The tributary modules are both powered from the aggregate module.

Summary - Hardware redundancy

Comments
Interface protection is supported SDH interface for all AM's
Optical interfaces are protected with 1+1 MSP protection and Ethernet interfaces are protected with other protection schemes e.g. MSP or RSTP
A failed TM will not affect the other TM or the AM
Only connectors can be mounted in the backplane
The AM has its own power supply feed from two redundant sources
The two power sources are connected together with wire-or diodes in the module
The modules has a fuse to protect against internal power failures
The modules include a power monitoring device
The modules (AM and TM) include a self test feature
Self test failures are reported to the AM
The FAN module includes more than one fan
The failure of a fan is detected and reported to the active AM
The fan module has redundant fans
A failure of a fan shall not affect the working of the shelf
It is possible to remove the fan tray for five minutes without affecting the working of the shelf

Table 62 Hardware redundancy

4.1.2 Mean time between failures (MTBF)

The mean time between failures (MTBF) are shown in the table Table 63 Note that MTBF values are calculated according to Bellcore specification SR-233. The calculation is based on a ground benign environment and a temperature of 40^{O}C.

Optical modules are included in the calculation for the relevant modules.

Module	**MTBF (Years)**
AXX 9100 CONNECT base unit	40,3
TM-3xE3/T3-1.0/2.3	238,1
TM-4xFEL2-4xMAP-RJ-45	98,9

Table 63 MTBF values for base units and modules

4.2 Mechanical features

4.2.1 Mechanical concept

The AXX 9100 CONNECT is provided as a shelf suitable for mounting within a 19" or ETSI equipment cabinet. The shelf comprises a sub-rack with room for an aggregate module, two tributary modules and a fan module.

The height of the unit is 1 U (44.45 mm).

It is possible to mount one single unit including cable terminating and cable handling facilities, within an enclosure with external dimensions:

Width	450 mm
Height	44.45 mm
Depth	280 mm

The size of the chassis has the following physical dimensions

Width	445 mm
Height	43.6 mm
Depth	222 mm

The shelf is delivered with 19" brackets as a default as specified in IEC 60917 and IEC 60297.

Mounting brackets for ETSI cabinets/racks as specified in ETS 300 119 are available.

The mechanical design of the AXX 9100 CONNECT meets the requirements of EN/IEC 60950.

Desktop solution is also supported.

The total weight of the AXX 9100 CONNECT fully equipped does not exceed 4 Kg. The weight of the AXX 9100 CONNECT without any tributary modules does not exceed 3.5 kg.

4.2.2 Aggregate modules (AM)

The aggregate modules in the AXX 9100 CONNECT have the following physical dimensions:

Depth:	215 mm
Height:	30 mm
Width:	231.5 mm

Table 64 Aggregate module - physical dimensions

NOTE! The AM is an integral part of shelf and cannot be changed in the field.

4.2.3 Tributary modules (TM)

The tributary modules in the AXX 9100 CONNECT have the following physical dimensions:

Depth:	220 mm
Height:	42 mm
Width:	86 mm

Table 65 Tributary modules - physical dimensions

4.2.4 Fan module (FM)

The fan module in the AXX 9100 CONNECT has the following physical dimensions:

Depth:	209 mm
Height:	40 mm
Width:	22 mm

Table 66 Fan module - physical dimensions

Summary - Mechanical

Description	Specification
Supports 19" rack mounting	IEC 60297-2 01/1982
Supports ETSI rack mounting	ETS 300 119-3 01/1994
The shelf meets the ETSI sub-rack requirements	ERS 300 119-4 01/1994
The shelf meets the 19" sub-rack requirements	IEC 60297-3 01/1994
The maximum height is 1 U	
Meets all mechanical requirements in EN/IEC60950	60950-1 10/2001 ch.4
Shelf have room for two tributary module	
Supports desktop mounting	
Maximum weight of fully equipped shelf is 3.5 kg	
Tributary module size see Table 65	

Table 67 Feature summary - Mechanical

Thermal design according to 60950	60950-1 10/2001 ch.4.5
Room for fan module	

Table 68 Thermal compliance

4.3 Cabling

4.3.1 Power cables (-48V DC)

A power cable is provided for AXX 9100 CONNECT. The cable is optimised for use in racks.

Two power sources can be connected with one power cable.

The power cable connects the AXX 9100 CONNECT to the internal -48V power-rails in the rack. It has a 4-pin power MINI-fit connector

in one end and is not terminated in the other end. The customer must add the preferred type of connector to the end that is not terminated.

The cable is not screened.

The individual wires in the cable have a cross section of 0.75 mm2.

The length of the power cables is 3m.

4.3.2 Power cables (230V AC)

A power cable is provided for AXX 9100 CONNECT. The power cable connects the external AC power module to the mains power sockets.

It has a 2 pin IEC-320 connector in one end and a standard power connector in the other end. The length of the cable is 3m. The cable is not screened.

Different variants are available for the different markets that are targeted by the AXX 9100 CONNECT.

4.3.3 Alarm cables

Alarm cables are not provided, but it is easy for the customer to make their own cable. The physical connector is an 8 pin RJ-45.

The alarm cable would typically be used to connect the AXX 9100 CONNECT to the rack-top alarm indicators or to external alarm input sources.

The cable can be unshielded.

4.3.4 VT-100 cable

A cable that connects the AXX 9100 CONNECT to a PC is available. This cable has an RJ-45 connector in one end and a 9 pins DSUB connector in the other end.

The cable is not shielded.

The length of the power cables is 3m.

4.3.5 LAN cables

LAN cables are not provided, but ordinary UTP-5 or STP-5 cables can be used. Note that STP-5 cabling must be used for GE traffic.

4.3.6 E1 cables

The E1 interface uses standard ISDN cabling. A balun is provided if a 75-ohm interface is needed.

The cables must be shielded.

4.3.7 Fibre cables

The optical interfaces for the AXX 9100 CONNECT are based on the LC connector. Patch cords are not provided by Ericsson AXXESSIT. Patch cords are available from multiple sources.

It is recommended to use LC connectors (UPC polishing type) with a back reflection of at least 50 dB. Note that in many cases can ordinary LC connectors (PC polishing type) be used.

Note that the angled boot (90^{O} type) is needed to be able to meet the minimum-bending radius of 30mm.

The cable diameter is maximum 3 mm.

Compliance

Description	Specification
Only support for front cabling	
Cable management area makes it possible to meet the minimum bending radius requirement of 30 mm	G.652 03/2003
Ethernet cable can be UTP-5 and STP-5	
Power cable for the -48V supply is provided with a 4-pin Minifit connector in one end and with no connector in the other end	
The length of the DC power cable is 3m	
Power cables for the 230V AC power adaptor are provided with 2 pins IEC-320 connector in one end and different types of mains connectors in the other end	
The length of the AC power cable is 3m	
Different variants of the AC power cable are provided for the different markets	
Alarm cables are not provided	
VT-100 cable is provided	
LAN cables are not provided	
Single interface E1 cables are not provided	
The LC connector has an angled boot	
The angled booth is 90^{O}	

Table 69 Compliance Cabling

4.4 Environment

4.4.1 Storage, transport and operation

The AXX 9100 CONNECT meets the following requirements for operational, transportation and storage environment as specified in ETS 300 019 (See table below).

