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Part 2: System characteristics;
Sub-part 3: Transport network and channel adaptation aspects

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Contents

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Services and Protocols for Advanced Networks (SPAN).

The present document is part 2, sub-part 3 of a multipart deliverable covering Dynamic synchronous Transfer Mode (DTM), as identified below:

Part 1: "System description";

Part 2: "System characteristics";

Sub-part 1: "Data link aspects";

Sub-part 2: "Network aspects";

Sub-part 3: "Transport network and channel adaptation aspects";

Part 3: "Physical protocol";

Part 4: "Mapping of DTM frames into SDH containers";

Part 5: "Mapping of PDH over DTM";

Part 6: "Mapping of Synchronous Digital Hierarchy (SDH) over DTM";

Part 7: "Ethernet over DTM Mapping";

Part 8: "Mapping of Frame relay over DTM";

Part 9: "Mapping of ATM over DTM";

Part 10: "Routeing and switching of Internet Protocol (IP) flows over DTM";

Part 11: "Mapping of video streams over DTM";

Part 12: "Mapping of MPLS over DTM";

Part 13: "System description of sub-rate DTM";

Part 14: "Network management".

Introduction

The present document describes the architecture and functions of the transport in the DTM system. Furthermore, how data is mapped on the DTM channels is also described.

1 Scope

The present document establishes system architecture for channel adaptation and transport in the Dynamic synchronous Transfer Mode (DTM).

More specifically the following is described:

- the channel adaptation within a DTM system;
- the DTM channel and its transport characteristics;
- switching of channels.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[EN50083-9] CENELEC EN 50083-9: "Cable networks for television signals, sound signals and interactive services - Part 9: Interface for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams".

[ES803-1] ETSI ES 201 803-1: "Dynamic synchronous Transfer Mode (DTM); Part 1: System description".

[ES803-2-1] ETSI ES 201 803-2-1: "Dynamic synchronous Transfer Mode (DTM); Part 2: System characteristics; Sub-part 1: Data link aspects"

[ES803-3] ETSI ES 201 803-3: "Dynamic synchronous Transfer Mode (DTM); Part 3: Physical protocol".

[ES803-6] ETSI ES 201 803-6: "Dynamic synchronous Transfer Mode (DTM); Part 6: Mapping of SDH over DTM".

[ISO8601] ISO 8601 (2000)(E): "Data elements and interchange formats - Information interchange - Representation of dates and times".

[RFC791] IETF RFC 791: "Internet Protocol; DARPA Internet program; Protocol Specification".

[BT656] ITU-R Recommendation BT.656: "Interfaces for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level of Recommendation ITU-R BT.601 (Part A)".

[M20] ITU-T Recommendation M.20: "Maintenance philosophy for telecommunication networks".

[M2100] ITU-T Recommendation M.2100: "Performance limits for bringing-into-service and maintenance of international multi-operator PDH paths and connections".

[M2101] ITU-T Recommendation M.2101: "Performance limits for bringing-into-service and maintenance of international multi-operator SDH paths and multiplex sections".

[M2120] ITU-T Recommendation M.2120: "International multi-operator paths, sections and transmission systems fault detection and localization procedures".

[G803] ITU-T Recommendation G.803: "Architecture of transport networks based on the synchronous digital hierarchy (SDH)".

[G806] ITU-T Recommendation G.806: "Characteristics of transport equipment - Description Methodology and Generic Functionality".

[X721] ITU-T Recommendation X.721: "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

address, DTM address: 64 bit numerical value that uniquely identifies a node in a DTM network (see further anycast address and multicast address)

allocation domain: same as a bypass chain but if the topology is point-to-point or bus, the last node is not counted as member of the AD

Bypass Chain (BC): series of concatenated physical links, where data can be transported end-to-end using bypass switching

bypass switching: space switching of slots from a receiver to a transmitter on the same physical port on a per slot basis

channel: set of slots allocated from one source access node to one or more destination access nodes in a network

NOTE: The source and destination access nodes can be the same, i.e. the channel is internal to the node.

channel adaptation: channel path termination function that provides an adaptation between the DTM slot based service and some other traffic service (such as word stream, bit stream or asynchronous packets)

Channel Multiplex Identifier (CMI): identifier by DCAP-1 used for multiplexing packets of different protocols on a single channel

control channel: channel used for DTM control signalling

data channel: channel used for transport data between interworking functions

DTM Channel Adaptation Type (DCAT): field in the DCP channel establishment message used for identifying the type of channel adaptation to be used by the channel

DTM network address, DTM address: see definition of address, DTM address

DTM Service Type (DST): identifying the type of interworking function to be associated with the channel

DTM Service Type Instance (DSTI): identifying which interworking function of a specific type to be addressed by the channel

Interface identifier (interface ID): globally unique identifier of an interface that is represented as a 48-bit Ethernet MAC address

master interface: interface in the allocation domain having the lowest interface identifier

multicast address: address used to represent all nodes belonging to a multicast group

network address: address to be used in the network layer of the ISO OSI model

NOTE: A network address may take on different forms depending on which protocol is being used in the network layer. (See also DTM network address).

node: network element containing DTM functions

node identifier (node ID): identifier that uniquely identifies a node over a global scope

ownership: responsibility to supervise an access token of a slot

physical link: unidirectional connection between the transmitter of one port and the receiver of another port

quark: smallest resource unit that is one slot wide and one bypass hop long. Used to model dynamic resource management on a data link

switch: node that is capable of switching slots from one interface to another

slot: time slot containing 64 bits of control or user data which also holds a special code for link layer or channel layer control

topology: specific physical, i.e. real, or logical, i.e. virtual, arrangement of the elements of a network

NOTE: Two networks have the same topology if the connection configuration is the same, although the networks may differ in physical interconnections, distances between nodes, transmission rates, and/or signal types.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

A	Adapted function
aAIS	Alarm Indication Signal action
AGC	Automatic Gain Control
AI	Adapted Information
AIS	Alarm Indication Signal
AP	Access Point
AP0	Application layer channel adaptation type 0
aSSF	Server Signal Fail action
BC	Bypass Chain
BIP	Bit Interleaved Parity
BP	ByPass layer
C	Connection Function
cAIS	Alarm Indication Signal cause
CDM	Code Division Multiplexing
CH	CHannel layer
CHn	CHannel layer type-n
CHp	CHannel layer protection
CI	Characteristic Information
CK	ClocK
cLOJ	Loss Of Justification cause
CMI	Channel Multiplex Identifier
CP	Connection Point
CRC	Cyclic Redundancy Check
D	Data
dAIS	Alarm Indication Signal defect
DCAP	DTM Channel Adaptation Protocol
DCAT	DTM Channel Adaptation Type
DCP	DTM Channel Protocol
dDEG	DEGraded signal defect
DLSP	DTM Link State Protocol
DMA	Defered Maintenance Alarm
dPLM	Payload Mismatch defect
DST	DTM Service Type
DSTI	DTM Service Type Instance
DTM	Dynamic synchronous Transfer Mode
EFS	Equipment Functional Specification
EMF	Equipment Management Function
fAIS	Alarm Indication Signal fault
FAS/PTR	Frame Alignment Signal/Pointer

FJ-	negative Frequency Justification
FJ+	positive Frequency Justification
fLOJ	Loss Of Justification fault
FS	Frame Start signal
II	Idle Insertion
LOF	Loss Of Frame defect
LOP	Loss Of Pointer
M	Media Layer
MAF	Management Application Function
MEI	Maintenance Event Information
MI	Management Information
Mn	Media layer type-n
MO	Managed Objects
MP	Management Point
MTU	Message Transfer Unit
nAIS	Alarm Indication Signal anomaly
NBBE	Near-end Background Block Error
NE	Network Element
nFJ-	negative Frequency Justification anomaly
nFJ+	positive Frequency Justification anomaly
nLOF	Loss Of Frame anomaly
nLOJ	Loss Of Justification anomaly
pFJ-	negative Frequency Justification performance counter
pFJ+	positive Frequency Justification performance counter
PLL	Physical Link Layer
PLn	Physical Link layer type-n
PRG	Pseudo-Random Generator
PS	Performance Supervision
SDH	Synchronous Digital Hierarchy
sFS	Frame Start signal
sII	Idle Insertion signal
Sk	Sink
So	Source
SOF	Start Of Frame
SSF	Server Signal Fail
TCP	Termination Connection Point
TDM	Time Division Multiplex
TI	Timing Information
TP	Timing Point
TS	Time Slot layer
TSF	Trail Signal Fail
TSL	Trail Signal Label
TSp	Time Slot layer Protection
TSt	Time Slot layer Tunnel
TT	Trail Termination
VC	Virtual Container
VC-3	Virtual Container, level 3
VC-4	Virtual Container, level 4
WDM	Wavelength Division Multiplexing
XOR	eXclusive OR

4 Modelling introduction

Digital transmission systems can be broadly described as a collection of multiplexing, framing, transport, routeing, timing and protection processes. The details of each process and the way in which they are interconnected is described by a digital transmission hierarchy. Each of these processes can be decomposed into a collection of atomic (indivisible) functions. The digital transmission hierarchy itself can be decomposed into a number of layers, each of which contain atomic functions. Interfaces between layers are also defined by atomic functions. Each layer and each function have a set of characteristics which are defined within the present document. Since equipment which is compliant with the present document is described as an interconnection of functions defined within the present document, compatibility between equipment of different vendors is assured.

The description methodology also imposes a discipline on manufacturers and purchasers of digital transmission equipment. Complicated networking and transportation processes are decomposed into a combination of much simpler functions thereby assisting system design.

The method of functional decomposition described in the following clauses and the symbols and unique names which are used to describe the atomic functions combine to form a short-hand diagrammatic notation which can be used to specify the functionality of an equipment or a network. It is intended that this short-hand notation should simplify technical descriptions and tenders since reference to the present document will give engineers a common understanding of the symbols and names used.

The modelling used in the present document deviates from that of traditional modelling as found in [G806] and [EN417-1-1] to fit the specific needs of DTM and additional clarity in details.

4.1 Functional modelling rationale

A limited set of atomic functions has been derived by decomposing the European digital transmission hierarchy to form the library contained within the present document. The contents of this library are consistent with the definitions of functions contained in the present document. In order to be compliant with the present document, equipment which contains functionality defined within the present document should only use the functions as explicitly defined. As technology evolves, new network elements requiring additional atomic functions may be developed. These additional atomic functions, which are not contained within the present document, may be used. The use and definition of such additional functions should be submitted for standardization and inclusion within the present document at the earliest opportunity.

Three types of atomic function are required to describe a transmission network. According to [G803], these are:

- the connection function;
- the adaptation function;
- the termination function.

Each of these functions can be unidirectional or bi-directional. The direction of transmission through a unidirectional function is identified by defining it as a sink or a source function.

Within the scope of DTM, only the unidirectional form is used, except for non-native DTM traffic where suitable.

4.1.1 Description of network elements - equipment functional specification

A Network Element (NE) (equipment) is described by its Equipment Functional Specification (EFS) that accommodates a list of applicable atomic functions and their interconnection scheme. A network element can be most easily and concisely specified as a collection of atomic and/or compound functions by representing these functions in diagrammatic form as stated in the present document.

The present document specifies the components and the methodology that should be used to specify DTM equipment; it does not describe an individual DTM equipment as such.

4.1.2 Implementation independence

The atomic functions and their interconnection in an EFS, describe the functionality as it can be observed from the inputs and outputs of the NE. The internal structure of the implementation of this functionality (equipment design) need not be identical to the structure of the functional model, as long as all the details of the externally observable behaviour comply with the EFS.

NOTE: One exception to this implementation independence rule is recognized. Refer to clause 5.2.1.

4.1.3 Universal representation for management

Implementation independent descriptions of network functions, such as those given in the present document, form the basis of a generic information model for digital transmission. This model will be applicable to any equipment which is compliant with the present document since network control and monitoring are related to the functions contained in the library of the present document, and from which subsets of functions are drawn to describe compliant equipment. Consequently, implementation and manufacturer information is reduced to a minimum. Some manufacturer specific information is required for repair and maintenance purposes.

4.2 The underlying principles of functional modelling

4.2.1 The client-server relationship

Clause 5.8 defines a collection of layers which model the digital transmission hierarchy. Each layer is related to the adjacent layer in one of two ways. It either serves the adjacent layer or is served by the adjacent layer. When the layer serves the adjacent layer it is called a server layer and when it is served by the adjacent layer it is called a client layer. Thus, a client/server relationship is established between the layers which describe the digital transmission hierarchy. This relationship is recursive. Clause 5.8 describes the generic properties of the layers which describe the digital transmission hierarchy and the functions from which such networks are constructed. The present document gives specific definitions for the network functions which form each layer of the DTM digital transmission hierarchy.

4.2.2 Atomic functions and compound functions

The main unit of equipment specification is the atomic function, which may be interconnected as discussed in clause 5.6. Groups of atomic functions within a library of atomic functions may be combined in accordance with the combination rules, stated in the present document, to form compound functions. Functions can also be combined across layer boundaries to form more complicated major compound functions. A number of (major) compound functions which are fundamental to the DTM digital transmission hierarchy are defined in the present document. Equipment which is compliant with the present document can be specified by using any valid combination of these compound functions and the atomic functions defined in the present document. The mechanism by which atomic and/or compound functions are combined by binding at compatible connection and access points is defined in clause 5.6.

4.2.3 Network functions included in specific equipment

The grouping of atomic and/or compound functions, drawn from the libraries of these functions contained within the present document, is restricted only by the combination rules given in clause 5.6. There is therefore no restriction on the functions which can be included in a specific equipment. Furthermore, it is possible to specify equipment which complies with the present document and which can be configured in a number of ways to carry out different network functions.

For example, more than one adaptation function, of the same or of a different type, can be "present" in a Network Element (NE) and connected to a single termination function. For such a case, a subset of the adaptation functions may be "active" (providing service) while the others are "in-active". The signals applied to the "in-active" group of adaptation source functions are not forwarded to the termination source function. This configuration can be modified over time.

4.2.4 The functional model and the information model

The **functional model** of an equipment describes the way in which the equipment accepts, processes and forwards information contained in a signal. Thus, not only are the internal processes of the equipment specified but the internal and external interfaces are also specified. The functional model also specifies the performance criteria which shall be met by each process, and the actions which shall be taken when these performance criteria are not met. The performance of a process or interface is determined by the number and nature of the anomalies which occur within the process.

The **information model** describes an equipment from the management viewpoint as a collection of Managed Objects (MOs) which can be manipulated by a management system. These MOs are instances of the MO classes defined in [ES803-14]. These MOs, and their attributes, are expressed in a standard notation defined for this purpose (refer to ITU-T Recommendation X.721 [X721]). The definition of each MO class is thus derived from a specific part of the functional model. It cannot be assumed that a one-to-one relationship exists between each function and each MO, neither should it be assumed that the functional model data is always displayed unchanged.

The relationship between functions in the functional model of an equipment, and the managed objects which represent them in the information model is demonstrated by the following examples. Interconnections between functions formed by binding compatible connection points appear in the information model as a relationship between the corresponding MOs. As a second example, when a function declares a failure it appears in the information model as a notification, which informs the manager of the functional model event. The management system can select the notifications it wishes to receive, so it cannot be assumed that an event in the equipment is always notified to the management system.

The present document and [ES803-14] are, therefore, closely associated. It is intended that the definition of the attributes for a MO contained within the information model corresponds to the functional definition of the NE concerned.

5 Network modelling principles

5.1 Transmission layers

The transport network can be described by a set of network layers. Figures 1 and 2 depict the server/client relationships of some of the SDH and PDH layers. Interconnection of SDH and PDH is possible via equivalent connection points; e.g. X4 CP (140 Mbit/s), P12x CP (2 Mbit/s).

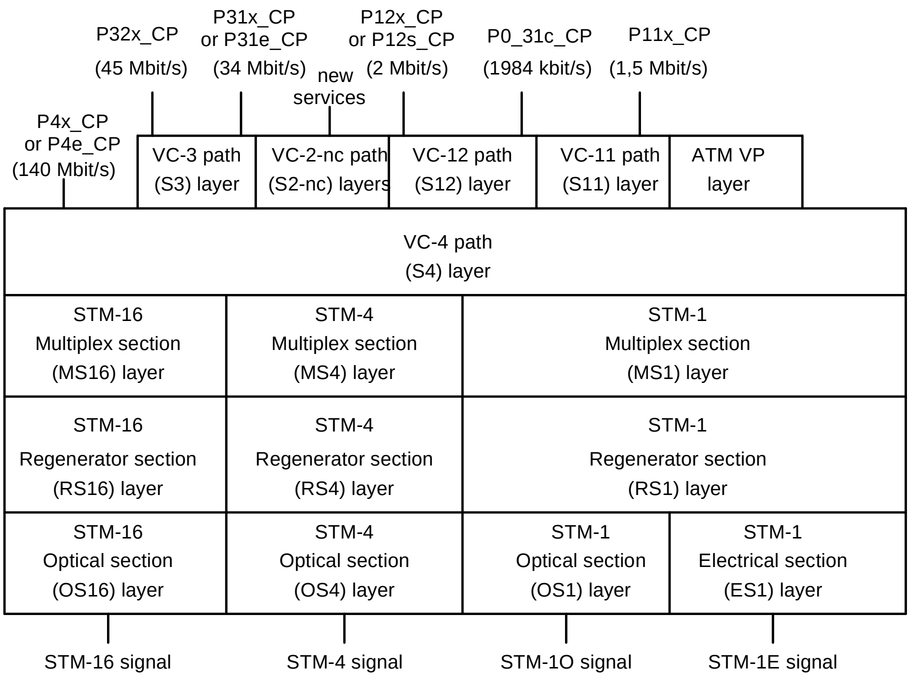


Figure 1: Example of SDH transmission layers and interface signals

Almost every layer has a server/client relationship with auxiliary channel layers. This is not shown in the figures. Examples are Order Wire (OW), User channels (USR) and National Use (NU) channels. Their electrical interface can be, for the case of a 64 kbit/s auxiliary channel, the E0 layer or a similar data communication layer can be V.11. Other examples are the Data Communications Channels (DCCs) in the regenerator and multiplex section layers.