Requirement	Specification	Classes
Storage	ETS 300 019-2-1	Class 1.1
Transportation	ETS 300 019-2-2	Class 2.1, 2.2 and 2.3
Operational (mandatory)	ETS 300 019-2-3	Class 3.1, 3.1E and 3.2

Table 70 Environmental classifications

4.4.2 Electromagnetic compatibility

The AXX 9100 CONNECT meets the requirement for EMC as specified in EN 300 386 for use in both inside Telecom Centres and outside Telecom Centres.

The power supply interface meets the requirements as specified in ETS 300 132-2.

A dedicated ground connector is available in the chassis. It is implemented with a screw that is connected to the chassis. The ground cable is connected to the chassis with this screw.

4.4.3 Health and safety

The equipment meets the safety requirements specified in EN/IEC 60950.

It also meets the optical safety requirement specified in EN 60825.

The equipment meets the requirements in ETS 300 753 for acoustic noise.

4.4.4 Grounding and bonding

The equipment meets the grounding and bonding requirements of ETS 300 253.

The shelf is made of metal and it is connected to signal ground inside. The shelf has a dedicated ground connector for connection to external ground.

The screens of all external cables are connected to signal ground/shelf ground.

Description	Specification
Support for storage class 1.1	300 019-2-1 V2.1.2 09/2000
Climatic tests according to table 1	300 019-2-1 V2.1.2 09/2000
Mechanical tests according to table 2	300 019-2-1 V2.1.2 09/2000
Support for transportation class 2.3	300 019-2-2 V2.1.2 09/2000
Climatic tests according to table 5	300 019-2-2 V2.1.2 09/2000
Mechanical tests according to table 6	300 019-2-2 V2.1.2 09/2000
Support for operation class 3.2	300 019-2-3 V2.1.2 09/2000
Climatic tests according to table 4	300 019-2-3 V2.1.2 09/2000
Mechanical tests according to table 5	300 019-2-3 V2.1.2 09/2000
See power supply interface specification	300 386-1 V1.3.2 12/2002
Enclosure port, Radiated electromagnetic field emissions	300 386-1 V1.3.2 12/2002 ch 7.1.1
Electrostatic discharge	300 386-1 V1.3.2 12/2002 ch 7.2.2.1.1
Radio frequency electromagnetic field amplitude modulated	300 386-1 V1.3.2 12/2002 ch 7.2.2.1.2
DC power supply for -48V	300 132-2 V2.1.2 09/2003
DC power supply for -60V	300 132-2 V2.1.2 09/2003
Grounding and bonding according to specification	300 253 V2.1.1 04/2002
The shelf has a dedicated ground connector	
The screens for external cables are grounded	300 253 V2.1.1 04/2002
Meets the safety requirements in 60950	60950-1 10/2001
Meets the safety requirements in UL 60950	
Meets the safety requirements in TS001, AS/NZS3260 to A4	
For laser safety see respective optical interface specification	
Acoustic noise according to specification for use in attended telecom rooms	300 753 10/1997

Table 71 Environmental - Compliance

4.5 REFERENCED SPECIFICATIONS

4.5.1 ANSI recommendations:

X3.262	Fibre Distributed Data Interface (FDDI) -Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)

Bellcore recommendations:

GR-253	Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria
SR-332	Reliability prediction procedure for electronic equipment

4.5.2 Cenelec recommendations

EN 50082-1	Generic immunity standard Industrial environment
EN 55022	Specification for Limits and methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
EN 55024	Electromagnetic Compatibility Requirements for Information Technology Equipment (Previously EN 55101)

4.5.3 ETSI recommendations

ETS 300011	Integrated Services Digital Network (ISDN); Primary rate user-network interface; Layer 1 specification and test principles
ETS 300019-2-1	Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-1: Specification of environmental test; Storage
ETS 300019-2-2	Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-2: Specification of environmental test; Transportation
ETS 300019-2-3	Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-2: Specification of environmental test; Stationary use at weatherprotected locations
ETS 300119-3	Equipment Engineering (EE); European telecommunication standard for equipment practice Part 3: Engineering requirements for miscellaneous racks and cabinets
ETS 300119-4	Equipment engineering (EE): European telecommunication standard for equipment practice Part 4: Engineering requirements for subracks in miscellaneous racks and cabinets
ETS 300132-2	Environmental engineering (EE): Power supply interface at the input to the telecommunication equipment: Part 2 Operated by direct current (dc)
ETS 300132-3	Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V
ETS 300147	Transmission and multiplexing (TM); Synchronous digital hierarchy (SDH); Mulitiplexing structure
ETS 300233	Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate
ETS 300246	Business Telecommunications (BT); Open Network Provision (ONP) technical requirements; 2 048 kbps digital unstructured leased line (D2048U) Network interface presentation

ETS 300247	Access and Terminals (AT); 2 048 kbps digital unstructured leased line (D2048U); Connection characteristics
ETS 300253	Environmental engineering (EE): Earthing and bonding configuration inside telecommunication centres
ETS 300386	Electromagnetic compatibility and radio spectrum matters (ERM); Telecommunication network equipment; Electromagnetic compatibility (EMC) requirements
ETS 300418	Access and Terminals (AT); 2 048 kbps digital unstructured and structured leased lines (D2048U and D2048S); Network interface presentation
ETS 300419	Access and Terminals (AT); 2 048 kbps digital structured leased lines (D2048S); Connection characteristics
ETS 300753	Equipment engineering (EE): Acoustic noise emitted by telecommunication equipment

4.5.4 IEC recommendations

IEC 60297-2	Dimensions of mechanical structures of the 482.6 mm (19 inch) series - Part 2: Cabinets and pitches of rack structures
IEC 60297-3	Dimensions of mechanical structures of the 482.6 mm (19 inch) series - Part 3: Subracks and associated plug-in units
IEC 60320-1	Appliance couplers for household and similar general purposes. Part 1: General requirements
IEC 60825-1	Safety of laser products - Part 1: Equipment classification, requirements and user's guide
IEC 60825-2	Safety of laser products - Part 2: Safety of optical fibre communication systems
IEC 60950-1	Information technology equipment - Safety - Part 1: General requirements

4.5.5 IEEE recommendations

IEEE 802.1D	IEEE Standard for Information technology--Telecommunications and information exchange between systems--IEEE standard for local and metropolitan area networks--Common specifications--Media access control (MAC) Bridges
IEEE 802.1p	Included in IEEE 802.1D
IEEE 802.1Q	IEEE Standard for Local and Metropolitan Area Networks: Virtual bridged local area networks
IEEE 802.1w	Part 3: Media Access Control (MAC) Bridges - Amendment 2: Rapid Reconfiguration
IEEE 802.1X	Port-Based Network Access Control
IEEE 802.2	IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 2: Logical Link Control
IEEE 802.3	Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
IEEE 802.3ad	Included in 802.3 (2002)

4.5.6 IETF recommendations

RFC 768	User Datagram Protocol (UDP)
RFC 791	Internetwork Protocol
RFC 793	Transmission Control Protocol (TCP)
RFC 826	An Ethernet Address Resolution Protocol
RFC 894	A Standard for the Transmission of IP Datagrams over Ethernet Networks
RFC 1127	A Perspective on the Host Requirements RFCs
RFC 1332	The PPP Internet Protocol Control Protocol
RFC 1661	Point to Point Protocol
RFC 1662	PPP in HDLC-like framing
RFC 1213	Management Information Base for Network Management of TCP/IP based internets: MIB-II
RFC 2037	Entity MIB using SMIv2
RFC 1493	Definition of Managed Objects for Bridges.
RFC 1238	CLNS MIB for use with Connectionless Network Protocol (ISO 8473) and End System to Intermediate System (ISO 9542)
RFC1812	Requirements for IP Version 4 Routers
RFC 2328	OSPF Version 2
RFC 2495	Definitions of Managed Objects for the DS1, E1, DS2 and E2 interface types.
RFC 2558	Definitions of Managed Objects for the SONET/SDH interface type.
RFC 2665	Definitions of Managed Objects for the Ethernet-like Interface Types
RFC 2784	Generic Routing Encapsulation
RFC 2819	Remote Network Monitoring Management Information Base
RFC 3147	Generic Routing Encapsulation over CLNS Networks

4.5.7 ISO recommendations

ISO 4335	High-level Data Link Control (HDLC) procedures
ISO 8473	Protocol for Providing the Connectionless-mode Networking Service (CLNS)
ISO 9542	End System to Intermediate System Protocol (ES-IS) for Use in Conjunction with ISO 8473
ISO 10589	Intermediate System to Intermediate System Protocol (IS to IS)

4.5.8 ITU-T Recommendations

G.652	Single Mode Optical Fibre
G.664	Optical safety procedures and requirements for optical transport systems
G.701	Vocabulary of Transmission and Multiplexing, and Pulse Code Modulation (PCM) Terms.
G.702	Digital Hierarchy Bit Rates
G.703	Physical/Electrical Characteristics of Hierarchical Digital Interfaces
G.704	Synchronous Frame Structures at Primary and Secondary Hierarchical levels
G.706	Frame Alignment and Cyclic Redundancy Check (CRC) Procedures Relating to Basic Frame Structures Defined in Recommendation G.704
G.707	Network node interface for the synchronous digital hierarchy (SDH)
G.751	Digital multiplex equipments operating at the third order bit rate of 34 368 kbps and the fourth order bit rate of 139 264 kbps and using positive justification
G.775	Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) defect detection and clearance criteria for PDH signals
G.783	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks
G.784	Synchronous digital hierarchy (SDH) management
G.806	Characteristics of transport equipment - Description methodology and generic functionality
G.810	Definition and terminology for synchronisation networks
G.811	Timing characteristic of primary reference clocks
G.812	Timing characteristics of slave clocks suitable for use as a node clocks in synchronisation networks
G.813	Timing characteristics of SDH equipment slave clocks (SEC)
G.823	The control of jitter and wander within digital networks which are based on the 2048 kbps hierarchy
G.824	The control of jitter and wander within digital networks which are based on the 1544 kbps hierarchy
G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)
G.826	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate

G.828	Error performance parameters and objectives for international, constant bit rate synchronous digital paths
G.832	Transport of SDH elements on PDH networks - Frame and multiplexing structures
G.841	Types and characteristics of SDH network protection architectures
G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy
G.958	Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables
G.7041	Characteristics of transport equipment - Description methodology and generic functionality
G.7042	LINK CAPACITY ADJUSTMENT SCHEME (LCAS) FOR VIRTUAL CONCATENATED SIGNALS
K.41	Resistibility of internal interfaces of telecommunication centres to surge overvoltages
V.28	ELECTRICAL CHARACTERISTICS FOR UNBALANCED DOUBLE-CURRENT INTERCHANGE CIRCUITS
X.150	Principles of maintenance Testing for Public Data Network using Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) test Loops

4.5.9 Miscellaneous recommendations

NSIF-DN-0101-001	A Standard for IP over DCC
DIX-2	Digital Equipment Corporation, Intel, Xerox, The Ethernet, Version 2.0, November 1982

5 AM-2xSTM1/4-16xE1-SFP

5.1 Overview

The module is an aggregate module that supports STM-1 or STM-4 optical aggregate interfaces to be used in SDH networks.

The module features:

- System controller
- SDH features
- Aggregate interfaces
- PDH interfaces
- Miscellaneous interfaces
- LED indicators
- Local power supply
- Fan controller
- Interface for the two tributary modules