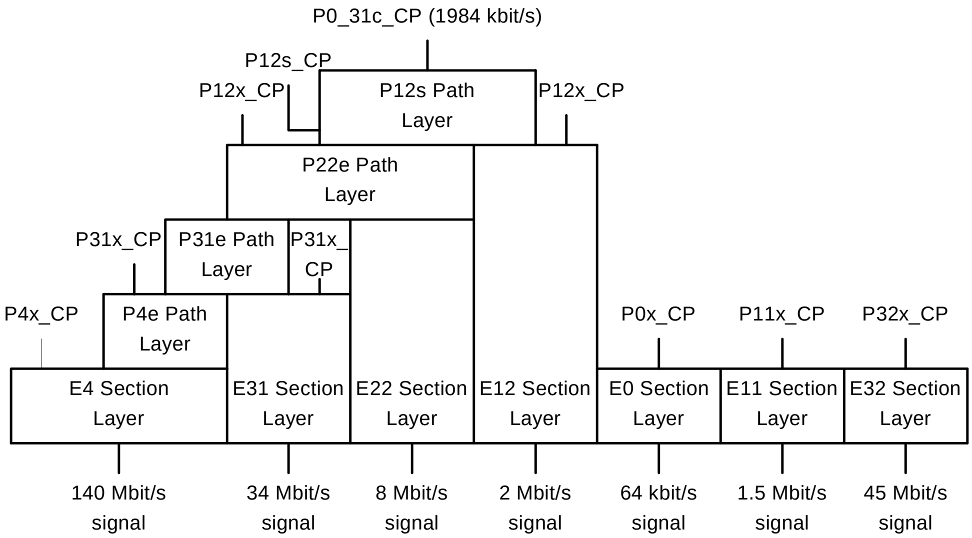


Figure 2: Example of PDH transmission layers and interface signals

Not shown, but addressed in this part of the EN, is the synchronization distribution layer which describes the synchronization function of SDH equipment. Management, power supply and station alarm interfaces are for further study.

5.2 Atomic functions

Each layer is described by a set of atomic functions (figure 3) a connection function, a trail termination function and one or more server layer to client layer adaptation functions.

An NE (i.e. transmission equipment) is described by means of these functions in an Equipment Functional Specification (EFS). If a layer is present in a network element any of the following atomic function groups might be present:

1) its connection function (cross-connecting only);

2) its connection function and its trail termination function (cross-connecting only with non-intrusive monitoring);

3) its trail termination and one or more of its adaptation functions. Its connection function may or may not be present. (trail is terminated and the payload is passed to the client layers).

Similarly, it is possible to describe a (sub-)network by means of those symbols.

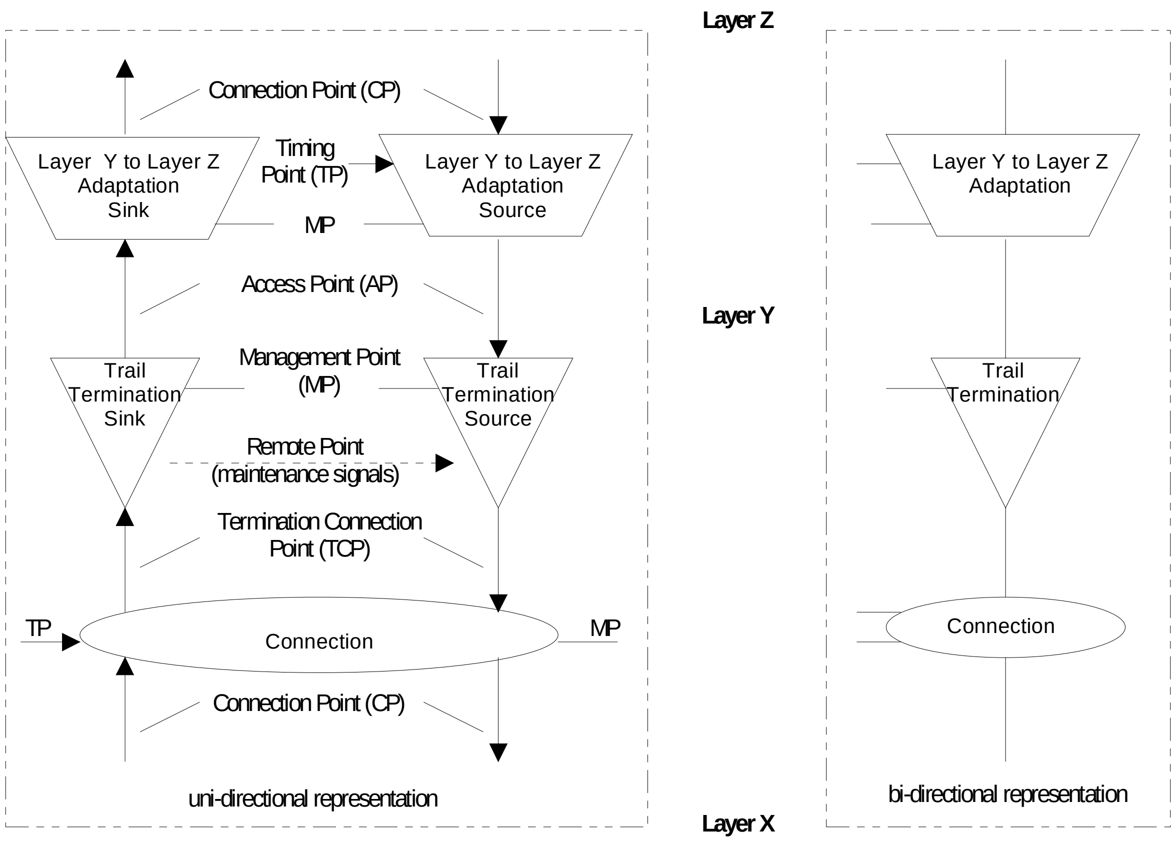


Figure 3: Atomic functions in a layer

5.2.1 Connection function

The connection function provides flexibility within a layer. It may be used by the network operator to provide routeing, grooming, protection and restoration.

The model describes the connection function as a space switch that provides connectivity between its inputs and outputs. Connections might be set up or turned down based on management commands via the Management Point (MP) and/or based on signal fail/degrade signals received over the Connection Point (CP) and Termination Connection Point (TCP) (e.g. protection switch).

The connectivity between inputs and outputs of the connection functions might be limited due to implementation constraints.

NOTE: The connection function's flexibility process is modelled as a "space switch". In equipment the switch matrix type may be either a "space switch" or a combination of "space and time switches". If a time switch is involved the adaptation source functionality shall be located at the input of the switch matrix (connection function) rather than at the output (as in the functional model).

The location of the adaptation source functionality (i.e. Elastic Store and Pointer Generator) with respect to the connection functionality (i.e. switch matrix) is observable at the physical interface when the matrix connection is changed (e.g. due to protection switch).

5.2.2 Trail termination function

The Trail Termination function performs the signal integrity supervision of the layer. This includes:

- signal conditioning;
- continuity supervision;
- connectivity supervision;
- signal quality supervision;
- processing of maintenance information (forward indications).

NOTE 1: These functionalities are reduced in the physical section layer termination functions, which can only monitor the signal loss. The physical section termination source function performs in addition logical/optical, respectively logical/electrical conversion. The physical section termination sink function performs in addition optical/logical, respectively electrical/logical conversion.

NOTE 2: In traditional modelling for SDH and PDH is remote signals used to transmit backwards along the connection the information of health. This is done in order to achieve single ended maintenance. In DTM there is no simple reverse direction in the transmission plane as in the bidirectional world of SDH and PDH, so signalling protocols has to be relied upon to achieve the same task. For further information on SDH and PDH remote information please see [G806] and [EN417-1-1].

5.2.2.1 Signal Conditioning

Signal conditioning adapt the signal between different signal forms including optical, analog and digital electric signals. Adaptation includes gain Automatic Gain Control (AGC), quantization, slow rate limit, emphasis and dispersion compensation.

5.2.2.2 Continuity supervision

In the sink direction, it monitors for some or all of the following:

- signal loss (disconnection, idle signal, unequipped signal).

5.2.2.3 Connectivity supervision

To monitor the provisioning of flexibility within a network, some Access Points (APs) can be identified (named/numbered). That identifier is inserted in the signal, by the Trail Termination source function, in the Trail Trace Identifier. (TTI) The Trail Termination sink function checks the received identifier with the expected one (provisioned by the network manager).

In the source direction it generates and adds some or all of the following:

- trail trace identifier (i.e. source address).

In the sink direction, it monitors for some or all of the following:

- (mis)connection.

5.2.2.4 Signal quality supervision

Bit errors are detectable via line code violations, parity violations or CRC violations; i.e. error detection code violations.

Degradation of the signal results in the detection of anomalies and defects. As a consequent action of the detection of defects, the signal is replaced by the Alarm Indication Signal (AIS). The defects are reported to the fault management process.

The number of near-end block errors, detected by means of error detection code violation monitoring, per second is counted. A second is indicated as a near-end defect second in cases where a signal fail condition was detected in that second.

Refer to the anomaly process description (clause 6.1) for detailed specifications.

In the source direction it generates and adds some or all of the following:

- error detection code or forward error indication (e.g. Bit Interleaved Parity (BIP), Cyclic Redundancy Check (CRC), incoming error count).

In the sink direction, it monitors for some or all of the following:

- signal quality (e.g. bit errors);
- near-end performance.

5.2.2.5 Maintenance information

In the sink direction, it monitors for some or all of the following:

- server signal fail (i.e. Alarm Indication Signal (AIS) instead of data).

5.2.3 Adaptation function

An adaptation function represents the conversion process between a server and a client layer. One or more of the following processes may be present in an adaptation function:

- scrambling/descrambling;
- encoding/decoding;
- frequency justification;
- alignment (framing, pointer interpretation, FAS/PTR generation);
- timing recovery;
- jitter attenuation and smoothing;
- bit rate adaptation;
- multiplexing/demultiplexing;
- time slot/frequency/wavelength/code assignment/access;
- payload identification;
- payload composition selection.

5.2.3.1 Scrambling/descrambling

The **scrambling** process alters digital data in a pre-defined way to ensure the resulting bit stream has a sufficient density of 0 to 1 and 1 to 0 transitions to allow bit clock recovery from it or to reduce the risk of a malicious user to set up the user data in order to control the output pattern such that normal operation is disturbed. The **descrambling** process recovers the original digital data from the scrambled bitstream.

The scrambling can be achieved by methods such as scrambling with the output of a pseudo-random generator (PRG) or by using a self synchronous scrambler.

NOTE: The scrambling/descrambling process would be adaptation processes. The (historical) definition of signals in existing standards causes a violation of this process allocation, hence the scrambling/descrambling processes are often located in the Trail Termination functions. Refer to the individual atomic functions for details.

5.2.3.2 Encoding/decoding

The **encoding/decoding** process adapts a digital data stream to the characteristics of the physical medium over which it is meant to be transported. The **decoding** process recovers the original digital data from the medium specific form in which it is received.

Failures in the decoding process results in the detection of an decoding anomaly.

NOTE: The encoding/decoding process would be adaptation processes. The combination of encoding/decoding and simple form of error detection that exists in some encoding schemes (i.e. 8B10B encoding) causing a violation of this process allocation, hence such encoding/decoding schemes may be located in the Trail Termination functions. Refer to the individual atomic functions for details.

5.2.3.3 Frequency justification

The **frequency justification** process accepts an input information at a certain frequency and outputs that same information either at the same or at a different frequency. In the source direction, in order to accommodate any frequency (and/or phase) differences between input and output signals, this process may write data into a specific "justification" bit/byte in the outgoing frame structure when the elastic store (buffer) is going to overflow. It will skip data writing when the elastic store is going to underflow. Examples are the S4/_BP_A_So and AP0/S4_A_So functions.

The frequency justification process is also known as Time Base Correction (TBC) and resampling. The common aspect is that the bitrate (can be sampling rate for sample oriented channels where) of the signal is changed while attempting to have a minimized effect of the contained information. Strategies includes overprovisioning of bitrate with controlled adjustment and signal resampling. Other mechanisms to achieve frequency justification may be necessary to use in order to achieve best possible quality on the signal being transmitted.

The justification events (if event oriented justification is operated) may result in a justification event anomaly. The rate of justification event anomalies may be used to judge the signal quality degradation of the justified signal.

The limits for which the justification is operated safely within may be monitored and operational conditions outside of these limits may result in justification error anomalies. The justification error anomalies thus represent signal quality failure of the justified signal.

NOTE 1: The commonly used terms mapping and demapping are covered by bit-rate adaptation and frequency justification processes.

For asynchronous traffic is frequency justification needed to indicate the lack of user data. This is by definition a continuous negative justification from the maximum rate of the channel.

NOTE 2: Lack of user data shall only be interpreted in the form of proper operation but user have not supplied data to be transported. It shall not be confused with improper operations of network equipment in which case the Alarm Indication Signal (AIS) shall be transmitted onto the channel in order for proper indication.

5.2.3.4 Alignment

The **alignment** process locates the first bit/byte of the framed signal (Frame Start (FS)) by means of a search for the Frame Alignment Signal (FAS) or the interpretation of the Pointer (PTR).

If the FAS can not be found or the PTR is corrupted an alignment anomaly is detected. The existence of anomalies for a specific period, an alignment defect is detected (LOF, LOP). The alignment defect may be the result of the reception of the Alarm Indication Signal (AIS). If so, the AIS defect is detected also. The defects are reported to the fault management layer/process.

NOTE: The insertion of a frame alignment signal would be an A_So process. The (historical) definition of the many signals in existing standards causes a violation of this process allocation, hence the frame alignment insertion process is often located in the TT_So function. Refer to the individual atomic functions for details.

5.2.3.5 Timing recovery

The **timing recovery** process extracts a clock signal, the "recovered clock", from the incoming data signal. The timing recovery process is performed in the adaptation sink function in the physical section layer; e.g. in M1/PL1_A_Sk.

5.2.3.6 Jitter attenuation and smoothing

The **jitter attenuation and smoothing** process filters reduces the jitter and wander of a signal. The phase step of "gapped input signals" may be smoothed in order to reduce peak phase deviations. The smoothing may be aided by justification information for improved properties. The smoothing process is performed in the adaptation sink functions.

In order to handle the dynamic relative timing properties between the input and output of the jitter attenuation/smoothing process, an elastic store is operated. Data is inserted to the elastic store in the receiver clock and extracted in the jitter attenuated clock. When the input signal conditions is outside of the design limits may the elastic store be either underflowed (i.e. there is no data when the extraction clock requests data) or overflowed (i.e. there is no spare position in the elastic store for data to be inserted into) a jitter attenuation/smoothing error anomaly is detected. When the anomaly is detected, loss of data is concluded, and accumulation into a defect may be done.

5.2.3.7 Bitrate adaptation

The **bitrate adaptation** process accepts input information at a certain bit rate and outputs that same information at a different bit rate. In the source direction, this process creates gaps in which other adaptation functions can add their signals. An example is the PL1/BP_A_So function; the bypass layer TDM frame input to this function is output at a higher bit rate, allowing for the inter-frame gap. The created gaps will be filled with the FILL encoding and SOF [ES803-3].

5.2.3.8 Multiplexing/demultiplexing

The **multiplexing/demultiplexing** process is modelled by means of multiple adaptation functions, connected to one AP (clause 5.3). The information applied by the connected adaptation source functions ends up in pre-allocated time slots of the resulting time division multiplexed signal. Adaptation sink functions extract their associated adapted information from the common access point. Adaptation source/sink functions receive the necessary information allowing determination of correct write/read timing.

5.2.3.9 Time slot/frequency/wavelength/code assignment/access

The **time slot/frequency/wavelength assignment/access** process assigns the adapted client layer information to specific time slots/wavelength of the server layer. Time slots are used in Time Division Multiplexing (TDM) systems. Frequency are used in Frequency Division Multiplexing (FDM) systems. Wavelength are used in Wavelength Division Multiplexing (WDM) systems. Code is used in Code Division Multiplexing (CDM) systems. The specific time slot/frequency/wavelength/code is normally fixed for the adaptation function and indicated by an index numbering.

NOTE: Variable connection of client signals to different time slots/wavelengths can be provided by the client layer connection function.

5.2.3.10 Selection process

For the case multiple adaptation functions are connected to the same AP and accessing the same timeslots (bits/bytes), a **selection** process controls the actual access to the AP. In the atomic functions this is modelled via the activation/deactivation signal (MI_active).

For the case only one adaptation function is present, it is selected. Control is not required; MI_active is always true.

5.2.3.11 Payload composition

Many layers are able to transport a variety of client signals applied to the layer via different adaptation functions. To monitor the provisioning process the source adaptation inserts the appropriate code in the Trail Signal Label (TSL). The sink adaptation will check the **composition of the payload** comparing the received TSL number with its own one.

5.3 Reference points

Reference points between atomic functions are called Connection Points (CPs), Access Points (APs), Timing Points (TPs) and Management Points (MPs) (see figure 3). A subset of the connection points are the Termination Connection Points (TCPs).

NOTE: ITU-T Recommendation M.3010 [M3010] defines reference points and interfaces as follows:

Reference points: reference points define service boundaries between management function blocks. The purpose of reference points is to identify the information passing between function blocks.

Interfaces: TMN standard interfaces are defined corresponding to the reference points. They are applied at these reference points when external physical connections to them are required.

The information passing a CP is called Characteristic Information (CI), the information passing an AP is called Adapted Information (AI), the information passing a MP is called Management Information (MI), and the information passing a TP is called Timing Information (TI). The CI, AI, TI, and MI is represented by a number of signals. See clause 5.6.4.

5.4 Transmission sub-layers

A transmission (transport) layer may be decomposed into sub-layers to support administrative domains or protection within the layer:

- trail protection is modelled by expansion of the trail termination function adding the protection adaptation function, the protection connection function and the protection trail termination function;
- tandem connection monitoring is modelled by the expansion of the (termination) connection point.

5.5 Transport, Control and Management planes

The DTM system can be divided into three distinct parts. The system contains a transmission part, a control part and a management part. Each such part is held within one of three planes.

5.5.1 Transport plane

The transport plane is the part of the system where the transmission of end-to-end and internode information is performed and supervised. All forms of processes relating to the transmission processing and supervision, including switching is included.

5.5.2 Control plane

The control plane is the part of the system where the automatic control of the system is performed. This includes both local and remote automatic maintenance functions including signalling protocols. The control plane interacts with the transport plane such that it retrieves supervision information from the transport plane, it controls the detailed configuration of the transmission planes, including the switch functionality (as found in the connection function and in the form of adaptation function configuration) and also for the transport of information between automatic maintenance functions (such as signalling protocols) in different DTM nodes.

5.5.3 Management plane

The management plane is the part of the system where the manual control, configuration and provisioning is handled, performance logs and performance evaluations as well as commercial management such as accounting and billing. The management plane does not include automatic maintenance of the system, but it includes the static configuration and manual interaction with the automatic maintenance found in the control plane. The management plane does have its own set of protocols, in order to support its set functions.

5.6 Naming conventions

5.6.1 Technology naming scheme

The interaction between different technologies and their respective formal modelling require means to separate modelling layer naming between different technology systems when describing such interactions. A technology prefix may then be used under the situations where such technology interactions is described, but it may be leaved out during the description of a single technology. The technology prefix is specified in table 1.

Table 1: Technology prefix definitions

Prefix	Technology	Reference
ASI	Asynchronous Serial Interface	EN 50083-9 [EN50083-9]
DTM	Dynamic synchronous Transmission Mode	ES 201 803-1 [ES803-1]
ETH	Ethernet	[IEEE802.3]
IP	Internet Protocol	[RFC791]
PDH	Plesiochronous Digital Hierarchy	
SDH	Synchronous Digital Hierarchy	[G803]
SDI	Serial Digital Interface	[BT656]

5.6.2 Layer naming scheme

In order to identify the different layers within a transmission system, a naming scheme for layers is defined. For DTM is the layer names defined as found in table 2.