The block diagram of the module is shown in Figure 39

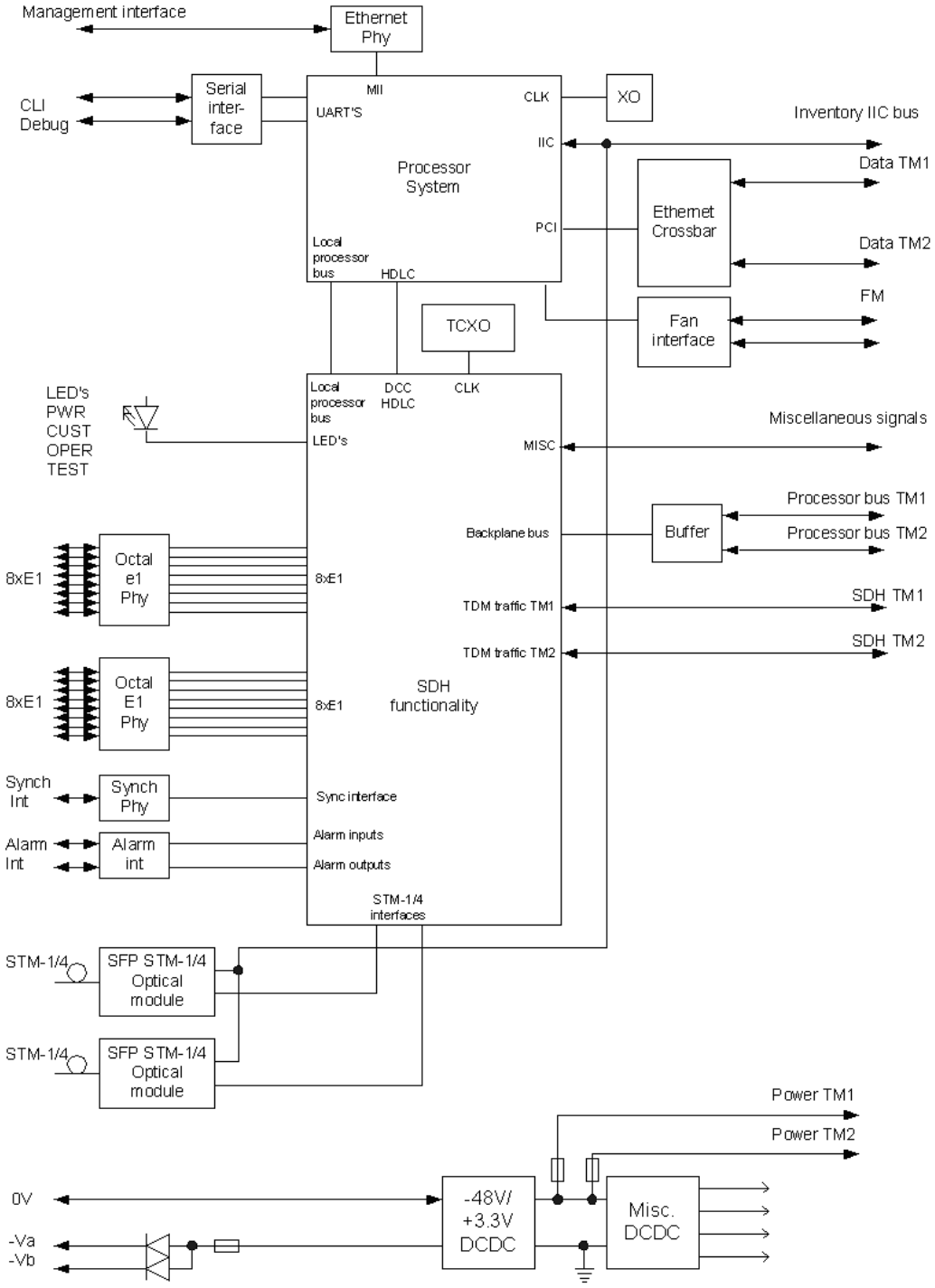

Figure 39 Block diagram of AM-2xSTM1/4-16xE1-SFP

5.1.1 Features

System controller

The system controller consists of a processor system with the following features:

- Processor with integrated communication processor
- Ethernet interface used by the craft terminal and the DCN interface
- Multiple HDLC controllers that is used for DCC traffic
- Two UART's for the CLI interface and the debug port (not accessible for customers)
- IIC interface for inventory
- Compact FLASH for storage of software and configuration data for FPGA's
- FLASH for boot SW
- SDRAM for execution of the software
- EEPROM for inventory data and configuration data

SDH features

The aggregate module includes the following SDH functionality:

- STM-1/4 line interfaces
- Higher order and lower order cross connect, equal to 24x24 VC-4 equivalents
- SDH termination for E1 interfaces
- SETS functionality

Aggregate interfaces

The two aggregate interfaces include full SDH processing before the traffic is connected to the cross-connect.

The traffic interfaces are based on the SFP multi source agreement (MSA) and it is possible to add the interface modules in the field. The modules support hot insertion.

The aggregate interface can only be configured for STM-1 line rates without a STM-4 license. It is configurable between STM-1 and STM-4 when the STM-4 license is added.

The following modules are supported in the first release:

- S-1.1 Short haul STM-1
- L-1.1 Medium haul STM-1
- L-1.2 Long haul STM-1
- TM-1e
- S-4.1 Short haul STM-4
- L-4.1 Medium haul STM-4
- L-4.2 Long haul STM-4

NOTE! It is also possible to add SFP modules that support STM-1e electrical interfaces. The physical connectors are 1.0/2.3 coaxial connectors.

PDH interfaces

The module has 16 electrical E1 interfaces using individual RJ-45 connectors.

Miscellaneous interfaces

The module supports the following miscellaneous interfaces:

- Management interface (10 base-T)
- CLI interface (serial)
- Debug interface (serial)
- Synchronisation interface (2 MHz G.703)
- Alarm interface (4 inputs and two outputs)
- Power interface (-48V)

LED indicators

Visual indicators (LED's) provide the status of the AXX 9100 CONNECT. The LED's are placed on the front of the aggregate module.

LED name	Colour	Functionality
CUST	Red	Alarm on the AXX 9100 CONNECT customer side, i.e. Tributary ports
OPER	Red	Alarm on the AXX 9100 CONNECT network side (Aggregate Port incl. VC12) or the device itself.
TEST	Yellow	Test loop is present
PWR	Green	Power OK

Table 72 LED functionality on AM-2xSTM1/4-16xE1-SFP

Local power supply

The module contains a -48V/-60V to 3.3V isolated power supply.

A fuse protects the power supply.

A number of low voltage power supplies convert the +3.3V to the other voltages needed in the module (e.g. +2.5V, +1.8V, +1.5V, etc.).

AC power is supported with an external power adaptor.

Fan controller

The module contains the control functionality for the two fans on the fan module.

Usually only a single fan is active at a time. The fan is activated for a specified time (24 hour). When the fan has been active for the specified time the fan is stopped and the other fan is activated. This is done to increase the MTBF for the fan module.

An alarm is reported if a fan fails. The other fan runs continuously if a fan fails. The fan module should be replaced if this happens since the remaining fan is not protected anymore.

Interface for the two tributary modules

The aggregate module has a number of interfaces toward the back plane:

- 2 interfaces for the tributary modules
- A number of miscellaneous signal
- Processor bus for the TM's
- I2C bus for collection of inventory and alarm information

5.1.2 Power consumption

The maximum power dissipation is 20W.

Summary - AM-2xSTM1/4-16xE1-SFP

Description
The module contains a system controller
The maximum SDRAM capacity is 128 Mbytes
The software is stored in Compact FLASH memory
It is possible to replace the Compact FLASH memory without opening the box
The boot SW is stored in a separate FLASH
It is possible to download new software to the module
Two banks of software is supported in the Compact FLASH memory
Automatic switchback to the old software is performed if the new software is not ok
The FPGA's configuration is also stored in the Compact FLASH memory
It is possible to download new configuration data for the FPGA's via software download
The system controller have a DCC processor that is capable of processing up to 2x DCC_M and 10xDCC_R kbps channels
The module includes a CLI interface and a debug interface
The CLI and debug interfaces compliance according to Table 57
The module supports a craft terminal interface
The craft terminal interfaces compliance according to “10 Base-T” on page 140
The module contains a TDM matrix with a HO and LO capacity of 24x24 STM-1 equivalents
The module provides the clocks needed for the systems
It includes a synchronisation interface (2 Mbps (E1) or 2 MHz clock)
The module supports two physical interfaces based on SFP MSA
It is possible to add or remove the SFP modules without affecting traffic on other interfaces in the shelf
The optical interfaces supports S-1.1, L-1.1, L-1.2 and STM-1e for STM-1
The STM-1 interface compliance for S-1.1 according to Table 57
The STM-1 interface compliance for L-1.1 according to Table 45
The STM-1 interface compliance for L-1.2 according to Table 36
The STM-1 interface compliance for STM-1e according to Table 37
The optical interfaces support S-4.1, L-4.1and L-4.2 for STM-4
The STM-4 interface compliance for S-4.1according to Table 39
The STM-4 interface compliance for L-4.1 according to Table 41
The STM-4 interface compliance for L-4.2 according to Table 43
The module includes 4 LED's

Description
The functionality of the LED's is as specified in Table 72
The FPGA's is automatically configured at power up without intervention from the aggregate modules
It is possible to upgrade the FPGA's with a software download from the TMN system
An alarm is raised if one or multiple FPGA's can not be configured
The module has an internal power supply connected to -48V
The power supply is connected to both power feeds with wire-or diodes
The power supply is protected by a fuse
The module monitors all secondary voltages an signal module failure if the voltages are outside specification
An external AC adaptor is available for connection to AC power sources
The module performs a self test procedure at power up
The module includes an inventory EEPROM
The module supports a connection to two tributary modules
The module is also connected to the parallel processor bus that is connected to the tributary modules
The module supports 16 electrical E1 interfaces
The E1 interface compliance is described in Table 49
The interfaces can be individually configured as transparent E1 or ISDN PRA interfaces
It is possible to individually switch of pointer processing on an interface to be able to deliver synchronisation through that interface
The module controls the 2 fans on the fan module
A fan failure is reported to the TMN system
A single fan is always be active
The fan is active for 24 hours
The other fan is then be active for the next 24 hours

Table 73 Feature summary - AM-2xSTM1/4-16xE1-SFP

6 AM-2xSTM1/4-SFP

6.1 Overview

The module is an aggregate module that supports STM-1 and STM-4 optical aggregate interfaces to be used in SDH networks.

It features the following functionality:

- System controller
- SDH features
- Aggregate interfaces
- Miscellaneous interfaces
- LED indicators
- Local power supply
- Fan controller
- Interface for the two tributary modules

The block diagram of the module is shown in Figure 40

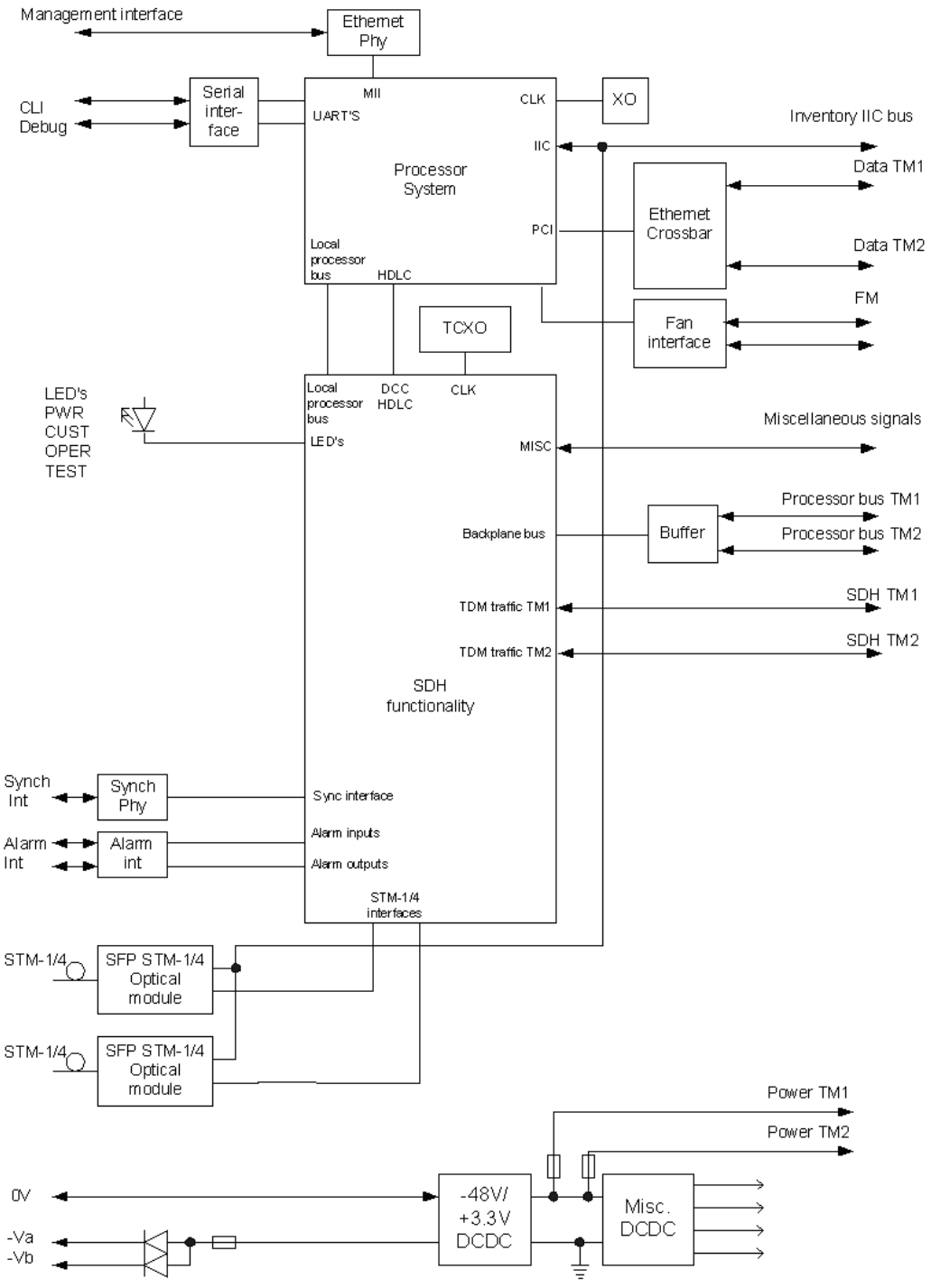

Figure 40 Block diagram of AM-2xSTM1/4-SFP

6.1.1 Features

System controller

The system controller consists of a processor system with the following features:

- Processor with integrated communication processor
- Ethernet interface used by the craft terminal and the DCN interface
- Multiple HDLC controllers that is used for DCC traffic
- Two UART's for the CLI interface and the debug port (not accessible for customers)
- IIC interface for inventory
- Compact FLASH for storage of software and configuration data for FPGA's
- FLASH for boot SW
- SDRAM for execution of the software
- EEPROM for inventory data and configuration data

SDH features

The aggregate module includes the following SDH functionality:

- STM-1/4 line interfaces
- Higher order and lower order cross connect, equal to 24x24 VC-4 equivalents
- SETS functionality

Aggregate interfaces

The two aggregate interfaces include full SDH processing before the traffic is connected to the cross-connect.

The traffic interfaces are based on the SFP multi source agreement (MSA) and it is possible to add the interface modules in the field. The modules supports hot insertion.

The aggregate interface can only be configured for STM-1 line rates without a STM-4 license. It is configurable between STM-1 and STM-4 when the STM-4 license is added.

The following modules are supported in the first release:

- S-1.1 Short haul STM-1

- L-1.1 Medium haul STM-1
- L-1.2 Long haul STM-1
- STM-1e
- S-4.1 Short haul STM-4
- L-4.1 Medium haul STM-4
- L-4.2 Long haul STM-4

NOTE! It is also possible to add SFP modules that support STM-1e electrical interface. The physical connectors are 1.0/2.3 coaxial connectors.

Miscellaneous interfaces

The module supports the following miscellaneous interfaces:

- Management interface (10 base-T)
- CLI interface (serial)
- Debug interface (serial)
- Synchronisation interface (2 MHz G.703)
- Alarm interface (4 inputs and two outputs)
- Power interface (-48V)

LED indicators

Visual indicators (LED's) provide the status of the AXX 9100 CONNECT. The LED's are placed on the front of the aggregate module.