Table 2: DTM Layer name definitions

Name	Layer
Mn	Media Layer n
PLn	Physical Link Layer n
BP	Bypass Layer
TS	Time Slot Layer
CHn	Channel Layer n

For the Media and Physical Link and Bypass layers the variable n denote which specific layer form according to the definitions in table 3.

Table 3: DTM Media and Physical Link Layer numbering definitions

n	Physical Interface form	Reference
1	Physical Interface using 8B10B encoding	[ES803-3]
2	Physical Interface using SDH VC4	[ES803-4]

For the Channel layer, the variable n denote whether the slot data is synchronous or asynchronous to the frame synchronization/timing signal. The value of n is defined in table 4.

Table 4: DTM Bypass Layer numbering definitions

n	Channel synchronization form
1	Channel synchronous relative frame timing
2	Channel asynchronous relative frame timing

5.6.3 Atomic function naming scheme

The naming of adaptation, trail termination and connection **functions** follow the following rules:

Adaptation function	**[<technology>_]<layer>/<client layer>_A[_<direction>];**
Trail Termination function	**[<technology>_]<layer>_TT[_<direction>];**
Connection function	**[<technology>_]<layer>_C,**

Examples are: MS1/S4_A, S12/P12s_A_So, P4e_TT, RS16_TT_Sk, S3_C.

5.6.4 Information naming scheme

The coding of the **CI** and Adapted Information (**AI**) in the model follows the following rules:

[<technology>_]<layer>[/<client layer>] _<information type>[_<direction>] _<signal type>[/<number>].

[...]	optional term
<layer>	represents one of the layer names (e.g. TS)
<client layer>	represents one of the client layer names (e.g. CH1 is a client of TS)
<information type>	CI or AI
<direction>	So (Source) or Sk (Sink)
<signal type>	CK (clock), or D (data), or FS (Frame Start), or SSF (Server Signal Fail), or TSF (Trail Signal Fail) SSD (Server Signal Degrade) TSD (Trail Signal Degrade)
<number>	see below

AI and CI coding examples are: TS_CI_D, BP_AI_CK, AP0/S4_AI_D.

NOTE: Additional signal types may be used.

The coding of the **MI** signals is for further study. As a working solution the following rule is followed:

<atomic function>_MI_<MI signal type>.

The coding of the **TI** signals is for further study. As a working solution the following rule is followed:

[<technology>_]<layer>_TI_<TI signal type: CK or FS>.

NOTE: Adaptation source functions (functionally) perform the adaptation of a signal from one clock domain to another and/or from one frame phase domain to another. XX_TI_CK and XX_TI_FS represent those other clock and frame start signals. For example MS1_TI_FS, S12_TI_CK.

The coding of the RI signals follows the following rule:

[<technology>_]<layer>_RI_<RI signal type>.

5.6.5 Reference points numbering scheme

The Access Point (AP) number is used to uniquely identify an AP.

The Termination Connection Point (TCP) number is the AP number associated with the trail termination function.

The Connection Point (CP) number is the AP number associated with the connected adaptation function, extended with the multiplex number, e.g. the AU or TU number.

5.6.6 Supervision variables numbering scheme

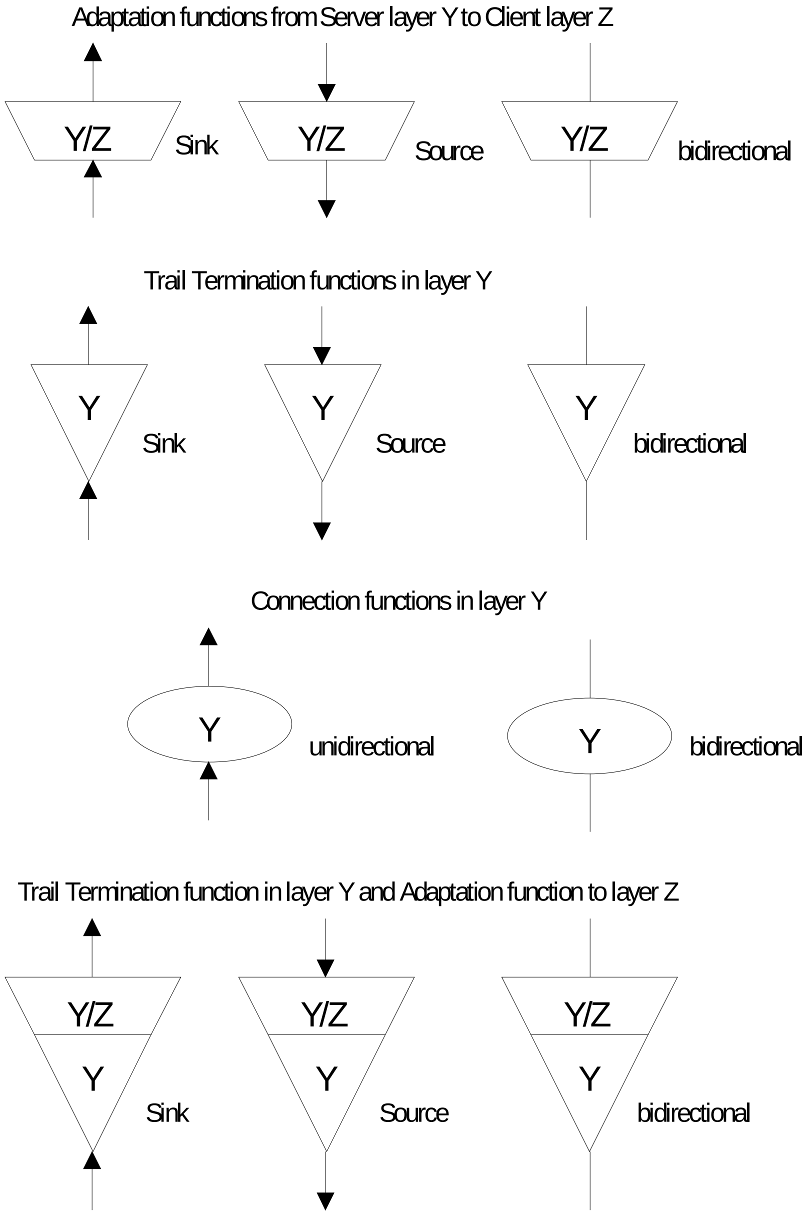
The supervision variables "yZZZ" are defined as:

y	defect:	y = d
	fault cause (i.e. correlated defect):	y = c
	failure:	y = f
	consequent action request:	y = a
	performance parameter:	y = p
	anomaly:	y = n
	signal:	y = s
ZZZ	kind of defect, fault cause, failure, consequent action, performance parameter or command	

dZZZ, cZZZ, and fZZZ represent Boolean variables with states TRUE or FALSE. pZZZ represents an integer variable. aZZZ, except aREI, represent a Boolean variable; aREI represents an integer variable.

5.7 Symbols and diagrammatic conventions

The diagrammatic conventions and nomenclature used in the present document for adaptation, termination and connection functions (used to describe the atomic functions) are shown in figure 4. As an example of the use of this nomenclature, figure 5 shows an example of an unidirectional VC-4 path in an DTM network [ES803-6] using a DTM over SDH VC-4 transport [ES803-4].



NOTE: If the above symbols are used for generic figures, i.e. not for specific layers, the layer references Y and Z may be omitted. Alternatively, the references may be to the type of function or layer, e.g. supervision, protection.

Figure 4: Symbols and diagrammatic conventions

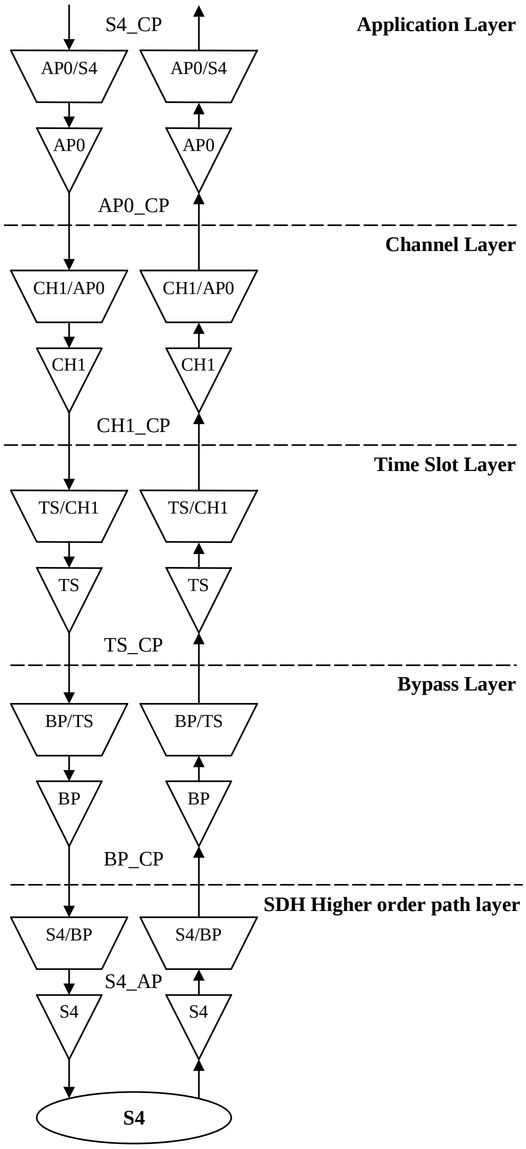


Figure 5: Example of a VC-4 path in an DTM network using SDH transport

5.8 Model overview

DTM is layered into 6 layers, the Media layer (M), the Physical Link layer (PL), the Bypass layer (BP), the Time Slot layer (TS), the Channel layer (CH) and the Application layer (AP). See figure 6 for an overview.

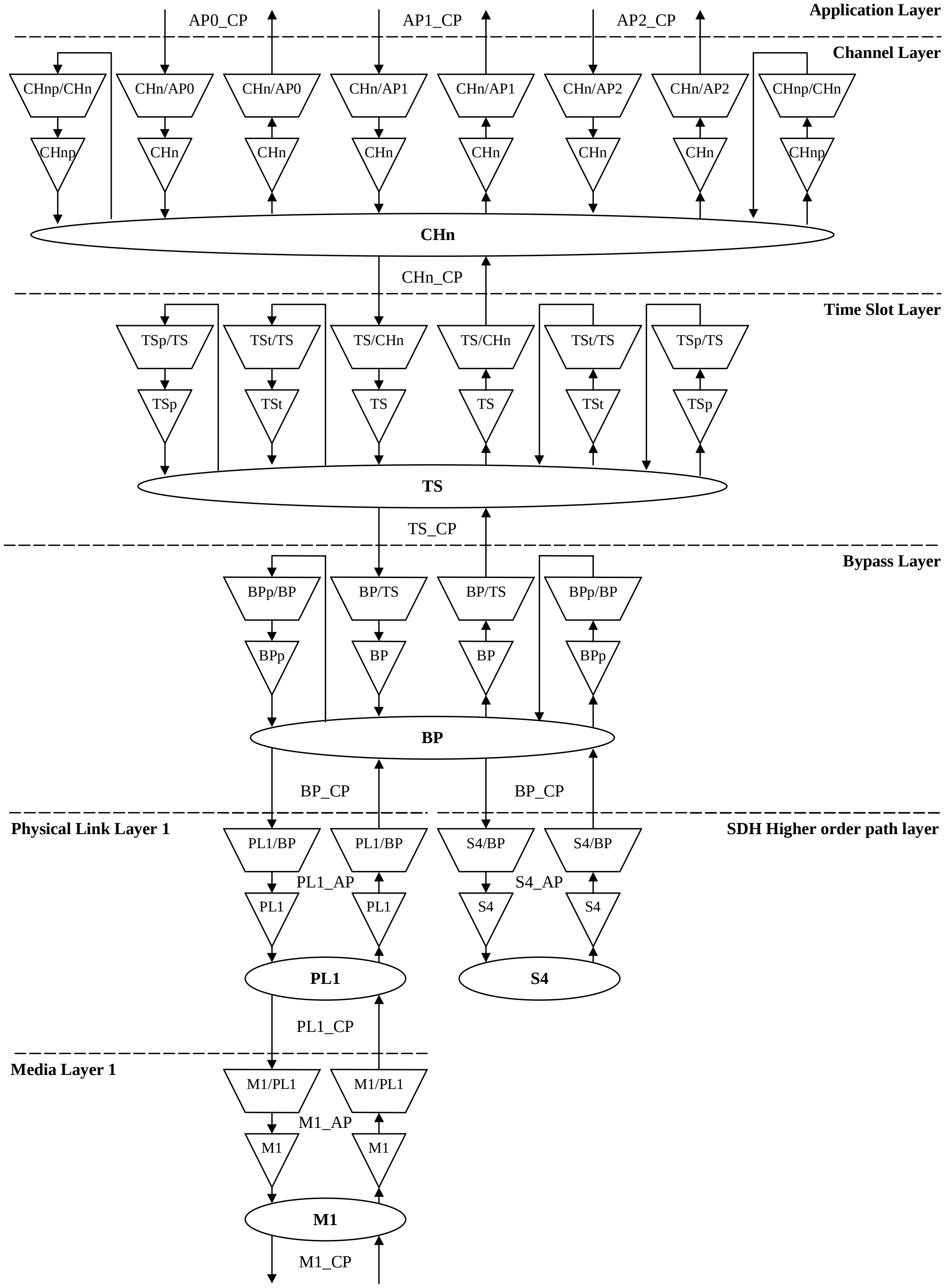


Figure 6: Transport Network Reference model

5.8.1 Media layer

The Media layer (M) constitutes the physical media and related supervision and adaptations particular to that media. A media could be a fibre link of 1.25 GBd [ES803-3].

5.8.2 Physical Link layer

The Physical Link layer (PL) constitutes the physical link between two nodes over a media and the related supervision and adaptations (i.e. line code) for that link. A physical link provides a unidirectional connectivity between two nodes. A physical link could be of the capacity 1 Gb/s [ES803-3].

5.8.3 Bypass layer

The Bypass layer (BP) constitutes the lowest form of space switching in which individual slots may be dropped, added or switched. A bypass switching may occur between one incoming and one outgoing physical link grouped together as a port [ES803-1] [ES803-2-1]. Slots may be both dropped and switched in order to provide for multicast (point-to-multipoint) connections.

Within the bypass layer is the full DTM TDM frame structure used, and the adaptation functions will adapt the channels individual TDM frames to that of the bypass layer TDM structure, my providing slot-to-slot mappings.

The bypass layer optionally provides protection switching over physical links, such that a 1 + 1 protection of the underlying physical links is achieved for the full TDM frames.

5.8.4 Time Slot layer

The Time Slot layer (TS) constitutes the synchronous channel space switching in which individual channels may be dropped, added or switched. Channels may be both dropped and switched, and the space switching may also provide direct point-to-multipoint switching and thus providing the full multicast (point-to-multipoint) connectivity.

A channel space switching will provide space switching of the channels TDM frame which is synchronous to the DTM frame synchronization. Each channel has an individually sized TDM frame depending on the capacity in the form of the number of slots allocated to the channel. The adaptation of the channels TDM frame from the channel layer depend on whether DTM frame synchronous or asynchronous channel layer type is used.

The time slot layer optionally provides protection switching over time slot TDM frames, such that a 1+1 protection of the time slot TDM frames is achieved for the channel.

The time slot layer optionally provides tunnel switching over time slot TDM frames, such that a multiple of time slot channels is mapped over a single time slot channel (being the tunnel channel).

5.8.5 Channel layer

The Channel layer (CH) constitutes the synchronous or asynchronous (in relation to the DTM frame synchronization in the node and network) channel space switching in which individual channels may be dropped, added or switched. Channels may be both dropped and switched, and the space switching may also provide direct point-to-multipoint switching and thus providing the full multicast (point-to-multipoint) connectivity.

A channel space switching will provide space switching of the channels TDM frame which is either synchronous or asynchron to the DTM frame synchronization. Each channel has an individual sized TDM frame depending on the capacity in the form of the number of slots allocated to the channel. The adaptation of the channels TDM frame from the application layer provide three different adaptation forms for isochronous (bitstreams and packets) and asynchronous (packet) traffic. These adaptations is called DTM Channel Adaptation Protocols (DCAP) and there exist three types of DCAPs (see clause 12).

The channel layer optionally provides protection switching over channel TDM frames, such that a 1 + 1 protection of the channel TDM frames is achieved for the channel.

NOTE: The channel protection may be used as a end-to-end protection.

5.8.6 Application layer

The Application layer (AP) constitutes the application specific adaptations to the DTM system. Three different application types exist in order to provide the basic adaptations to the channels from the channel layer.

The optional space switching may be used by applications to make application specific switching, static or dynamic.

NOTE: The space switch may operate by DCAP-1 data such as CMI number and/or the priority field.

5.9 Model description

The description of the full model is found in clause 6. The description includes all processes of the transmission model. The main division of processes are (in order of appearance):

- processes and anomalies;
- defect filter;
- consequent action filter;
- defect correlation/Fault cause;
- one second performance monitoring filter;
- atomic function output mapping;
- fault management;
- performance monitoring process.

Within each category of processes is different aspects handled. These aspects form the second level of subdivision. These aspects are (in order of appearance):

- signal conditioning;
- continuity supervision;
- connectivity supervision;
- scrambling processes;
- encoding/decoding processes;
- signal quality supervision;
- alignment processes;
- multiplexing/demultiplexing;
- time slot/frequency/wavelength/code assignment/access processes;
- bitrate adaptation processes;
- frequency justification processes;
- timing recovery processes;
- jitter attenuation and smoothing processes;
- payload type identification processes;
- payload composition processes;

- maintenance signal supervision;
- administrative modes.

Each aspect shall have a small written description of what is generally handled within that aspect at the first place of appearance.

Each aspect will then contain one or more instances of a process type/signal generation. Each such have their own clause within the aspect.

Each process type/signal generation description will contain a textual description of the goal of the process type/signal generation. It will then have a clause named "model" containing the template text for the formal model relating to the formal model description of the process type/signal generation. The formal model description shall always be prefixed with a line having the category in bold text.

For process types the text will have the form of:

<process type > ([TT_So, TT_Sk, A_So, A_Sk]): <textual description>. See clause <clause of process type description>.

For signal names the text will have the form of:

<signal name> ([TT_So, TT_Sk, A_So, A_Sk]): When <textual condition> then will the <long signal name> (<signal name>) be asserted. See clause <clause of signal name description>.

<signal name> ← <logical condition>

The textual condition and logical condition shall be logically equivalent and equally ordered for the sake of clarity.

5.10 Formal model

The formal model is divided into several clauses, one clause for each layer.

Each clause shall have the full name of the layer it describes.

It shall first have a textual overview of what functionality is contained in the layer and how it interfaces with other layers.

It shall have a figure containing all the atomic functions that exist in the layer.

The Characteristic Information (CI) of the Connection Point (CP) in the layer shall be detailed.