LED name	Colour	Functionality
CUST	Red	Alarm on the AXX 9100 CONNECT customer side, i.e. Tributary ports
OPER	Red	Alarm on the AXX 9100 CONNECT network side (Aggregate Port incl. VC12) or the device itself.
TEST	Yellow	Test loop is present
PWR	Green	Power OK

Table 74 LED functionality on AM-2xSTM1/4-SFP

Local power supply

The module contains a -48V/-60V to 3.3V isolated power supply. A fuse protects the power supply.

A number of low voltage power supplies convert the +3.3V to the other voltages needed in the module (e.g. +2.5V, +1.8V, +1.5V, etc.).

AC power is supported with an external power adaptor.

Fan controller

The module contains the control functionality for the two fans on the fan module.

Usually only a single fan is active at a time. The fan is activated for a specified time (24 hour). When the fan has been active for the specified time the fan is stopped and the other fan is activated. This is done to increase the MTBF for the fan module.

An alarm is reported if a fan fails. The other fan runs continuously if a fan fails. The fan module should be replaced since the remaining fan is not protected anymore.

Interface for the two tributary modules

The aggregate module has a number of interfaces toward the back plane:

- 2 interfaces for the tributary modules
- A number of miscellaneous signal
- Processor bus for the TM's
- I2C bus for collection of inventory and alarm information

Summary - AM-2xSTM1/4-SFP

Description
The module contains a system controller
The maximum SDRAM capacity is 128 Mbytes
The software is stored in Compact FLASH memory
It is possible to replace the Compact FLASH memory without opening the box
The boot SW is stored in a separate FLASH
It is possible to download new software to the module
Two banks of software is supported in the Compact FLASH memory
Automatic switchback to the old software is performed if the new software is not ok
The FPGA's configuration is also stored in the Compact FLASH memory
It is possible to download new configuration data for the FPGA's via software download
The system controller has a DCC processor that is capable of processing up to 2x DCC_M and 10xDCC_R channels
The module includes a CLI interface and a debug interface
The CLI and debug interfaces compliance according to Table 57
The module supports a craft terminal interface
The craft terminal interfaces compliance according to “10 Base-T” on page 140
The module contains a TDM matrix with a HO and LO capacity of 24x24 STM-1 equivalents
The module provides the clocks needed for the systems
It includes a synchronisation interface (2 Mbps (E1) or 2 MHz clock)
The module supports two physical interfaces based on SFP MSA
It is possible to add or remove the SFP modules without affecting traffic on other interfaces in the shelf
The optical interfaces support S-1.1, L-1.1, L-1.2 and STM-1e for STM-1
The STM-1 interface compliance for S-1.1 according to Table 57
The STM-1 interface compliance for L-1.1 according to Table 45
The STM-1 interface compliance for L-1.2 according to Table 36
The STM-1 interface compliance for STM-1e according to Table 37
The optical interfaces support S-4.1, L-4.1 and L-4.2 for STM-4
The STM-4 interface compliance for S-4.1according to Table 39
The STM-4 interface compliance for L-4.1 according to Table 41
The STM-4 interface compliance for L-4.2 according to Table 43
The module includes 4 LED's

Description
The functionality of the LED's is as specified in Table 74
The FPGA's is automatically configured at power up without intervention from the aggregate modules
It is possible to upgrade the FPGA's with a software download from the TMN system
An alarm is raised if one or multiple FPGA's can not be configured
The module has an internal power supply connected to -48V
The power supply is connected to both power feeds with wire-or diodes
The power supply is protected by a fuse
The module monitors all secondary voltages an signal module failure if the voltages are outside specification
An external AC adaptor is available for connection to AC power sources
The module performs a self test procedure at power up
The module includes an inventory EEPROM
The module supports a connection to two tributary modules
The module is also connected to the parallel processor bus that is connected to the tributary modules
The module controls the 2 fans on the fan module
A fan failure is reported to the TMN system
A single fan is always active
The fan is active for 24 hours
The other fan is then be active for the next 24 hours

Table 75 Feature summary -AM-2xSTM1/4-SFP

6.1.2 Power consumption

Maximum power dissipation is 20W.

7 TM-3xE3/T3-1.0/2.3

7.1 Overview

The module is a tributary module that supports three E3 or T3 electrical interfaces.

It consists of the following functionality:

- Electrical interfaces
- SDH features
- Inventory EEPROM
- Aggregate module interface

The block diagram of the module is shown in Figure 41

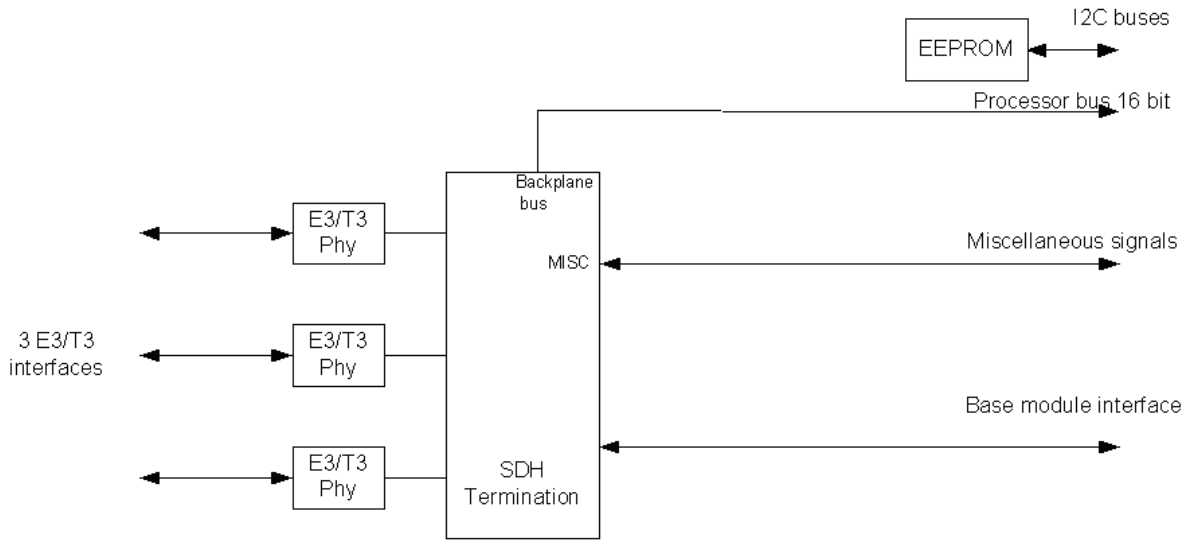

Figure 41 Block diagram of TM-3xE3/T3-1.0/2.3

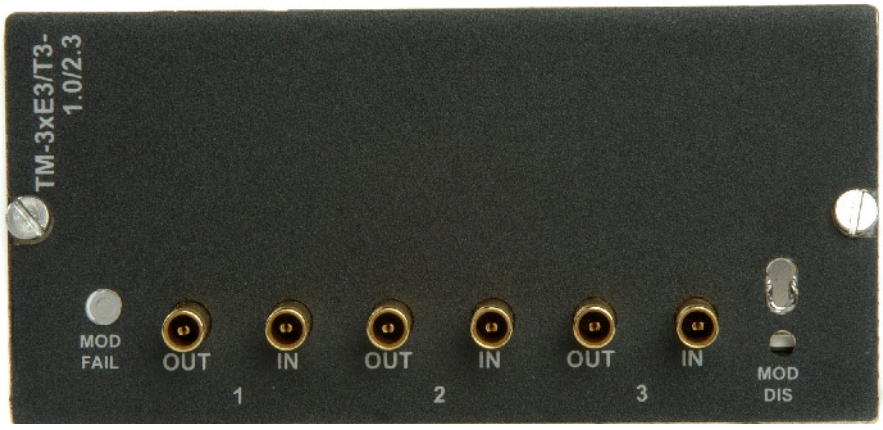

Figure 42 TM-3xE3/T3-1.0/2.3 Module

7.1.1 Features

Electrical interfaces

The module has three electrical E3 or T3 interfaces.