The Adapted Information (AI) of the Adaptation Point (AP) in the layer shall be detailed.

The Management Information (MI) of the Management Point (MP) in the layer shall be detailed.

The Timing Information (TI) of the Timing Point (TP) in the layer shall be detailed.

Clauses for the atomic functions shall be given in this order:

- connection function;
- trail termination function;
- adaptation function.

For each atomic function clause shall there be clauses for each atomic function pair. For each such pair shall there be a clauses for each of the directions of the atomic function type.

Each detailed atomic function clause shall have (in order):

- symbol for the atomic function (labelled "Symbol" in bold);
- signal table for all interface signals of the atomic function (labelled "Interfaces" in bold), the table shall have two columns: inputs and outputs;

- the contained processes and detected anomalies (labelled "Processes and anomalies" in bold);
- the contained defect filters (labelled "Defects" in bold);
- the contained consequent actions (labelled "Consequent actions" in bold);
- the contained defect correlation and fault cause (labelled "Defect correlation" in bold);
- the contained one second performance monitoring filter (labelled "Performance monitoring" in bold);
- the contained atomic function output mapping (labelled "Output mapping" in bold);
- the contained fault management (labelled "Fault management" in bold);
- the contained performance monitoring process (labelled "Long term performance monitoring" in bold).

The text contained in the respective category of process type/signal name shall be that from the model description, but with the atomic function designation removed.

6 Processes and Supervision

The supervision process philosophy is based on the concepts underlying the functional model of DTM [ES803-1] and the information model of [ES803-14] which distinguishes between Transmission and Equipment supervision processing.

Transmission and equipment supervision processes are concerned with the management of the transmission resources in the network and is only interested in the functionality which is being provided by a Network Element (NE). It requires a functional representation of an NE that is implementation independent. Any equipment faults are represented by the unavailability of the affected functions because the transmission management has no knowledge of the equipment as such. Most functions monitor the signals they are processing for certain characteristics and provide performance information or alarm conditions based on these characteristics. Therefore, transmission supervision processing provides information on the external interface signals that are processed by an NE.

Equipment supervision processing is concerned with the fault localization and repair of the equipment itself. Its purpose is to answer the classic questions: "who to send where to repair what?" It does not require a knowledge of the transmission network, other than that the equipment faults may have been categorized to indicate the urgency (e.g. prompt, deferred, mei (maintenance event information)) of the fault.

NOTE: Refer to ITU-T Recommendation M.20 [M20].

The basic functions of the supervision process and their inter-relationships are depicted in figure 7. Figure 8 illustrates three major process groups. Supervision terms used throughout the present document are defined in clauses 3.1.

The supervision process describes the way in which the actual occurrence of a disturbance or fault is analysed with the purpose of providing an appropriate indication of performance and/or detected fault condition to maintenance personnel.

The minimally observed deviation from ideal behaviour (i.e. the observation of a flaw) detected as an *anomaly*. In order to reduce information (based on statistical assumptions) one or more anomalies are accumulated and qualified such that severe deviations in observed quality of service can be found, and then a *defect* is detected.

As a result of a detected defect certain actions may be taken in order to handle the defect. Such action may be informative (i.e. tell other parts of the system about the defect) as well as active (i.e. protection switching, Alarm Indication Signal insertion etc.) and thus these actions is referred to as *consequent actions*.

To enable the management system to isolate the cause of a fault, a *defect correlation* is performed in order to remove the cases where one defect where a consequence of another defect. The result of the defect correlation is the *fault cause*. If reduction of the ability to perform the functionality have been ruled out from being temporary, i.e. the failure is persistent, a persistent *failure* (the detection of a *fault*) is detected. A detected failure may result in an *alarm* in order to draw human attention to the failure.

Statistics of defects is collected in *performance monitoring* and treated in order to reduce information while still capture different long term defect frequency patterns.

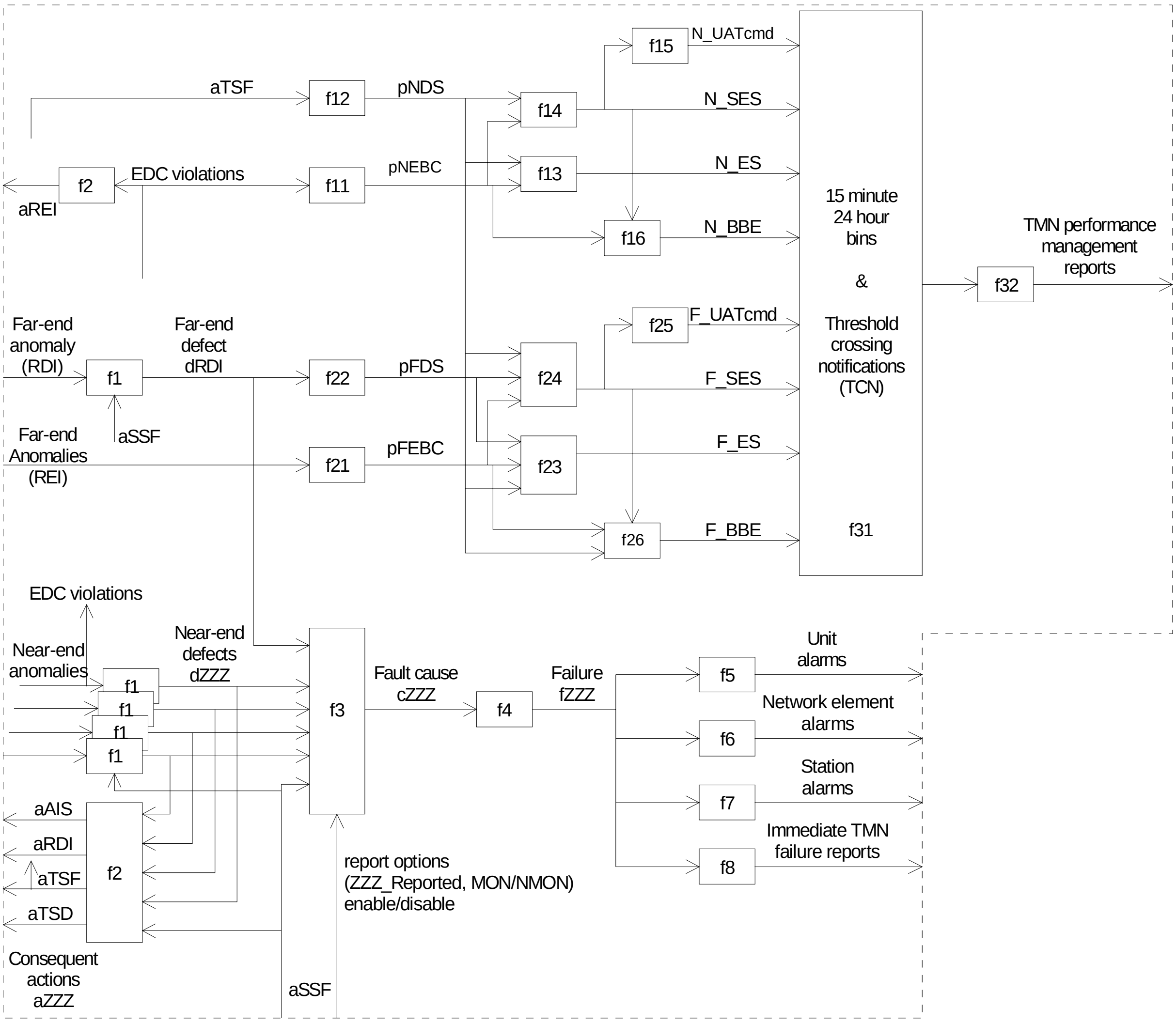


Figure 7: Fault management and performance monitoring decomposition

The supervision process is decomposed into three major sub-processes; atomic function fault management and performance monitoring, Equipment Management Function (EMF) fault management and EMF performance monitoring (figure 8). These sub-processes are described in clauses 6.1 to 6.8.

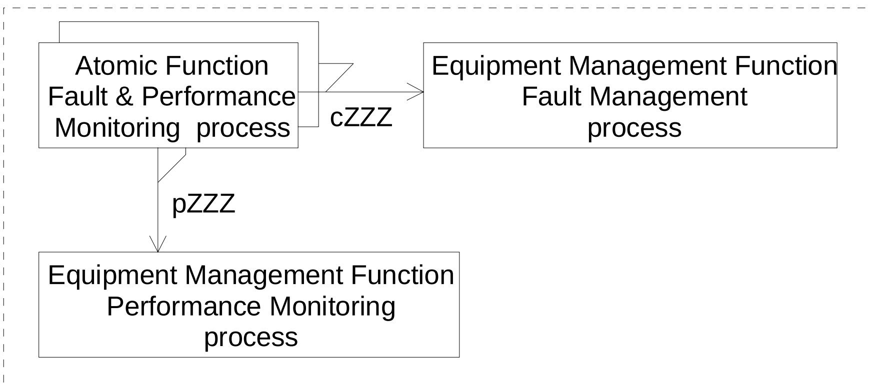


Figure 8: Decomposition of supervision process

Figure 9 shows the main supervision process related (sub)processes within trail termination and adaptation functions. These processes are referred to as "filters" (see table 5) and are introduced in this clause.

Table 5: Filter types

Filter	Function
f1	integration of anomalies into defects
f2	consequent action control
f3	correlation of defects; result is fault cause (correlated defect)
f11	Near-end errored block counting
f12	Near-end defect second determination process

Filters f1 (see clause 6.2), f2 (see clause 6.3), and f3 (see clause 6.4) are components of the fault management process located within the atomic functions. Filters f11 and f12 (see clause 6.5) are components of the performance monitoring process located within the atomic function. The output signals cZZZ (e.g. cTIM) are the input signals for the EMF fault management process (clause 6.6), while the output signals pZZZ (e.g. pN_EBC) are the input signals for the EMF performance monitoring process (see clause 6.8).

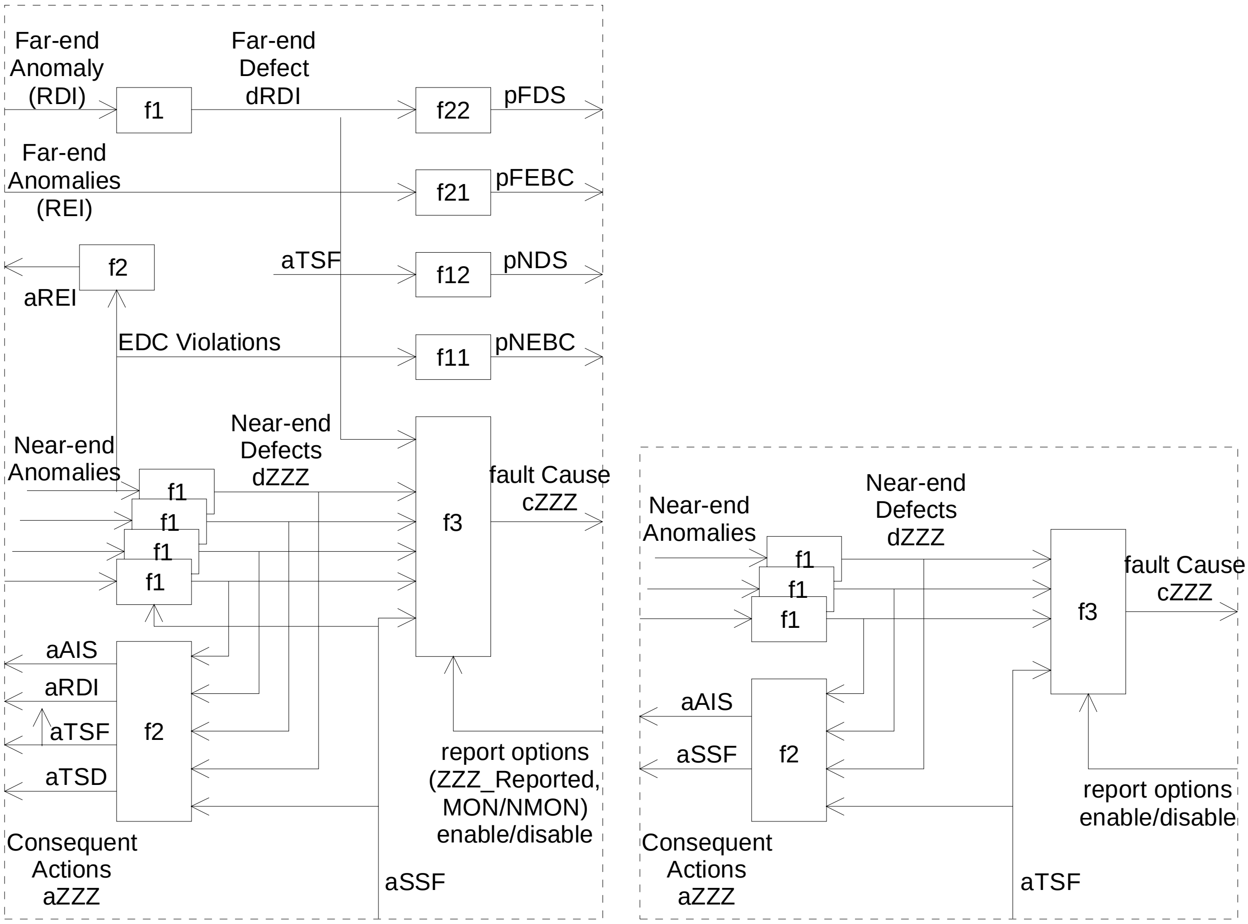


Figure 9: Fault management and performance monitoring inside trail termination (left) and adaptation (right) functions

The equipment management function (see figure 10) provides the means through which a network element level manager manages the network element function.

The EMF interacts with the transport and synchronization layer atomic functions by exchanging Management Information (MI) across the Management Point (MP) reference points. The EMF contains a number of functions that provide a data reduction mechanism on the information received across the MP reference points. These function outputs are available to the agent via the network element resources and management application functions (MAF) which represent this information as managed objects.

Network element resources provide event processing and storage. The MAF process the information provided to and by the NE resources.

NOTE: The management application function specification is outside the scope of the present document.

Network elements may support several functions, which can be operated only in exclusivity of each other. Besides such configuration provisionings, provisionings are needed for parameters in individual functions and processes within a NE.

A number of functions/processes and reports have a notion of time. The network element Real Time Clock function (see clause 6.7) provides this time information.

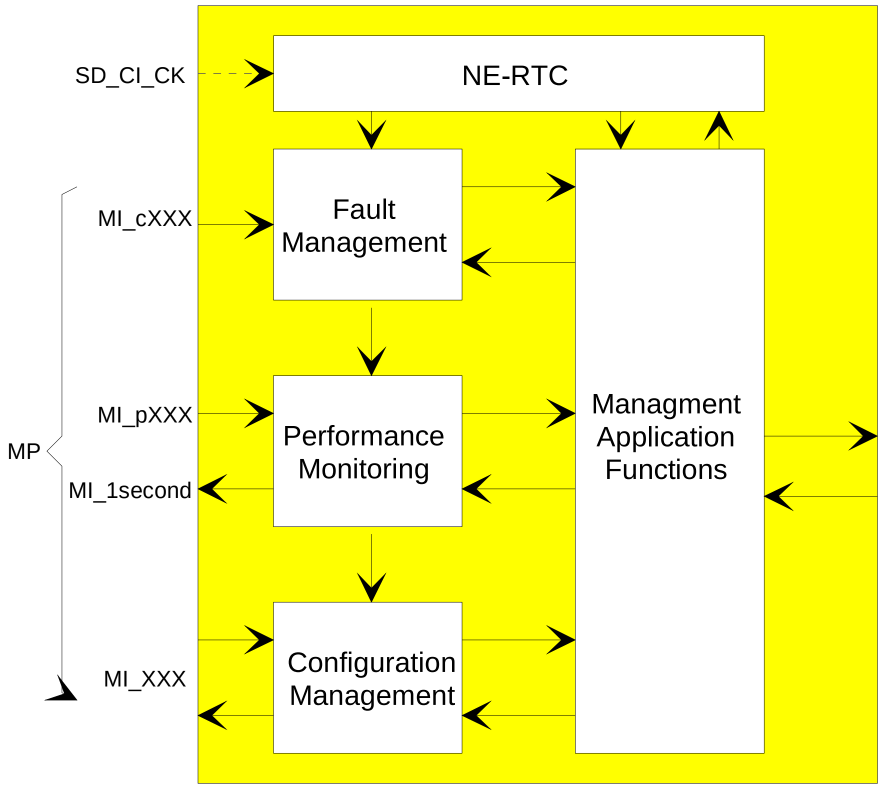


Figure 10: Equipment Management Function process block diagram

The management information at management point is a set of management signals to/from the atomic functions, including configuration and operation control, fault management, performance monitoring, protection switching, synchronization control and reporting signals.

6.1 Processes and anomalies

The detection of anomalies is described in conjunction with the related processes which may flaw (i.e. state machines) or provide the supervision processing.

6.1.1 Signal Conditioning processes

Signal conditioning adapt the signal between different signal forms including optical, analog and digital electric signals. Adaptation includes gain, Automatic Gain Control (AGC), quantization, slow rate limit, emphasis and dispersion compensation.

6.1.1.1 8B10B Optical conditioning

Performs the optical conditioning of 8B10B encoded DTM physical interfaces [ES803-3].

6.1.1.1.1 Model

Processes and anomalies

(TT_So): The signal conditioning of the M1_AP_D for transmission over the optical medium at M1_CI_D according to [ES803-3] clause 7. See clause 6.1.1.1.

(TT_Sk): The signal conditioning of the optical signal at M1_CI_D and conversion into the digital format of M1_AP_D. The signal conditioning includes an Automatic Gain Control (AGC) loop which monitors the average signal level of the received optical signal at M1_CI_D. See [ES803-3] clause 7. See clause 6.1.1.1.

6.1.1.1.2 Use

(TT_So): Clause 7.3.1.1 (M1_TT_So).

(TT_Sk): Clause 7.3.1.2 (M1_TT_Sk).

6.1.2 Continuity supervision

Continuity supervision monitors the integrity of the continuity of a trail. This is done by monitoring the presence/absence of the Characteristic Information (CI).

The only dedicated continuity supervision in DTM is the Loss of Signal anomaly (nLOS). In addition is the Alarm Indication Signal defect (dAIS) an aggregated defect providing similar continuity supervision as dLOS.

6.1.2.1 Loss of Signal anomaly (nLOS)

The Loss Of Signal (LOS) supervision is performed at the physical layer trail termination sink by monitoring the power level of the incoming signal.

When the detected average power level goes below the LOS threshold power level for more than the specified time, the Loss Of Signal anomaly is asserted, and similarly when the average power level goes above the LOS threshold power level for more than the specified time, the Loss Of Signal anomaly is deasserted.

6.1.2.1.1 Model

Processes and anomalies

nLOS (TT_Sk): The average signal level is being monitored (by the signal conditioning Automatic Gain Control loop). The Loss Of Signal anomaly (nLOS) is asserted when the monitored signal level is below the LOS threshold level. See clause 6.1.2.1.