The interfaces can individually be configured as an E3 interface or as a T3 interface.

SDH features

The tributary module includes the following SDH functionality:

- E3/T3 line interfaces
- SDH termination for the interfaces

Inventory EEPROM

The module includes an inventory EEPROM that is connected to the I2C bus.

Aggregate module interfaces

The aggregate module has a number of interfaces toward the back plane:

- An interfaces from the aggregate module
- A number of miscellaneous signal
- Processor bus from the AM's
- I2C bus for collection of inventory information

Summary - TM-3xE3/T3-1.0/2.3

Description
The module supports three electrical E3/T3 interfaces
The E3 interface compliance according to Table 50
The T3 interface compliance according to Table 51
The interfaces can be individually configured as transparent E3 or a transparent T3 interfaces
The module includes an inventory EEPROM
The inventory EEPROM is accessible from the I2C bus
The module is also connected to the parallel processor bus

Table 76 Feature summary - TM-3xE3/T3-1.0/2.3

7.1.2 Power consumption

Maximum power dissipation is 10W.

8 TM-4xFEL2-4xMAP-RJ45

8.1 Overview

The module is a tributary module that supports electrical Ethernet interfaces. It supports up to four interfaces.

It includes up to four Ethernet to SDH mappers. The module supports both L1 and L2 services.

It consists of the following functionality:

- Ethernet features
- SDH features
- Electrical interfaces
- LED indicators
- Inventory EEPROM
- Back plane interfaces

The block diagram of the module is shown in Figure 43

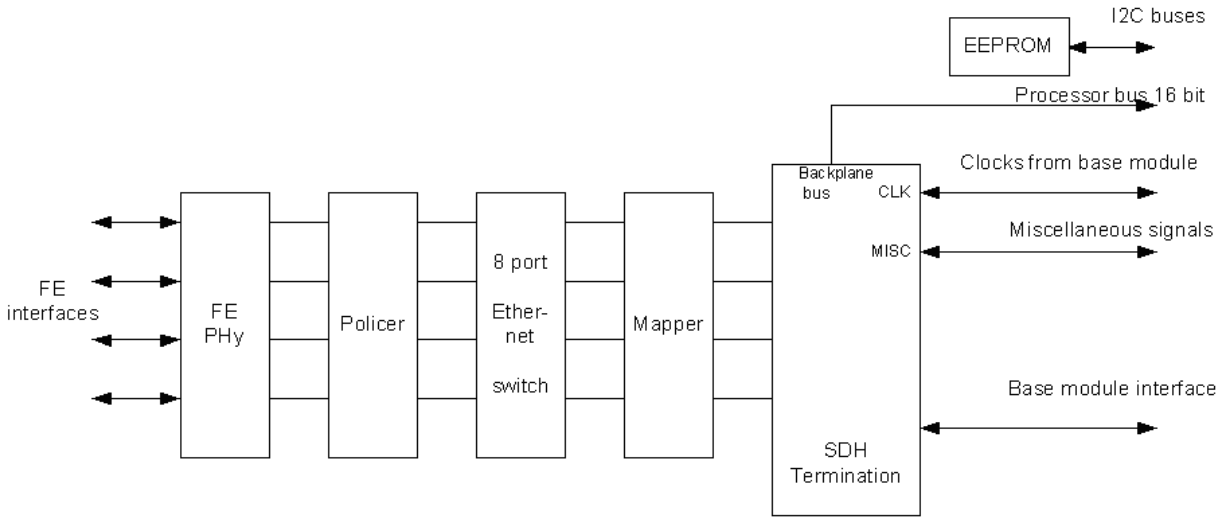

Figure 43 Block diagram of TM-4xFEL2-4xMAP-RJ45

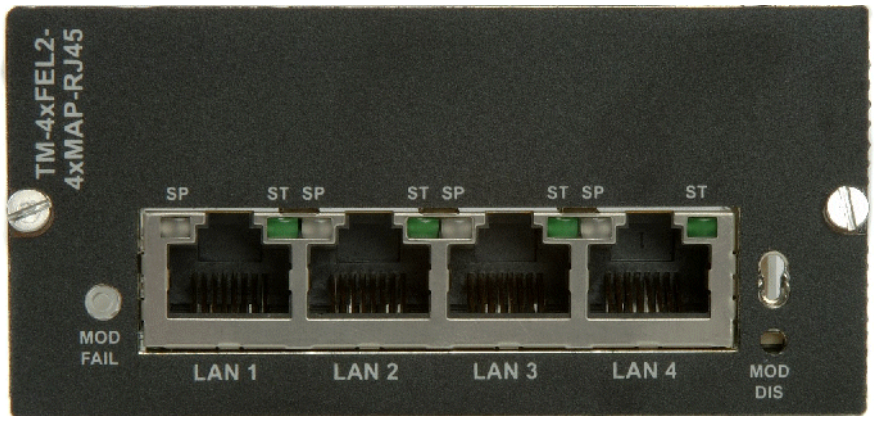

Figure 44 TM-4xFEL2-4xMAP-RJ45 Module

8.1.1 Features

Ethernet features

The module supports both L1 and L2 services. The number of physical interfaces is four. They can be independent configured as electrical 10 Base-T or 100 Base-TX.

The module performs the following functions:

- Ethernet FE physical interfaces
- Auto negotiation
- Auto crossover
- Flow control and back pressure
- Fixed Ethernet Port settings i.e. 10/100 half/full duplex
- MTU Size 6144 bytes (9K in L1)
- MAC switching
- Static MAC entries
- Automatic Learning & Ageing for MAC addresses
- Transparent Bridging
- Head of Line Blocking prevention
- Port-based Virtual LANs (VLANs)
- IEEE 802.1Q VLAN tagging compliance (VLAN id. 1-4000)
- GARP VLAN registration protocol (GVRP)

- MAC Multicast
- MAC IGMP snooping
- Link Aggregation
- Rapid spanning tree (RSTP) per device
- IEEE 802.1p priorities (Strict Policy, 4 queues)
- Provider bridging
- Port Mirroring
- Tunnelling of user traffic
- Tunnelling of L2 control protocols
- RMON performance monitoring

SDH features

The tributary module includes the following SDH functionality:

- GFP-F encapsulation of Ethernet traffic
- Support of Virtual Concatenation with NxVC-12 or MxVC-3 (N=1..50 and M=1..3)
- Support for up to 4 independent mappers
- Support for LCAS
- SDH termination

Electrical interfaces

The module supports up to four electrical Ethernet interfaces. The PHY is placed on the respective connector module. The interfaces support both 10 Base-T and 100 Base-TX.