NOTE: The reaction time for a complete loss of signal is due to the AGC loop reaction time.

6.1.2.1.2 Use

nLOS (TT_Sk): Clause 7.3.1.2 (M1_TT_Sk).

6.1.2.1.3 Cross reference

nLOS: Used in clause 6.2.1.1 (dLOS).

6.1.3 Connectivity supervision

Connectivity supervision monitors the integrity of the trail between sink and source. The connectivity is supervised by attaching a unique identifier at the source. If the received identifier does not match the expected identifier a connectivity defect has occurred.

Within DTM the connectivity supervision is used to supervise the underlying connectivity as supplied through SDH, DWDM and cables. No inband connectivity supervision is defined for the channels within DTM, a task assigned to signalling protocols of channel management. The underlying connectivity supervision is performed by the topology management protocols. Thus, no inband connectivity supervision is explicitly defined for the transmission plane.

6.1.4 Signal Quality supervision

Signal quality supervision monitors the performance of a trail. If the performance falls below a certain threshold this might activate a defect.

For DTM channel supervision there exists three different methods depending on the channel adaptation being used. Common to them is that the supervision is end-to-end such that the signal quality supervision payload is generated in the source and is monitored in the sink of the channel. Non-intrusive monitoring can be performed by multicast-split the traffic into a monitoring sink.

6.1.4.1 Error Detection Code

Bit errors in a signal are detectable by checking the signal's associated Error Detection Check (EDC) for violations. Examples of EDCs are the DCAP-1 CRC-32 and DCAP-2 BIP-16.

For the 8B10B based physical interface will the code group and ordered set anomaly detection be used for signal quality supervision. For further details see [ES803-3].

The computed EDC shall be compared with the received EDC value in the following frame. If these values differ an Near-end Errored Block anomaly (nN_EB) shall be detected.

As the detection of AIS results in the declaration of a Severely Errored Second (SES), the Error Detection Code Violation (EDCV) process shall assume "zero" EDCVs in the incoming Alarm Indication Signal (AIS) during an incoming Server Signal Fail (CI_SSF) condition or detection of dAIS (see note).

NOTE: When the server layer does not activate CI_SSF on reception of AIS in the client signal, the termination sink functions (including non-intrusive monitor) need to use the local detection of dAIS to represent the SSF condition.

6.1.4.1.1 Model

Processes and anomalies

Generic:

(TT_So): The generation of a CRC-32 checksum signal (sCRC32) of the data slot words of CI_D/AI_D. See clause 6.1.4.1 and 12.

nN_EB (TT_Sk): The Near-end Errored Block anomaly (nN_EB) is asserted when the CRC-32 checksum of the data slot words of CI_D/AI_D does not match the CRC-32 checksum signal (sCRC32) as the encoded checksum . See clause 6.1.4.1 and 12.

DCAP-1:

sCRC32 (A_So/A_Sk): The generation of a CRC-32 checksum signal (sCRC32) of the data slot words of AI_D. See clause 6.1.4.1 and 12.2.

sDCAP1s (A_So): The generation of a DCAP-1 slot word checksum (sDCAP1s) of the AI_D according to clause 12.2. See clause 6.1.4.1.

nN_EB (A_Sk): The Near-end Errored Block anomaly (nN_EB) is asserted when the DCAP-1 slot word checksum of the AI_D according to clause 12.2 does not match the DCAP-1 slow word checksum signal (sDCAP1s) for either the DCAP-1 header or trailer, or when the CRC-32 checksum of the data slot words of CI_D/AI_D does not match the CRC-32 checksum signal (sCRC32) as the encoded checksum. See clause 6.1.4.1 and 12.2.

DCAP-2:

sBIP16 (A_So/A_Sk): The generation of a BIP-16 checksum signal (sBIP16) of the data slot words of AI_D. See clause 6.1.4.1 and 12.3.

nN_EB (A_Sk): The Near-end Errored Block anomaly (nN_EB) is asserted when the BIP-16 checksum of the data slot words of AI_D does not match the BIP-16 checksum signal (sBIP16) as the encoded checksum . See clause 6.1.4.1 and 12.

DTM 8B10B:

nCGF (TT_Sk): The Code Group Fail anomaly (nCGF) is asserted when the received 10 bit code group form of PL1_CI_D does not form a legal DTM 8B10B code group according to [ES803-3] clause 9.4.4. See clause 6.1.4.1.

nOSF (A_Sk): The Ordered Set Fail anomaly (nOSF) is asserted when the slot code groups form an invalid combination according to clause 9.5.2. See clause 6.1.4.1.

6.1.4.1.2 Use

(TT_So): Clause X (_TT_So).

sCRC32 (A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

sDCAP1s (A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

nN_EB (TT_Sk): Clause X (_TT_Sk).

nN_EB (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

sBIP16 (A_So/A_Sk): Clause 11.4.3.1 (CH1/AP2_A_So) and 11.4.3.2 (CH1/AP2_A_Sk).

nN_EB (A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

nCGF (TT_Sk): Clause 8.3.1.2 (PL1_TT_Sk).

nOSF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.1.4.1.3 Cross reference

nN_EB: Used in clause 6.2.3.1 (dN_EB).

nOSF: Use in clause 6.4.6.4 (cSSF).

6.1.4.2 Degraded Signal Period anomaly (nDSP)

Once every second, pN_EBC shall be compared with DEGTHR. If pN_EBC ≥ DEGTHR the one second shall be declared BAD, otherwise it shall be declared GOOD.

DEGTHR shall be provisioned by the network manager with:

$$0 < DEGTHR \leq N.$$

where N is the number of blocks in one second.

NOTE: For further details, look in clause 6.2.3.2 (dDEG) and clause 6.5.1.1 (pN_EBC).

6.1.4.2.1 Model

Processes and anomalies

nDSP (TT_Sk/A_Sk): The Degrades Signal Period anomaly (nDSP) is asserted when the Near-end Error Block Counter performance (pN_EBC) is above or equal to the Degraded Threshold (DEGTHR), else it shall be deasserted. See clause 6.1.4.2.

6.1.4.2.2 Use

nDSP (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.1.4.2.3 Cross reference

pN_EBC: Defined in clause 6.5.1.1.

nDSP: Used in clause 6.2.3.2 (dDEG).

6.1.5 Maintenance signal supervision process

The maintenance signal supervision processes allow for maintenance signals to be transported within the transmission path. Additional maintenance information may be transported using management protocols.

6.1.5.1 Alarm Indication Signal

The Alarm Indication Signal (AIS) marker replaces the traffic as a maintenance signal in order to indicate an alarm state such that no proper signal is to be expected.

NOTE: It is normally assumed that all slots of a channel or a physical interface is marked with the AIS-marker. Some implementations (of for instance software based AIS insertion) may however only transmit the AIS-marker on a limited set of slots or with some average rate. The rate of AIS-marker transmission must however be sufficient for proper and unambiguous detection of the AIS defect. Implementors are advised to reach for maximum AIS transmission rate.

6.1.5.1.1 Model

Processes and anomalies

AIS (A_So): The Alarm Indication Signal (AIS) insertion into AI_D instead of received signal when the CI_SSF signal is asserted. See clause 6.1.5.1.

AIS (A_Sk): The Alarm Indication Signal (AIS) insertion into CI_D instead of received data when the Alarm Indication Signal defect (dAIS) is asserted. See clause 6.1.5.1.

nAIS (A_Sk): The Alarm Indication Signal anomaly (nAIS) is asserted when a AIS-marker is being detected in the AI_D stream. See clause 6.1.5.1.

6.1.5.1.2 Use

AIS (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

AIS (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk) and 8.4.2.2 (S4/BP_A_Sk). [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

nAIS (A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk).

6.1.5.1.3 Cross reference

nAIS: Used in clause 6.2.6.1 (dAIS).

6.1.6 Scrambling processes

Scrambling is performed for physical media adaptation (as indicated in [G.806, clause 8.1]).

6.1.6.1 SDH VC-4 Self synchronous scrambler

For SDH VC-4 traffic, the SDH scrambler and the Self Synchronous Scrambler ensure that the line coding goals is achieved.

6.1.6.1.1 Model

Processes and anomalies

(A_So): The scrambling of the unscrambled octet stream into the scrambled octet stream using a self-synchronous scrambler with the polynomial $X^{43}+1$ according to [ES803-4] clause 6.1. See clause 6.1.6.1.

(A_Sk): The descrambling of the scrambled octet stream into the unscrambled octet stream using a self-synchronous descrambler with the polynomial $X^{43}+1$ according to [ES803-4] clause 6.1. See clause 6.1.6.1.

6.1.6.1.2 Use

(A_So): Clause 8.4.2.1 (S4/BP_A_So).

(A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.7 Encoding/decoding processes

Line coding and scrambling is performed for physical media adaptation (as indicated in [G.806, clause 8.1]).

6.1.7.1 8B10B encoding/decoding

For 8B10B encoding will the 8B10B line coding achieve the line coding goals.

6.1.7.1.1 Model

Processes and anomalies

(TT_So): The 8B10B encoding of PL1_AI_D into the 10 bit code group form of PL1_CI_D according to [ES803-3] clause 9.5.2. See clause 6.1.7.1.

(TT_Sk): The 8B10B decoding of the 10 bit code group form of PL1_CI_D into the 8+1 bit code group form of PL1_AI_D according to [ES803-3] clause 9.5.2. See clause 6.1.7.1.

6.1.7.1.2 Use

(TT_So): Clause 8.3.1.1 (PL1_TT_So).

(TT_Sk): Clause 8.3.1.2 (PL1_TT_Sk).

6.1.7.2 8B10B slot mapping

The mapping of DTM slots into 8B10B code groups of the 8+1 form.

6.1.7.2.1 Model

Processes and anomalies

(A_So): The encoding of data, special markers (Idle, PS and AIS) as received from BP1_CI_D, Fill generation and frame synchronization signals into slot code groups. See [ES803-3] clause 9.5. See clause 6.1.7.2.

(A_Sk): The decoding of slot code groups into data, special markers (Idle, PS, AIS) as transmitted to BP1_CI_D as well as Fill and Start Of Frame (SOF). See [ES803.3] clause 9.5. See clause 6.1.7.2.

sFS (A_Sk): When a Start Of Frame (SOF) special marker has been detected, the Frame Start signal (sFS) is asserted, else the sFS is deasserted. See [ES803-3] clause 9.5.2. See clause 6.1.7.2.

sFILL (A_Sk): When a Fill special marker has been detected, the Fill signal (sFILL) is asserted, else the sFILL is deasserted. See [ES803-3] clause 9.5. See clause 6.1.7.2.

nFE (A_Sk): The Frame Error anomaly (nFE) is asserted when the Frame Start signal (sFS) has not been asserted within the time as specified in [ES803-3] clause 9.1. See clause 6.1.7.2.

6.1.7.2.2 Use

(A_So): Clause 8.4.1.1 (PL1/BP_A_So).

(A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

sFS (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

sFILL (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

nFE (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.1.7.3 VC-4 slot mapping

The mapping of DTM slots into a 65 bit format suitable for mapping into the VC-4 octet stream.

6.1.7.3.1 Model

Processes and anomalies

(A_So): The encoding of slots from BP2_CI_D into the 65 bit format is performed according to [ES803-4] clause 6.3. See clause 6.1.7.3.

(A_Sk): The decoding of 65 bit format into slots, which is sent to BP2_CI_D, is performed according to [ES803-4] clause 6.3. See clause 6.1.7.3.

sFS (A_So): The S4 Frame Start (S4_AI_FS) is asserted when the Bypass layer 2 Frame Start (B2_CI_FS) is asserted. See clause 6.1.7.3.

sFS (A_Sk): The Bypass layer 2 Frame Start (B2_CI_FS) is asserted when the S4 Frame Start (S4_AI_FS) is asserted. See clause 6.1.7.3.

6.1.7.3.2 Use

(A_So): Clause 8.4.2.1 (S4/BP_A_So).

(A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

sFS (A_So): Clause 8.4.2.1 (S4/BP_A_So).

sFS (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.7.4 VC-4 overhead mapping

The mapping of DTM over VC-4 specific information into the VC-4 overhead octets.

6.1.7.4.1 Model

Processes and anomalies

F2, F3, H4 and K3 (A_So): These unused octets shall be generated according to [ES803-4] clause 6.1.
See clause 6.1.7.4.

F2, F3, H4 and K3 (A_Sk): These unused octets is not processed according to [ES803-4] clause 6.1. See clause 6.1.7.4.

6.1.7.4.2 Use

F2, F3, H4 and K3 (A_So): Clause 8.4.2.1 (S4/BP_A_So).

F2, F3, H4 and K3 (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.7.5 Channel special markers

The encoding and decoding of DTM channel special markers.

The idle special marker is a non-data channel slot word used to perform 64 bit frequency justification. See clause 6.1.8 and 12. The Idle insertion is made explicitly available to the DCAP client for the application specific frequency justification.

NOTE 1: The Idle-marker is used by DCAP-0 and DCAP-1 where as DCAP-2 uses another frequency justification method.

The Performance Supervision (PS) special marker is a non-data channel slot word used to perform supervision. See clause 6.1.4 and 12. The PS insertion is made explicitly available to the DCAP client and may in addition to the performance supervision be used as a delimiter for the application stream.

NOTE 2: Currently only DCAP-0 uses the PS. DCAP-1 and DCAP-2 uses other performance supervision methods.

The Alarm Indication Signal (AIS) special marker is a non-data channel slow word used to maintenance signal supervision. See clause 6.1.5.

6.1.7.5.1 Model

Processes and anomalies

Idle (A_So): The Idle special marker insertion to AI_D instead of received signal CI_D when CI_II is asserted. See clause 6.1.7.5.

Idle (A_Sk): The Idle Indication signal (sII) is asserted when the AI_D is detected to be an Idle special marker, else it is deasserted. See clause 6.1.7.5.

PS (TT_So): The Performance Supervision (PS) special marker insertion to CI_D instead of received signal when the Performance Supervision Insertion (PSI) signal AI_PSI is asserted. See clause 6.1.7.5.

PS (TT_Sk): The Performance Supervision Insertions signal (sPSI) is asserted when the CI_D is detected to be

6.1.7.5.2 Use

Idle (A_So): Clause 11.4.1.1 (CH1/AP0_A_So), 11.4.2.1 (CH1/AP1_A_So), 11.4.5.1 (CH2/AP0_A_So) and 11.4.6.1 (CH2/AP1_A_So).

Idle (A_Sk): Clause 11.4.1.2 (CH1/AP0_A_Sk) and 11.4.5.2 (CH2/AP0_A_Sk).

PS (TT_So): Clause X (_TT_So).

PS (TT_Sk): Clause X (_TT_Sk).

6.1.8 Frequency justification processes

Frequency justification is generically described in clause 5.2.3.3. In DTM multiple frequency justification schemes exists in form of different channel adaptations. DCAP-0 provides the justification resolution of 64 UI, DCAP-1 provides the justification resolution of 8 UI justification and DCAP-2 provides the justification resolution of 1 UI when used for isochronous traffic. DCAP-1 is intended for asynchronous traffic (i.e. packets) but may be used for isochronous traffic, but with certain drawbacks.

The frequency justification of DCAP-0 and DCAP-1 when used for asynchronous traffic is of continuous insertion of idle markers and no further detailing of justification mechanism is done.

6.1.8.1 DCAP-0 for isochronous traffic

Frequency justification for a stream oriented application using DCAP-0 is performed by inserting idle markers (or when appropriate, performance supervision markers, which from frequency justification point is equivalent to idle markers) into the channel. The justification opportunity may either be any slot, or restricted to one or a few slot, according to the scheme appropriate for each specific application.

Each justification can be either positive or negative. When the signal rate is above the nominal rate, a positive justification is performed by sending 64 bit of data when an idle marker where to be transmitted. When the signal rate is below the nominal rate, a negative justification is performed by sending and idle marker (or when appropriate, an performance supervision marker) instead of sending 64 bit of data.

Frequency justifications in DCAP-0 provide means to adjust the relative phase of the transmitted signal such that nominal phase of the signal and that of the incoming signal can be kept within limits. A continuous frequency error translates into a continuous justification in order to compensate for the difference in frequency between the signal and the DTM synchronization signal.

NOTE 1: Normally the phase difference is being monitored by means of monitoring the buffer fill level of the flexible buffer holding the received but yet to be sent traffic of the incoming signal.

Monitoring may be performed of justifications such that excess justifications (i.e. excess frequency deviation) can be identified. The positive and negative justifications is to be counted separately.

NOTE 2: Several methods of performing balanced justifications (i.e. justification dithering) is allowed in order to provide means for improved system performance. Such controlled balanced justifications shall not be counted, just the excess justifications relating to frequency compensation is to be counted.

6.1.8.1.1 Model

Processes and anomalies

(A_So): The continuous monitoring of the deviation in phase between the incoming signal and the transmitted signal is performed in order do perform frequency justifications. See clause 6.1.8.1.

(A_So): The performance of positive justification when the incoming signal rate is above the nominal signal rate, by the transmission of a data in replacement of an idle-marker where positive justification is allowed. See clause 6.1.8.1.

(A_So): The performance of negative justification when the incoming signal rate is below the nominal signal rate, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.1.

nFJ+ (A_So): The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See clause 6.1.8.1.

nFJ- (A_So): The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See clause 6.1.8.1.

6.1.8.1.2 Use

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

nFJ+ (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

nFJ- (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

6.1.8.1.3 Cross reference

nFJ+: Used in clause 6.5.3.1 (pFJ+).

nFJ-: Used in clause 6.5.3.2 (pFJ-).

6.1.8.2 DCAP-1 for isochronous traffic

Frequency justification for a isochronous oriented application using DCAP-1 is performed by marking the number of used octets in a DCAP-1 frame. Further may idle markers be sent in-between the DCAP-1 frames to provide justification space in the case of varying size of DCAP-1 frames. The justification opportunity may either be any DCAP-1 frame, or restricted to one or a few DCAP-1 frames, according to the scheme appropriate for each specific application.

Each justification can be either positive or negative. When the signal rate is above the nominal rate, a positive justification is performed by sending 8 bit (or more, in 8 bit quantization) of additional data. When the signal rate is below the nominal rate, a negative justification is performed by sending 8 bit (or less, in 8 bit quantization) less on a justification opportunity. Justification may make the DCAP-1 frame vary in size and insertion and removal of idle markers between the DCAP-1 frame shall be performed accordingly.

Frequency justifications in DCAP-1 provide means to adjust the relative phase of the transmitted signal such that nominal phase of the signal and that of the incoming signal can be kept within limits. A continuous frequency error translates into a continuous justification in order to compensate for the difference in frequency between the signal and the DTM synchronization signal.

NOTE 1: Normally the phase difference is being monitored by means of monitoring the buffer fill level of the flexible buffer holding the received but yet to be sent traffic of the incoming signal.

Monitoring may be performed of justifications such that excess justifications (i.e. excess frequency deviation) can be identified. The positive and negative justifications is to be counted separately.

NOTE 2: Several methods of performing balanced justifications (i.e. justification dithering) is allowed in order to provide means for improved system performance. Such controlled balanced justifications shall not be counted, just the excess justifications relating to frequency compensation is to be counted.

6.1.8.2.1 Model

Processes and anomalies

(A_So): The continuous monitoring of the deviation in phase between the incoming signal and the transmitted signal is performed in order do perform frequency justifications. See clause 6.1.8.2.

(A_So): The performance of positive justification when the incoming signal rate is above the nominal signal rate, by the transmission of a data in replacement of an idle-marker where positive justification is allowed. See clause 6.1.8.2.

(A_So): The performance of negative justification when the incoming signal rate is below the nominal signal rate, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.2.

nFJ+ (A_So): The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See clause 6.1.8.2.

nFJ- (A_So): The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See clause 6.1.8.2.

6.1.8.2.2 Use

(A_So): clause X (AP1/X_A_So).

(A_So): clause X (AP1/X_A_So).

(A_So): clause X (AP1/X_A_So).

nFJ+ (A_So): clause X (AP1/X_A_So).

nFJ- (A_So): clause X (AP1/X_A_So).

6.1.8.2.3 Cross reference

nFJ+: Used in clause 6.5.3.1 (pFJ+).

nFJ-: Used in clause 6.5.3.2 (pFJ-).

6.1.8.3 DCAP-2 for isochronous traffic

Frequency justification for a isochronous oriented application using DCAP-2 is performed by marking the number of used bits and not by use of idle markers. The justification opportunity is given by the DCAP-2 definition (see clause 12.3) and the bit rate characteristics of the specific signal.

Each justification can be either positive or negative. When the signal rate is above the nominal rate, a positive justification is performed by sending 1 bit (or more) of additional data on a justification opportunity. When the signal rate is below the nominal rate, a negative justification is performed by sending 1 bit (or more) less data on a justification opportunity.

NOTE 1: Due to the intolerance for idle markers DCAP-2 requires the switching to be synchronous and no insertion of idle markers may be performed on the channel.

Frequency justifications in DCAP-2 provide means to adjust the relative phase of the transmitted signal such that nominal phase of the signal and that of the incoming signal can be kept within limits. A continuous frequency error translates into a continuous justification in order to compensate for the difference in frequency between the signal and the DTM synchronization signal.

NOTE 2: Normally the phase difference is being monitored by means of monitoring the buffer fill level of the flexible buffer holding the received but yet to be sent traffic of the incoming signal.

Monitoring may be performed of justifications such that excess justifications (i.e. excess frequency deviation) can be identified. The positive and negative justifications is to be counted separately.

NOTE 3: Several methods of performing balanced justifications (i.e. justification dithering) is allowed in order to provide means for improved system performance. Such controlled balanced justifications shall not be counted, just the excess justifications relating to frequency compensation is to be counted.

6.1.8.3.1 Model

Processes and anomalies

(A_So): The continuous monitoring of the deviation in phase between the incoming signal and the transmitted signal is performed in order do perform frequency justifications. See clause 6.1.8.3.

(A_So): The performance of positive justification when the incoming signal rate is above the nominal signal rate, by the transmission of a data in replacement of an idle-marker where positive justification is allowed. See clause 6.1.8.3.

(A_So): The performance of negative justification when the incoming signal rate is below the nominal signal rate, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.3.

nFJ+ (A_So): The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See clause 6.1.8.3.

nFJ- (A_So): The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See clause 6.1.8.3.

6.1.8.3.2 Use

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

nFJ+ (A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

nFJ- (A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

6.1.8.3.3 Cross reference

nFJ+: Used in clause 6.5.3.1 (pFJ+).

nFJ-: Used in clause 6.5.3.2 (pFJ-).

6.1.8.4 DCAP-0 for asynchronous traffic

Frequency justification for an asynchronous oriented application using DCAP-0 is performed by inserting idle markers (or when appropriate, performance supervision markers, which from frequency justification point is equivalent to idle markers) into the channel. The justification opportunity may either be any slot, or restricted to specific slots, according to the scheme appropriate for each specific application.

Each justification can be only negative. When the signal rate is below the maximum rate, a negative justification is performed by sending and idle marker (or when appropriate, an performance supervision marker) instead of sending 64 bit of data.

NOTE: Normally the justification is done by means of monitoring the buffer fill level of the flexible buffer holding the received but yet to be sent traffic of the incoming signal. When there is no data, negative frequency justification is done by transmitting idle markers.

Monitoring of frequency justifications for asynchronous traffic is not considered useful and therefore no performance monitoring is performed.

6.1.8.4.1 Model

Processes and anomalies

(A_So): The continuous monitoring of the deviation in phase between the incoming signal and the transmitted signal is performed in order do perform frequency justifications. See clause 6.1.8.4.

(A_So): The performance of negative justification when the incoming signal rate is below the nominal signal rate, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.4.

6.1.8.4.2 Use

(A_So): clause X (AP0/X_A_So).

(A_So): clause X (AP0/X_A_So).

6.1.8.5 DCAP-1 for asynchronous traffic

Frequency justification for an asynchronous oriented application using DCAP-1 is performed by inserting idle markers into the channel. The justification opportunity may either be any slot, or restricted to specific slots (such as only between the DCAP-1 frames), according to the scheme appropriate for each specific application.

Each justification can be only negative. When the signal rate is below the maximum rate, a negative justification is performed by sending and idle marker (or when appropriate, an performance supervision marker) instead of sending 64 bit of data (DCAP-1 frame).

NOTE 1: Normally the justification is done by means of monitoring the buffer fill level of the flexible buffer holding the received but yet to be sent traffic of the incoming signal. When there is no data, negative frequency justification is done by transmitting idle markers.

NOTE 2: In a store-and-forward system will only the existence of complete packets in the flexible buffer be viewed as having data to transmit. It is however not necessary to use store-and-forward except when explicitly required elsewhere.

Monitoring of frequency justifications for asynchronous traffic is not considered useful and therefore no performance monitoring is performed.

6.1.8.5.1 Model

Processes and anomalies

(A_So): The continuous monitoring of transmit buffer fill level in order do perform frequency justifications.
See clause 6.1.8.5.

(A_So): The performance of negative justification when the transmit buffer has no data for transmission, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.5.

6.1.8.5.2 Use

(A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

(A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

6.1.9 Alignment processes

For 8B10B based physical interfaces is three levels of alignment achieved: code group alignment, slot alignment and frame alignment. Further details is found in [ES803-3].

6.1.9.1 8B10B bit/code group alignment process

The alignment of bit stream into 10-bit code groups is achieved by using a comma character for alignment synchronization marker. For further details see [ES803-3].

6.1.9.1.1 Model

Processes and anomalies

(A_Sk): The bit alignment is achieved by detection of the comma sequence (1111100) in the M1_AI_D bitstream. The alignment is enabled by CI_EN_FS. The bit alignment is according to [ES803-3] clause 8. See clause 6.1.9.1.

sFS (A_Sk): If a comma sequence is detected and CI_EN_FS is asserted, then the Frame Start signals (sFS) is asserted, else is sFS deasserted. See [ES803-3] clause 8. See clause 6.1.9.1.

6.1.9.1.2 Use

(A_Sk): Clause 7.4.1.2 (M1/PL1_A_Sk).

sFS (A_Sk): Clause 7.4.1.2 (M1/PL1_A_Sk).

6.1.9.2 8B10B code group/slot alignment process

The alignment of code group stream into slot words is achieved by use of special code groups for non-data slots, inter-frame gap and frame start encoding. For further details see [ES803-3].

6.1.9.2.1 Model

Processes and anomalies

(A_Sk): The codegroup/slot alignment is achieved by detection of the Fill ordered set in the PL1_AI_D codegroup stream. The codegroup/slot alignment is achieved and maintained by a state machine process. The codegroup/slot alignment is according to [ES803-3] clause 9.6.2. See clause 6.1.9.2.

nLOSS (A_Sk): If the slot synchronization state machine is in the LOSS state, then the Loss Of Slot Synchronization anomaly (nLOSS) is asserted, else is nLOSS deasserted. See [ES803-3] clause 9.6.2. See clause 6.1.9.2.

6.1.9.2.2 Use

(A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

nLOSS (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.1.9.3 8B10B slot/frame alignment process

The alignment of slots into frames is achieved by use of a dedicated start of frame encoding. For further details see [ES803-3].

6.1.9.3.1 Model

Processes and anomalies

(A_Sk): The slot/frame alignment is achieved by detection of the Start Of Frame (SOF) ordered set in the slot codegroup stream. The slot/frame alignment is achieved and maintained by a state machine process. The slot/frame alignment is according to [ES803-3] clause 9.6.3. See clause 6.1.9.3.

nLOF (A_Sk): If the frame synchronization state machine is in the Init or Verify states, then the Loss Of Frame anomaly (nLOF) is asserted, else is nLOF deasserted. See [ES803-3] clause 9.6.3. See clause 6.1.9.3.

6.1.9.3.2 Use

(A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

nLOF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.1.9.3.3 Cross reference

nLOF: Used in clause 6.2.4.1 (dLOF).

6.1.9.4 SDH VC-4 and VC-3 transport DCAP-0 Frame alignment process

The alignment of sections into VC-4 and VC-3 frames is achieved by use of a dedicated start of frame encoding. For further details see [ES803-6].

6.1.9.4.1 Model

Processes and anomalies

(A_So): The generation of frame alignment pattern in order to indicate the initial segment of a multi-segment VC4 transport stream according to [ES803-6] clause 6.2.1. See clause 6.1.9.4.

(A_Sk): The monitoring of frame alignment pattern in order to identify the initial segment of a multi-segment VC4 transport stream according to [ES803-6] clause 6.2.1. See clause 6.1.9.4.

sFS (A_Sk): When the initial segment is detected and the first of its data words is transmitted on CI_D shall the Frame Start signal (sFS) be asserted, else it shall be de-asserted. See clause 6.1.9.4.

nLOJ (A_Sk): If the initial segment does not occur after the specified justification, then the Loss Of Justification anomaly (nLOJ) is asserted, else nLOJ is deasserted. See clause [ES803-6] 6.2.1 and clause 6.1.9.4.

6.1.9.4.2 Use

(A_So): [ES803-6] Clause 5.4.1.1 (AP0/S4_A_So) and 5.4.2.1 (AP0/S3_A_So).

(A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

sFS(A_Sk): [ES803-.6] Clause 5.4.1.2 (AP0/S4_A_Ak) and 5.4.2.2 (AP0/S3_A_Sk).

nLOP(A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.1.9.4.3 Cross reference

nLOJ: Used in dLOJ, clause 6.2.4.2.

6.1.9.5 DCAP-1 Frame alignment process

For the DTM Channel Adaptation Protocol 1 (DCAP-1) will packet alignment be achieved by use of dedicated encoding and checksums for both packet header and trailer (see clause 6.1.4.7 and 12.2).

6.1.9.5.1 Model

Processes and anomalies

(A_So): The DCAP-1 transmitter statemachine according to clause 12.2.3.1 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clause 6.1.9.5 and 12.2.3.1.

(A_Sk): The DCAP-1 receiver statemachine according to clause 12.2.3.2 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clause 6.1.9.5 and 12.2.3.2.

nLOF (A_Sk): The receiver statemachine asserts the Loss Of Frame anomaly (nLOF) whenever it is in out of sync state. See clause 6.1.9.5 and 12.2.3.2.

6.1.9.5.2 Use

(A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

(A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

nLOF (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.1.9.6 DCAP-2 Frame alignment process

For the DTM Channel Adaptation Protocol 2 (DCAP-2) will frame alignment be achieved by use of dedicated encoding (see clause 12.3).

6.1.9.6.1 Model

Processes and anomalies

(A_So): The generation of frame alignment pattern in order to indicate the initial slot word of a multi-slot word DCAP-2 frame according to clause 12.3. See clause 6.1.9.6.

(A_Sk): The monitoring of frame alignment pattern in order to identify the initial slot word of a multi-slot word DCAP-1 frame stream according to clause 12.3. See clause 6.1.9.6.

(A_Sk): The frame synchronization state machine process of clause 12.3.1.1. See clause 6.1.9.6.

sFS (A_Sk): When the initial slot word is detected and the first of its data words is transmitted on CI_D shall the Frame Start signal (sFS) be asserted, else it shall be de-asserted. See clause 6.1.9.6.

nLOF (A_Sk): If the frame synchronization state machine is in the Out Of Frame (OOF) state, then the Loss Of Frame anomaly (nLOF) is asserted, else nLOF is deasserted. See clause 12.3.1.1 and clause 6.1.9.6.

6.1.9.6.2 Use

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

(A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

(A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

sFS (A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

nLOF (A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

6.1.10 Timing recovery processes

The timing recovery processes recovers the bit clocks from line encoded data on physical interfaces.

6.1.10.1 8B10B timing recovery

The 8B10B encoded physical interfaces [ES803-3] require timing recovery of the line encoded data as received from the optical conditioning (see clause 6.1.1).

6.1.10.1.1 Model

Processes and anomalies

(A_Sk): The timing recovery from AI_D to form the regenerated clock (CI_CK) as specified in [ES803-3] clause 8. See clause 6.1.10.1.

6.1.10.1.2 Use

(A_Sk): Clause 7.4.1.2 (M1/PL1_A_Sk).

6.1.11 Jitter attenuation and smoothing processes

Jitter attenuation and smoothing processes is used to lower the jitter and wander measures (i.e. phase deviations) in order to fulfil certain application specific requirements.

6.1.11.1 8B10B Transmit clock jitter attenuation

For the 8B10B based physical interface [ES803-3] it may be necessary to reduce the jitter of the reference clock.

6.1.11.1.1 Model

Processes and anomalies

(A_So): The smoothing of the received clock (CI_CK) in order to ensure a maximum output jitter of 0.1 UI as specified in [ES803-3] clause 8. See clause 6.1.11.1.

6.1.11.1.2 Use

(A_So): Clause 7.4.1.1 (M1/PL1_A_So).

6.1.11.2 VC-4 frame sync smoothing

For the SDH VC-4 based physical interfaces [ES803-4] it is necessary to perform jitter attenuation of the received VC-4 frame starts in order to fulfil the DTM synchronization jitter and wander requirements.

6.1.11.2.1 Model

Processes and anomalies

(A_Sk): The jitter and wander attenuation of the AI_FS generating CI_FS. See clause 6.1.11.2.

6.1.11.2.2 Use

(A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.11.3 DCAP-0 frequency justification smoothing

Some of the applications using DCAP-0 may require smoothing of the phase variations introduced by the DCAP-0 frequency justification process. For those applications will DCAP-0 frequency justification smoothing be performed.

NOTE 1: The smoothing of the signal clock is performed in a PhaseLocked Loop (PLL) designed for the purpose. The properties of the applications requirements and the mechanism of the justification and justification opportunities puts requirements on the specific design of this PLL. Such design parameters include phase detector choice, degree of PLL, hold-in range etc.

NOTE 2: For some applications may balanced justifications introduced in addition to the necessary frequency justifications such that quantization error of the incoming phase difference can be reduced. Such frequency justification dither matches with the properties of the frequency justification smoothing may result in a significantly improved system property since the phase jumps of individual frequency justifications is effectively distributed more evenly over time.

The transported data is stored in an elastic buffer such that it is being stored in the elastic buffer as it is being received, and being retrieved from the elastic buffer using the smoothed clock.

NOTE 3: For the process to be non-lost the elastic buffer depth and nominal fill level is adjusted to tolerate the maximum phase deviations between the input and output signals. This jitter tolerance requirement puts restrictions onto the smoothing PLL.

6.1.11.3.1 Model

Processes and anomalies

(A_Sk): The clock smoothing process in order to reduce phase deviations on the transmitted signal. The clock smoothing must comply with the jitter and wander requirements as defined in [EN417-1-1]. The resulting clock is delivered as CI_CK. See clause 6.1.11.3.

(A_Sk): The elastic buffering of the transported signal such that the buffer output is being clocked by the smoothed clock. See clause 6.1.11.3.

6.1.11.3.2 Use

(A_Sk): [ES803-5] clause 5.4.1.2 (AP2/PX_A_Sk) and [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

(A_Sk): [ES803-5] clause 5.4.1.2 (AP2/PX_A_Sk) and [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.1.11.4 DCAP-0 frequency justification smoothing

Some of the applications using DCAP-0 may require smoothing of the phase variations introduced by the DCAP-0 frequency justification process. For those applications will DCAP-0 frequency justification smoothing be performed.

NOTE 1: The smoothing of the signal clock is performed in a phase locked loop (PLL) designed for the purpose. The properties of the applications requirements and the mechanism of the justification and justification opportunities puts requirements on the specific design of this PLL. Such design parameters include phase detector choice, degree of PLL, hold-in range etc.

NOTE 2: For some applications may balanced justifications introduced in addition to the necessary frequency justifications such that quantization error of the incoming phase difference can be reduced. Such frequency justification dither matches with the properties of the frequency justification smoothing may result in a significantly improved system property since the phase jumps of individual frequency justifications is effectively distributed more evenly over time.

The transported data is stored in an elastic buffer such that it is being stored in the elastic buffer as it is being received, and being retrieved from the elastic buffer using the smoothed clock.

NOTE 3: For the process to be non-lost the elastic buffer depth and nominal fill level is adjusted to tolerate the maximum phase deviations between the input and output signals. This jitter tolerance requirement puts restrictions onto the smoothing PLL.

6.1.11.4.1 Model

Processes and anomalies

(A_Sk): The clock smoothing process in order to reduce phase deviations on the transmitted signal. The clock smoothing must comply with the jitter and wander requirements as defined in the associated application. The resulting clock is delivered as CI_CK. See clause 6.1.11.4.

(A_Sk): The elastic buffering of the transported signal such that the buffer output is being clocked by the smoothed clock. See clause 6.1.11.4.

6.1.11.4.2 Use

(A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

(A_Sk): Clause 11.4.3.2 (CH1/AP2_A_Sk).

6.1.12 Bitrate adaptation processes

Bitrate adaptation processes convert the bitrate of some information such that gaps is inserted or removed in the datastream without data loss. This is used to adapt to other bit rates. See clause 5.2.3.7.

6.1.12.1 Physical Interface

The bitrate adaptation in order to adapt to the bit rate of the physical line.

6.1.12.1.1 Model

Processes and anomalies

(A_So): The transmitter side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

(A_Sk): The receiver side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

6.1.12.1.2 Use

(A_So): Clause 8.4.1.1 (PL1/BP_A_So) and 8.4.2.1 (S4/BP_A_So).

(A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk) and 8.4.2.2 (S4/BP_A_Sk)

6.1.13 Multiplexing/demultiplexing processes

The multiplexing and demultiplexing processes according to clause 5.2.3.8.

6.1.13.1 8B10B bit/code group

The 8B10B bit/code group multiplexing and demultiplexing achieves bit-width adaptation between the 10-bit code group stream and the 1-bit transmission stream.