LED indicators

Visual indicators (LED's) provide the status of the AXX 9100 CONNECT. The LED's are placed on the front of the tributary module.

LED name	Colour	Functionality
STATUS	Green	The link is down if the LED is extinguished The link is up if the LED is green The link is up and receiving or transmitting traffic when the LED is blinking green There is one status LED for each interface
SPEED	Yellow/Green	The link speed is 10 Mbps when the LED is yellow The link speed is 100 Mbps when the LED is green There is one speed LED for each interface

Table 77 LED functionality on TM-4xFEL2-4xMAP-RJ45

Inventory EEPROM

The module includes an inventory EEPROM that is connected to both I2C buses.

Back plane interfaces

The tributary module has a number of interfaces toward the aggregate module:

- An interfaces from the aggregate module
- A number of miscellaneous signal
- Processor bus from the AM
- I2C bus for collection of inventory information

Summary - TM-4xFEL2-4xMAP-RJ45

Description
The module supports 4 electrical FE interfaces
The electrical interfaces can individually support both 10 Base-T and 100 Base-TX
The FE interface meets the requirements in chapter 3.4.8 for 10 Base-T
The FE interface meets the requirements in chapter 3.4.9 for 100 Base-TX
The module provides L1 Ethernet functionality
Supports up to 4 SDH mappers
The mappers can individually configured for GFP-F or Ericsson AXXESSIT mapping schemes
The Ericsson AXXESSIT mapping scheme supports NxVC-12 mapping with n=1...50
The GFP-F mapping scheme supports NxVC-12-Xv mapping with n=1...50
The GFP-F mapping scheme supports NxVC-3-Xv mapping with n=1...3
The GFP-F mapping scheme supports VC-4-Xv mapping
The module includes 8 LED's
The functionality of the LED's is as specified in Table 77
The module includes an inventory EEPROM
The inventory EEPROM is accessible from the I2C bus
The module is also connected to the parallel processor bus
Ethernet physical interfaces compliance according to “Physical interface” on page 61.
MAC switching compliance according to “MAC switching” on page 66
VLAN compliance according to “VLAN” on page 69
Multicast traffic compliance according to “Multicast traffic” on page 73
Ethernet protection compliance according to “Ethernet protection” on page 75
Traffic priority compliance according to “Traffic priority” on page 77
Provider bridging compliance according to “Provider bridging” on page 81
Performance monitoring compliance according to “Performance monitoring” on page 87

Table 78 Feature summary - TM-4xFEL2-4xMAP-RJ45

8.1.2 Power consumption

Maximum power dissipation is 15W.

9 AC Power Adaptor

9.1 Description

The AXX 9100 CONNECT does not include an internal AC power supply. It can still be powered from an AC power source with the help of an external AC power adaptor.

The power adaptor has a standard 2-pin power connector (IEC 320) and a number of different power cords can be used for the different markets.

The output voltage from the power supply is -48V and is directly connected to the power connector on the AXX 9100 CONNECT.

Parameter	**Value**
Input voltage	90-264 Vac
Frequency range	47-63 Hz
Minimum output power	0W
Maximum output power at $25^{O}C$	50W
Output voltage	-48V
Load regulation	1%
Line regulation	1%
Output voltage ripple	50 mV
Efficiency	>80%
Input connector	2 pin IEC 320
Output connector	4 pin Mini fit (Molex)

Table 79 AC power adaptor

The 230V AC supply input is provided via a 2-pin power connector (IEC 320), with the following pin-out:

Pin	**Signal**
1	L
2	N

Table 80 Pin-out AC connector

The -48V DC supply output is provided via a 4-pin power connector (Molex Mini-fit 4x1), with the following pin-out:

Pin	Signal
1	0V
2	-48V
3	
4	

Table 81 Pin-out DC connector

Compliance

Description	Specification
The physical AC connector is a 2-pin IEC 320 connector	
The pin out is according to Table 80	
The physical DC connector is a 4-pin Minifit connector	
The pin out is according to Table 81	
Includes an internal fuse	
Minimum output power is 0W	
Maximum output power is 50W	
Meets safety requirements	IEC 60950 10/2001
Efficiency greater than 80%	
Meet nominal voltage of 230V AC	300132-3 V1.2.1 09/2003 ch 5.1
Normal service voltages at interface A3	300132-3 V1.2.1 09/2003 ch 5.2
Nominal frequencies	300132-3 V1.2.1 09/2003 ch 5.3
Frequency range 47 - 53 Hz	
Abnormal service voltage under steady-state conditions	300132-3 V1.2.1 09/2003 ch 5.4.1
Meet nominal voltage of 110V AC	
Frequency range 57 - 63 Hz	
Voltage dips, short interruptions and transients	300132-3 V1.2.1 09/2003 ch 5.4.2
Supply protection	300132-3 V1.2.1 09/2003 ch 5.5
Maximum current drain	300132-3 V1.2.1 09/2003 ch 5.6
Surge current on connection to interface A	300132-3 V1.2.1 09/2003 ch 5.7
Emission AC ports Conducted emissions	300386 V1.3.2 12/2002 ch 7.1.2.1
Emission AC ports Current harmonics	300386 V1.3.2 12/2002 ch 7.1.2.2
Emission AC ports Voltage fluctuations	300386 V1.3.2 12/2002 ch 7.1.2.3
Immunity enclosure port (Telecom Centres) ESD	300386 V1.3.2 12/2002 ch 7.2.1.1.1
Immunity enclosure port (Telecom Centres) Radio frequency electromagnetic field amplitude modulated	300386 V1.3.2 12/2002 ch 7.2.1.1.2

Description	Specification
Immunity AC port (Telecom Centres) Fast transients	300386 V1.3.2 12/2002 ch 7.2.1.4.1
Immunity AC port (Telecom Centres) Surges	300386 V1.3.2 12/2002 ch 7.2.1.4.2
Immunity AC port (Telecom Centres) Radio frequency conducted continues	300386 V1.3.2 12/2002 ch 7.2.1.4.3
Immunity enclosure port ESD	300386 V1.3.2 12/2002 ch 7.2.2.1.1
Immunity enclosure port Radio frequency electromagnetic field amplitude modulated	300386 V1.3.2 12/2002 ch 7.2.2.1.2
Immunity AC port Fast transients	300386 V1.3.2 12/2002 ch 7.2.2.4.1
Immunity AC port Surges	300386 V1.3.2 12/2002 ch 7.2.2.4.2
Immunity AC port Radio frequency conducted continues	300386 V1.3.2 12/2002 ch 7.2.2.4.3
Immunity AC port Voltage dips and short interruptions	300386 V1.3.2 12/2002 ch 7.2.2.4.4
Nominal output voltage -48V	
Nominal output voltage tolerance <2%	
Load regulation <1%	
Line regulation <1%	
Output voltage ripple <50mV	

Table 82 Power supply physical compliance