6.1.13.1.1 Model

Processes and anomalies

(A_So): The multiplexing of bits in PL1_CI_D into the bitstream of M1_AI_D. The bit multiplexing is according to [ES803-3] clause 8. See clause 6.1.13.1.

(A_Sk): The demultiplexing of the bitstream M1_AI_D into the code group bits of PL1_CI_D. The demultiplexing is aligned when EN_FS is asserted. The bit demultiplexing is according to [ES803-3] clause 8. See clause 6.1.13.1.

6.1.13.1.2 Use

(A_So): Clause 7.4.1.1 (M1/PL1_A_So).

(A_Sk): Clause 7.4.1.2 (M1/PL1_A_Sk).

6.1.13.2 8B10B code group/slot

The 8B10B code group/slot multiplexing and demultiplexing achieves word-width adaptation between the 8 + 1-bit format and the 8 × (8+1) bit format needed for mapping to the 65 bit slot word format.

6.1.13.2.1 Model

Processes and anomalies

(A_So): The multiplexing of slot codegroups in BP1_CI_D into the codegroup stream. The bit multiplexing is according to [ES803-3] clause 9.5. See clause 6.1.13.2.

(A_Sk): The demultiplexing of the codegroup stream into the slot code groups of BP1_CI_D. The demultiplexing is aligned when the Loss Of Slot Synchronization anomaly (nLOSS) is deasserted after previously been asserted. The bit demultiplexing is according to [ES803-3] clause 9.5. See clause 6.1.13.2.

6.1.13.2.2 Use

(A_So): Clause 8.4.1.1 (PL1/BP_A_So).

(A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.1.13.3 VC-4 slot/octet stream

The VC-4 slot/octet multiplexing and demultiplexing achieves adaptation between the 65 bit slot format and the octet oriented of the VC-4 payload format.

6.1.13.3.1 Model

Processes and anomalies

(A_So): The multiplexing of 65 bit slot format into the unscrambled octet stream of 9 rows and 260 x n octets according to [ES803-4] clause 6.2. See clause 6.1.13.3.

(A_Sk): The demultiplexing of the unscrambled octet stream of 9 rows and 260 x n octets into the 65 bit slot format according to [ES803-4] clause 6.2. See clause 6.1.13.3.

6.1.13.3.2 Use

(A_So): Clause 8.4.2.1 (S4/BP_A_So).

(A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.13.4 VC-4 octet stream and overhead

The VC-4 octet stream and overhead multiplexing and demultiplexing will combine and isolate the VC-4 payload data with the POH header fields.

6.1.13.4.1 Model

Processes and anomalies

(A_So): The multiplexing of the scrambled octet stream and the C2, F2, F3, H4 and K3 octets to form the S4_AI_D according to [ES803-4] clause 6.1. See clause 6.1.13.4.

(A_Sk): The demultiplexing of the S4_AI_D into the scrambled octet stream and the C2, F2, F3, H4 and K3 octets according to [ES803-4] clause 6.1. See clause 6.1.13.4.

6.1.13.4.2 Use

(A_So): Clause 8.4.2.1 (S4/BP_A_So).

(A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.13.5 SDH VC4 transport DCAP-0 sub-frame multiplexing process

The SDH VC4 transport of a VC4-Xc (where VC4 implies X=1) involves dividing the VC4 octet stream into X individual segments. These segments each holds 2349 octets, which is contiguous in the VC4 octet stream. Each segment thus forms a sub-frame format in the VC4 frame structure, only for the purpose of ease of transport over DTM. Details of this processing is given in [ES803-6] clause 6. The sub-frame format is synchronous to the VC4 frame structure and is strictly aligned.

6.1.13.5.1 Model

Processes and anomalies

(A_So): The division of the VC4 octet stream into segments as specified in [ES803-6] clause 6. See clause 6.1.13.5.

(A_Sk): The reconstruction of the VC4 octet stream from the received segments as specified in [ES803-6] clause 6. See clause 6.1.13.5.

6.1.13.5.2 Use

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

(A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk).

6.1.13.6 SDH VC-4 and VC-3 transport DCAP-0 section transmission process

The SDH VC-4 stream has been divided into sections, each section is then divided into an initial slot (holding 5 octets of VC-4 stream data) and data slot (holding 8 octets of VC-4 stream data) as specified in [ES803-6]. The VC-3 is contained in a single section with a initial slot (holding 7 octets of the VC-3) and data slot (holding 8 octets of the VC-3 stream data) as specified in [ES803-6].

The initial slot and data slots is being multiplexed into a channel. Before each initial slot is an performance supervision slot expected to be transmitted (as indicated by the AI_FS signal) and before the first section in a VC-4 or VC-3 frame, the justification opportunity exist allowing the transmission of 0, 1 or 2 idle-markers (each indicated by the AI_II signal). In the received the reverse process is being performed.

6.1.13.6.1 Model

Processes and anomalies

(A_So): The multiplexing of the section alignment signal and the 5 first octets of the segment into an initial slot. See clause 6.1.13.6.

(A_So): The multiplexing of 8 contiguous octets in the segment into a data slot. See clause 6.1.13.6.

(A_So): The multiplexing of an initial slot and 293 contiguous data slots into a slot stream on AI_D. See clause 6.1.13.6.

sII (A_So): The indirect multiplexing (performed by the TT_So) of 0, 1 or 2 idle markers prior to the initial segment (see clause 6) by assertion of the Idle Insertion signal (sII). The number of idle markers is given by the frequency justification process, see [ES803-2-3] clause 6.1.12.1. See [ES803-2-3] clause 6.1.13.6.

sPSI (A_So): The Performance Supervision Insertion signal (sPSI) is asserted when the performance supervision special marker of a segment is to be transmitted according to clause 6, else it is de-asserted. See [ES803-2-3] clause 6.1.13.6.

sFS (A_So): The Frame Start signal (sFS) is asserted when the performance supervision marker of the initial segment is issued according to clause 6, else it is de-asserted. See [ES803-2-3] clause 6.1.13.6.

(A_Sk): The demultiplexing of the initial slot and 293 contiguous data slots from the slot stream on AI_D. See clause 6.1.13.6.

(A_Sk): The demultiplexing of the initial slot to the section alignment signal and the 5 first octets of the segment. See clause 6.1.13.6.

(A_Sk): The demultiplexing of the data slots into 8 contiguous octets in the VC-4 octet stream. See clause 6.1.13.6.

6.1.13.6.2 Use

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

(A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

sII (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

sPSI (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

sFS (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and clause 5.4.2.1 (AP0/S3_A_So).

(A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk) and clause 5.4.2.2 (AP0/S3_A_Sk).

(A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk) and clause.5.4.2.2 (AP0/S3_A_Sk).

(A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk) and clause 5.4.2.2 (AP0/S3_A_Sk).

6.1.13.7 DCAP-1 multiplexing

The DCAP-1 channel adaptation allows for a number of octets to be sent as one unit (package) with the additional side information of the Channel Multiplexing Identifier (CMI) and Priority (PRI).

6.1.13.7.1 Model

Processes and anomalies

sDCAP1h (A_So): The multiplexing resulting in the DCAP-1 header signal (sDCAP1h) from the static values of clause 12.2.2.1, the channel multiplexing identifier CI_CMI, the packet length (in octets) indicated by CI_LEN, the priority CI_PRI, the DCAP-1 slot word checksum signal (sDCAP1s) and with the C and T bits asserted. See clause 6.1.4.5, 6.1.13.7 and 12.2.

sDCAP1t (A_So): The multiplexing resulting in the DCAP-1 trailer signal (sDCAP1t) from the static values of clause 12.2.2.3, the CRC-32 checksum signal (sCRC32), the DCAP-1 slot word checksum signal (sDCAP1s) and C bit enabled. See clause 6.1.13.7 and 12.2.

(A_So): The multiplexing into the AI_D of the DCAP-1 headers signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clause 6.1.9.5 and 6.1.13.7.

(A_Sk): The demultiplexing of AI_D into the DCAP-1 header signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clause 6.1.9.5 and 6.1.13.7.

sDCAP1h (A_Sk): The demultiplexing of the DCAP-1 header signal (sDCAP1h) to the channel multiplexing identifier CI_CMI, the packet length CI_LEN, the priority CI_PRI and the DCAP-1 slot word checksum signal (sDCAP1s). See clause 6.1.13.7 and 12.2.

sDCAP1t (A_Sk): The demultiplexing of the DCAP-1 trailer signal (sDCAP1t) to the CRC-32 checksum signal (sCRC32) and the DCAP-1 slot word checksum signal (sDCAP1s). See clause 6.1.13.7 and 12.2.

6.1.13.7.2 Use

sDCAP1h (A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH1/AP1_A_So).

sDCAP1t (A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH1/AP1_A_So).

(A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH1/AP1_A_So).

(A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH1/AP1_A_Sk).

sDCAP1h (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH1/AP1_A_Sk).

sDCAP1t (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH1/AP1_A_Sk).

6.1.13.8 DCAP-2 transmission process

The bit stream is divided into m slot words, containing q bits per slot word, except for r slotwords which contains $q+1$ bits per slot word (see clause 12.3.1.2). The frame synchronization, performance supervision, justification control and payload size control (see clause 12.3.1).

6.1.13.8.1 Model

Processes and anomalies

(A_So): The demultiplexing/multiplexing of the bitstream to form a 61 bit data format signal (s61b) according to clause 12.3.1. See clause 6.1.13.8.

(A_So): The multiplexing of the BIP-16 signal (sBIP16) to the BIP-16 serial signal (sBIP16s) according to clause 12.3.1. See clause 6.1.13.8.

(A_So): The multiplexing of the positive justification control signal (sJC+) and the negative justification control signal (sJC-) into the justification control signal (sJC) according to clause 12.3.1. See clause 6.1.13.8.

(A_So): The multiplexing of the payload size parameters into the payload size signal (sPS) according to clause 12.3.1. See clause 6.1.13.8.

(A_So): The multiplexing of the 61 bit data format signal (s61b), the BIP-16 serial signal (sBIP16s), the frame synchronization pattern signal (sFSP), justification control signal (sJC) and payload size signal (sPS) into the AI_D according to clause 12.3.1. See clause 6.1.13.8.

(A_Sk): The demultiplexing/multiplexing of the 61 bit data format signal (s61b) to the bitstream according clause 12.3.1. See clause 6.1.13.8.

(A_Sk): The demultiplexing of the BIP-16 serial signal (sBIP16s) to the BIP-16 received signal (sBIP16r) according to clause 12.3.1. See clause 6.1.13.8.

(A_Sk): The demultiplication of the justification control signal (sJC) into the positive justification control signal (sJC+) and the negative justification control signal (sJC-) according to clause 12.3.1. See clause 6.1.13.8.

(A_Sk): The demultiplexing of the payload size signal (sPS) into the payload size parameters according to clause 12.3.1. See clause 6.1.13.8.

NOTE: This process is optional. The payload size parameters can for certain applications be implied by other parameters and the retrieval of those parameters from the stream is thus not necessary.

(A_Sk): The demultiplexing of the AI_D into the 61 bit data format (s61b), the BIP-16 serial signal (sBIP16s), the frame synchronization pattern signal (sFSP), justification control signal (sJC) and payload size signal (sPS) according to clause 6.1.13.8.

6.1.13.8.2 Use

(A_So): Clause 11.4.3.1 (AP0/S4_A_So).

(A_Sk): Clause 11.4.3.2 (AP0/S4_A_Sk).

6.1.14 Time slot/wavelength/frequency/code assignment/access processes

These processes contains parts of the DTM switching functionality, the rest is to be found in the relevant connection functions of clause 9.2, 10.2 and 11.2.

6.1.14.1 Bypass slot assignment/access process

The per channel TDM structure of the time slot layer is mapped to the full DTM TDM frame structure of the bypass layer. A channel which is not changing capacity (at the point of the BP/TS adaptation function) will have equivalent number of slots words in both the time slot layer and bypass layer. The channel will also have a mapping between the slots such that each slot in the bypass layer maps to only one slot in the time slot layer and vice versa. The bypass slot assignment/access mapping is dynamically configured over the management point.

There exist two mapping forms, the monotonic rising and the arbitrary mapping. In the monotonic rising will the time slot order within the time slot layer be maintained within the bypass layer, i.e. the monotonic rising sequence of slot numbers in the time slot layer is directly mapped to some monotonic rising sequence of slot numbers. The arbitrary mapping allows permutations in the mapping of the sequences. The arbitrary mapping to BP is only used towards nodes known through management to handle arbitrary mapping, since such nodes can handle both, while a node only supporting monotonic rising requires the incoming TDM structure of a channel to be monotonic rising.

NOTE 1: An implementation may have only support for monotonic rising mappings since full remapping may require additional hardware for the necessary time-switching. For monotonic rising systems can a low processing delay be maintained.

NOTE 2: An implementation may have support for arbitrary mapping since it allows for additional freedom in management of resources. The use of arbitrary mapping on one bypass chain of a channel does not affect the end-to-end order of slotwords since the order is restored in the access mapping back to the time slot layer. This makes the specific time reordering a local property of that bypass layer section.

For a channel changing capacity such that for the slot assignment into the bypass layer the bypass slot count is higher than the time slot layer slot count, then the excess (unmapped) bypass TDM slots shall have Idle-markers continuously generated into them.

For a channel changing capacity such that for the slot access out of the bypass layer the bypass slot count is lower than the time slot layer slot count, then the excess (unmapped) time slot layer TDM slots shall have Idle-markers continuously generated into them.

NOTE 3: The generation of Idle-markers allows safe inclusion and exclusion of a set of slots to a channel. This assumes that the channel receivers are Idle-marker tolerant (i.e. uses DCAP-0 or DCAP-1).

6.1.14.1.1 Model

Processes and anomalies

(A_So): The TDM slot assignment of slots in the TS_CI_D TDM frame to the BP_AI_D TDM frame slots according to a slot-to-slot mapping given by the management slot table BP/TS_A_So_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.1.

(A_So): The excess TDM slots in the BP_AI_D TDM frame which have no mapping from the TS_CI_D TDM frame shall continuously (once per frame and slot position) be sent an Idle-marker. A BP_AI_D TDM slot is marked as an excess slot in the management slot table BP/TS_A_So_MI_SMT. See clause 6.1.14.1.

(A_Sk): The TDM slot access of slots in the BP_AI_D TDM frame to the TS_CI_D TDM frame for the channel according to a slot-to-slot mapping given by the management slot table BP/TS_A_Sk_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.1.

(A_Sk): The excess TDM slots in the TS_CI_D TDM frame which have no mapping from the BP_AI_D TDM frame shall continuously (once per frame and slot position) be send an Idle-marker. A TS_CI_D TDM slot is marked as an excess slot in the management slot table BP/TS_A_Sk_MI_SMT. See clause 6.1.14.1.

6.1.14.1.2 Use

(A_So): Clause 9.4.1.1 (BP/TS_A_So).

(A_Sk): Clause 9.4.1.2 (BP/TS_A_Sk).

6.1.14.2 Time slot assignment/access process

The channel layer TDM frame is either synchronous (CH1) or asynchronous (CH2) to the DTM frame starts. The time slot assignment process in the time slot layer is to ensure that a mapping of slot words is established into and out of the time slot layer TDM frame.

For the synchronous channel layer TDM frame is a static mapping established such that the synchronous channel layer TDM frame is directly mapped onto the time slot layer TDM frame. The access mapping is a direct mapping.

For the asynchronous channel layer TDM frame must a dynamic mapping be performed. Since the asynchronous mapping may include the handling of an uneven stream, Idle-marker processing must be performed which may cause insertion and removal of Idle-markers. The unmapped data (except for Idle-markers) is intermittently stored in an elastic store. The binding of a TDM frame slot and a slot word is done on each slot occasion. If the elastic store is empty an Idle marker is issued. The access mapping is a direct mapping.

6.1.14.2.1 Model

Processes and anomalies

(TS/CH2_A_So): The storage of CH2_CI_D slot words into an elastic store except for the case of CH2_CI_D being an Idle-marker. See clause 6.1.14.2.

(TS/CH2_A_So): The reset of the next slot in TDM frame to become the first slot upon TS_TI_FS. See clause 6.1.14.2.

(TS/CH2_A_So): The retrieval of a slot word from the elastic store and binding to the next slot in TDM frame. If there where a slot word in the elastic store, then that is sent to AI_D, else an Idle-marker is sourced to the AI_D. See clause 6.1.14.2.

6.1.14.2.2 Use

(A_So): Clause 10.4.2.1 (TS/CH2_A_So).

(A_Sk): Clause 10.4.2.2 (TS/CH2_A_Sk).

6.1.14.3 Time slot tunnel assignment/access process

The time slot tunnel provides a grouping of channels into a common transport channel. This is achieved by mapping of time slots.

The per channel TDM structure of the time slot layer is mapped to the TDM frame structure of the time slot tunnel sub-layer. A channel which is not changing capacity (at the point of the TSt/TS adaptation function) will have equivalent number of slots words in both the time slot layer and time slot tunnel sub-layer. The channel will also have a mapping between the slots such that each slot in the time slot tunnel sub-layer maps to only one slot in the time slot layer and vice versa. The time slot tunnel slot assignment/access mapping is dynamically configured over the management point.

For a channel changing capacity such that for the slot assignment into the time slot tunnel sublayer the time slot count is higher than the time slot layer slot count, then the excess (unmapped) time slot tunnel TDM slots shall have Idle-markers continuously generated into them.

For a channel changing capacity such that for the slot access out of the time slot tunnel sublayer the time slot count is lower than the time slot layer slot count, then the excess (unmapped) time slot layer TDM slots shall have Idle-markers continuously generated into them.

NOTE: The generation of Idle-markers allows safe inclusion and exclusion of a set of slots to a channel. This assumes that the channel receivers are Idle-marker tolerant (i.e. uses DCAP-0 or DCAP-1).

6.1.14.3.1 Model

Processes and anomalies

(A_So): The TDM slot assignment of slots in the TS_CI_D TDM frame to the TSt_AI_D TDM frame slots according to a slot-to-slot mapping given by the management slot table TSt/TS_A_So_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.3.

(A_So): The excess TDM slots in the TSt_AI_D TDM frame which have no mapping from the TS_CI_D TDM frame shall continuously (once per frame and slot position) be sent an Idle-marker. A TSt_AI_D TDM slot is marked as an excess slot in the management slot table TSt/TS_A_So_MI_SMT. See clause 6.1.14.3.

(A_Sk): The TDM slot access of slots in the TSt_AI_D TDM frame to the TS_CI_D TDM frame for the channel according to a slot-to-slot mapping given by the management slot table TSt/TS_A_Sk_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.3.

(A_Sk): The excess TDM slots in the TS_CI_D TDM frame which have no mapping from the TSt_AI_D TDM frame shall continuously (once per frame and slot position) be send an Idle-marker. A TS_CI_D TDM slot is marked as an excess slot in the management slot table TSt/TS_A_Sk_MI_SMT. See clause 6.1.14.3.

6.1.14.3.2 Use

(A_So): Clause 10.4.4.1 (TSt/TS_A_So).

(A_Sk): Clause 10.4.4.2 (TSt/TS_A_Sk).

6.1.15 Payload type identification processes

An adaptation source function transmits the TSL (TxSL) which identifies the local (near-end) selected payload type and hence the adaptation or composition (see note 1), of adaptation function type(s) (see note 2). The TSL code acts as an adaptation source function identification code. The exact coding of the TSL is described in the respective adaptation functions in the other parts of the present document.

NOTE 1: The identification of a composition of adaptation function types by one TSL code is due to the limited number of code values per TSL.

NOTE 2: A particular adaptation function type serves a particular type client layer. An other adaptation function type serves another type client layer.

An adaptation sink function compares the content of the accepted TSL (AcSL) (see note 3), identifying the remote (far-end) adaptation function, with the "Expected TSL" (ExSL), identifying the local adaptation function as a check on consistency between the provisioning operation at each end of the trail.

NOTE 3: Refer to clause 8.2.1.2 for the definition of AcSL.

For backward compatibility (to interwork with old equipment not containing equipped-specific TSLs), every equipped-specific "expected TSL" code is matched by the "equipped - non specific" TSL code (code "1").

The TSL identifies the presence of a payload and the signal type carried in the payload. Refer to clause 7.2 for the application description.

The trail signal label is used as input for the process, the payload mismatch detection process (within adaptation functions).

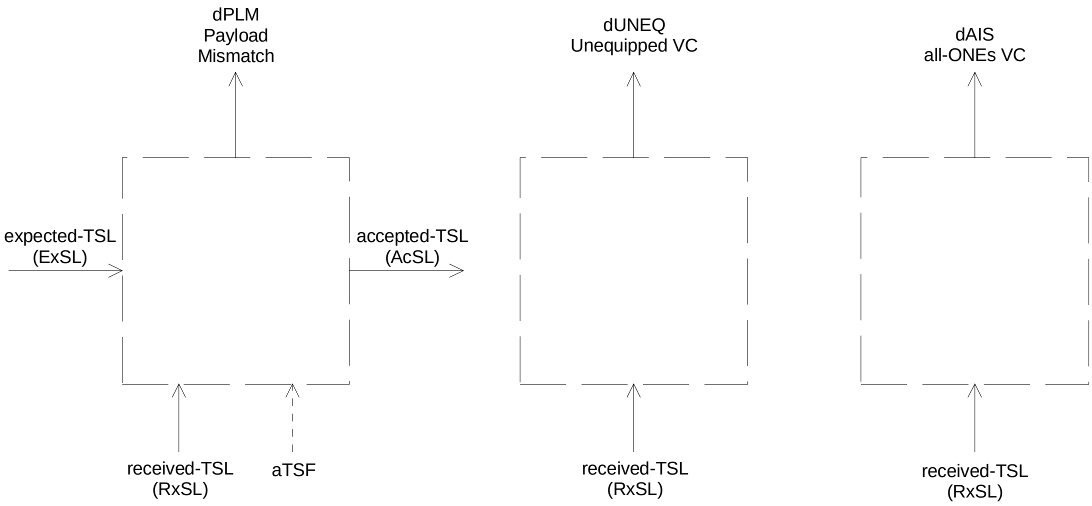


Figure 11: Generic trail signal label acceptance, payload mismatch and unequipped detection process

6.1.15.1 DCAP-1 CMI

Expected trail signal label

The "expected TSL" shall be derived from the adaptation function type.

Received trail signal label acceptance

The value of the signal label passed to the management system should be an accepted value rather than the received value.

In case of adaptation functions, a new signal label code value shall be accepted if the signal label carries the same code value in m consecutive (multi)frames, with $3 \leq m \leq 10$.

In the case of termination functions, a new signal label code value shall be accepted if the signal label carries the same code value in five consecutive (multi)frames.

Payload Mismatch (PLM) defect

The Payload Mismatch defect (dPLM) shall be detected if the "accepted TSL" code does not match the "expected TSL" code. If the "accepted TSL" code is "equipped non-specific" the mismatch is not detected. dPLM shall be cleared if the "accepted TSL" code matches the "expected TSL" code, or if the "accepted TSL" code is "equipped non-specific".

6.1.15.1.1 Model

Processes and anomalies

TSL (A_So): The Trail Signal Label (TSL), as specified through MP_TxSL, is generated into XXX.
See clause 6.1.15.1.2.

TSL (A_Sk): The Trail Signal Label (TSL) is received from XXX and when accepted made available as the Accepted TSL (MI_AcSL). See clause 6.1.15.1.2.

nPLM (A_Sk): The Payload Mismatch anomaly (nPLM) is asserted when the accepted Trail Signal Label (TSL) is not equal to the Expected TSL (MI_ExSL). See clause 6.1.15.1.2.

6.1.15.1.2 Use

TSL (A_So): Clause 11.4.2.1 (CH1/AP1_A_So) and 11.4.6.1 (CH2/AP1_A_So).

TSL (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk) .

nPLM (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.1.15.1.3 Cross reference

nPLM: Used in clause 6.2.5.1 (dPLM).

6.1.15.2 VC4 C2 payload type

Expected trail signal label

The "expected TSL" shall be derived from the adaptation function type.

Received trail signal label acceptance

The value of the signal label passed to the management system should be an accepted value rather than the received value.

In case of adaptation functions, a new signal label code value shall be accepted if the signal label carries the same code value in m consecutive (multi)frames, with $3 \leq m \leq 10$.

In the case of termination functions, a new signal label code value shall be accepted if the signal label carries the same code value in five consecutive (multi)frames.

Payload Mismatch (PLM) defect

The Payload Mismatch defect (dPLM) shall be detected if the "accepted TSL" code does not match the "expected TSL" code. If the "accepted TSL" code is "equipped non-specific" the mismatch is not detected. dPLM shall be cleared if the "accepted TSL" code matches the "expected TSL" code, or if the "accepted TSL" code is "equipped non-specific".

6.1.15.2.1 Model

Processes and anomalies

C2/TSL (A_So): The Trail Signal Label (TSL), as specified through MP_TxSL, shall be generated into the C2 octet according to clause 5.3.4.1 and [ES803-4] clause 6.1. See clause 6.1.15.2.

C2/TSL (A_Sk): The Trail Signal Label (TSL) is received in form of the C2 octet and is made available as the Accepted TSL (MI_AcSL) according to clause 5.3.4.1 and [ES803-4] clause 6.1. See clause 6.1.15.2.

nPLM (A_Sk): The Payload Mismatch anomaly (nPLM) is asserted when the accepted Trail Signal Label (TSL) is not equal to the Expected TSL (MI_ExSL). See clause 6.1.15.2.

6.1.15.2.2 Use

C2/TSL (A_So): Clause 8.4.2.1 (S4/BP_A_So).

C2/TSL (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

nPLM (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.1.15.2.3 Cross reference

nPLM: Used in clause 6.2.5.1 (dPLM).

6.1.16 Void

6.1.17 Void

6.1.18 Administrative modes

To prevent alarms being raised and failures being reported during trail provisioning actions trail termination functions shall have the ability to enable and disable fault cause declaration. This shall be controlled via their termination point mode and port mode parameter.

6.1.18.1 Void

6.1.18.2 Port mode

In physical section layers, the termination point mode is called the port mode. It has three modes (figure 12): MON, AUTO and NMON. The AUTO mode is like the NMON mode with one exception: if the LOS defect clears, the port mode is automatically changed into MON. This allows for alarm free installation without the burden of using a management system to change the monitor mode. The AUTO mode is optional. When it is supported, it shall be the default mode; otherwise, NMON shall be the default mode.

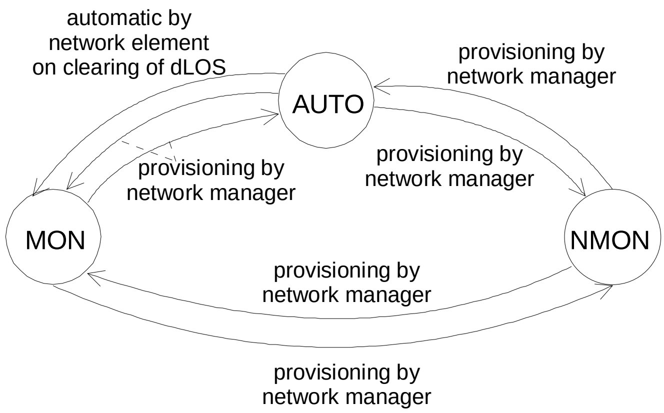


Figure 12: Port modes

6.1.18.2.1 Model

Processes and anomalies

PM (TT_Sk): The Port Mode (PM) state machine process according to clause 6.1.18.2.

MON (TT_Sk): The Monitor signal (MON) is asserted when the Port Mode (PM) state machine is in its MON state. See clause 6.1.18.2.

6.1.18.2.2 Use

PM (TT_Sk) : Clause 7.3.1.2 (M1_TT_Sk).

MON (TT_Sk): Clause 7.3.1.2 (M1_TT_Sk).

6.1.18.3 Administrative mode

In adaptation functions can the administrative use of the adapted resource be controlled through the administrative mode. It has three modes (figure 13): active (ACT), automatic (AUTO) and not active (NACT). The AUTO mode is like the NACT mode except that when defects clears, the administrative mode is automatically changed into ACT. This allows for alarm free installation without the burden of using a management system to change the administrative mode. The AUDO mode is optional. When supported, it shall be the default mode; otherwise, NACT shall be the default mode.

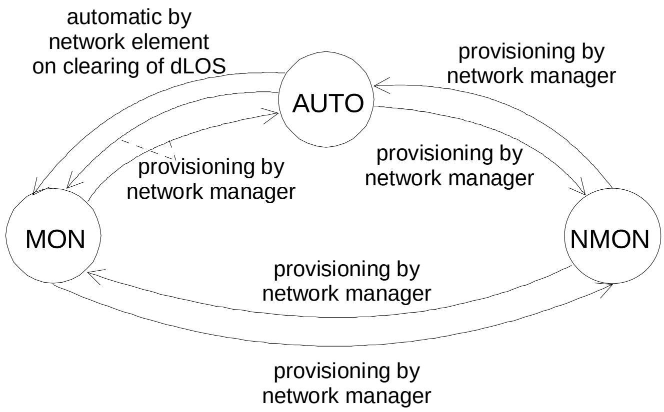


Figure 13: Administrative modes

6.1.18.3.1 Model

Processes and anomalies

AM (A_Sk): The Administrative Mode (PM) state machine process according to clause 6.1.18.3.

NACT (A_Sk): The Not Active signal (NACT) is deasserted when the Administrative Mode (PM) state machine is in its ACT state, else it is asserted. See clause 6.1.18.3.

6.1.18.3.2 Use

AM (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk) and 8.4.2.2 (S4/BP_A_Sk).

NACT (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk) and 8.4.2.2 (S4/BP_A_Sk).

6.2 Defect filter f1

Two classes of defects are distinguished: transmission and equipment defects. Transmission defects which are not dedicated to one specific layer are specified hereafter. Equipment defects are addressed at the end of this clause in general terms. Defect filter f1 integrates anomalies into defects by performing a persistency check.

Each atomic function specified in the present document monitors for (a subset of) the transmission defects given in table 6. The each atomic function type can generate any defect out of a subset of the transmission defects, the subset per atomic function is given in table 7.

Table 6: Transmission defects

signal loss	dLOS	Loss Of Signal defect
alignment loss	dLOF	Loss Of Frame defect
	dLOM	Loss Of Multiframe defect
	dLOJ	Loss Of Justification defect
		Generically - dLOA: Loss Of Alignment defect
mis-composed payload	dPLM	Payload Mismatch defect
bit errors	dDEG	Degraded signal defect
Alarm Indication Signal	dAIS	Alarm Indication Signal defect
protocol faults	dFOP	e.g. MSP protocol defect

Table 7: Defects generated in trail termination, adaptation and connection functions

Termination sink	Adaptation sink	Connection
dLOS	dPLM	dFOP
dDEG	dLOF	
	dLOM	
	dLOP	
	dAIS	

6.2.1 Continuity supervision

6.2.1.1 Loss of Signal defect (dLOS)

The Loss Of Signal (LOS) supervision is performed at the physical layer trail termination sink by monitoring the power level of the incoming signal.

6.2.1.1.1 Model

Defects

dLOS (TT_Sk): The Loss Of Signal defect (dLOS) is asserted when the Loss of Signal anomaly (nLOS) have been asserted, else it is deasserted. See clause 6.2.1.1.

6.2.1.1.2 Use

dLOS (TT_Sk): Clause 7.3.1.2 (M1_TT_Sk).

6.2.1.1.3 Cross reference

nLOS: Defined in clause 6.1.2.1.

dLOS: Used in clause 6.3.1.1 (aAIS), 6.4.1.1 (cLOS)

6.2.2 Void

6.2.3 Signal Quality supervision

Signal quality supervision monitors the performance of a trail. If the performance falls below a certain threshold this might activate a defect.

6.2.3.1 Error Detection Code defect

Bit errors in a signal are detectable by checking the signal's associated Error Detection Check (EDC) for violations. Examples of EDCs are the SDH BIP-N and 2 Mbit/s CRC-4.

EDC violation defect

The existence of an detected EDC anomaly (nN_EB) during a block will cause that block to be defect, i.e. the Near-end Error-Block defect (dN_EB) is asserted.

6.2.3.1.1 Model

Defects

dN_EB (TT_Sk/A_Sk): The Near-end Errored Block defect (dN_EB) is asserted when one or more Near-end Errored Block anomalies (nN_EB) have occurred during the period of a block. See clause 6.2.3.1.

dN_EB ← nN_EB

6.2.3.1.2 Use

dN_EB (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.2.3.1.3 Cross reference

nN_EB: Defined in clause 6.1.4.1.

dN_EB: Used in clause 6.5.1.1 (pN_EBC).

6.2.3.2 Degraded signal defect (dDEG) assuming bursty distribution of errors

Degraded signal defect (dDEG)

The Degraded defect (dDEG) shall be detected if M consecutive BAD seconds have occurred.

The Degraded defect (dDEG) shall be cleared if M consecutive GOOD seconds have occurred.

The defect shall be suppressed and the process shall be reset during the receipt of CI_SSF or dAIS detection.

M shall be provisioned by the network manager with:

$$2 \leq M \leq 10.$$

where M is the number of seconds in the (sliding) monitoring period.

NOTE: The monitor period restarts when a GOOD second has occurred after one or more BAD seconds, and when a BAD second has occurred after one or more GOOD seconds.

Hysteresis is for further study.

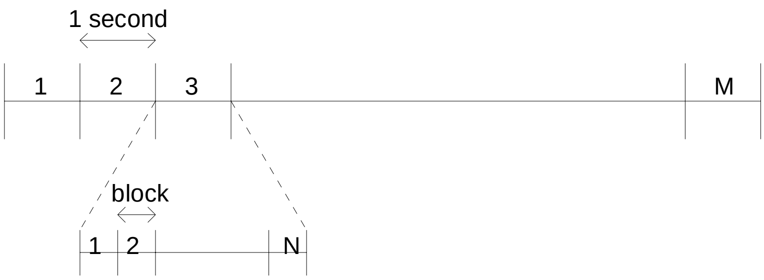


Figure 14: Signal degrade defect specification

6.2.3.2.1 Model

Defects

dDEG (TT_Sk/A_Sk): The Degraded signal defect (dDEG) is asserted when M consecutive Degrade Signal Period defects (dDSP) has been asserted and it shall be deasserted when M consecutive Degrade Signal Period anomaly (nDSP) has been deasserted. See clause 6.2.3.2.

6.2.3.2.2 Use

dDEG (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.2.3.2.3 Cross reference

nDSP: Defined in clause 6.1.4.2.

dDEG: Used in clause 6.4.3.1 (cDEG).

6.2.4 Alignment supervision

Alignment supervision checks that the client layer data can be correctly recovered. Detected according to the generic definitions in [G.806, clause 6.2.5].

6.2.4.1 Loss of Frame defect (dLOF)

Generic

The persistence filtering of Loss Of Frame anomaly (nLOF) expects three consecutive deasserted nLOF (on frame alignment opportunity) to enter the In Frame state, and requires 5 consecutive asserted (on frame alignment opportunity) to enter the Out Of Frame state. On reset of the function shall the default state be the Out Of Frame state. When the frame defect persistence state machine is in the Out Of Frame state, the Loss Of Frame defect (dLOF) is asserted.

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The persistence filtering is performed in the Frame Synchronization State Machine as defined in ES 201 803-3 [ES803-3] clause 9.6.3.

DCAP-1

The DCAP-1 specification in clause 12.2 gives the criteria.

6.2.4.1.1 Model

Defects

Generic:

(A_Sk): The justification persistence state machine monitors the Loss Of Frame anomaly (nLOF). The default state is Out Of Frame (OOF). When in the OOF state the nLOF is deasserted on three consecutive justification opportunities, the state of the machine shall change to In Frame (IF). When in the IF state the nLOF is asserted on five consecutive justification opportunities, the state of the machine shall change to OOF. See clause 6.2.4.1.

dLOF (A_Sk): The Loss Of Frame defect (dLOF) shall be asserted when the justification persistence state machine is in the OOF state. See clause 6.2.4.1.

DTM 8B10B:

dLOF (A_Sk): The Loss Of Frame defect (dLOF) is asserted when the Loss Of Frame anomaly (nLOF) is asserted, else it is deasserted. See clause 6.2.4.1.

DCAP-1:

dLOF (A_Sk): The Loss Of Frame defect (dLOF) is asserted when the Loss Of Frame anomaly (nLOF) is asserted, else it is deasserted. See clause 6.2.4.1 and 12.2.

6.2.4.1.2 Use

Generic

(A_Sk): Clause X.X.X.X (_A_Sk).

dLOF (A_Sk): Clause X.X.X.X (_A_Sk).

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dLOF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

DCAP-1

dLOF (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.2.4.1.3 Cross reference

nLOF: Defined in clause 6.1.9.3 (8B10B).

dLOF: Used in clause 6.3.1.1 (aAIS), 6.4.4.2 (cLOF).

6.2.4.2 Loss of Justification defect (dLOJ)

The persistence filtering of Loss Of Justification anomaly (nLOJ) expects three consecutive deasserted nLOJ (on justification opportunity) to enter the In Frame state, and requires 5 consecutive asserted (on justification opportunity) to enter the Out Of Frame state. On reset of the function shall the default state be the Out Of Frame state. When the justification persistence state machine is in the Out Of Frame state, the Loss Of Justification defect (dLOJ) is asserted.

6.2.4.2.1 Model

Defects

(A_Sk): The justification persistence state machine monitors the Loss Of Justification anomaly (nLOJ). The default state is Out Of Frame (OOF). When in the OOF state the nLOJ is deasserted on three consecutive justification opportunities, the state of the machine shall change to In Frame (IF). When in the IF state the nLOJ is asserted on five consecutive justification opportunities, the state of the machine shall change to OOF. See clause 6.2.4.2.

dLOJ (A_Sk): The Loss Of Justification defect (dLOJ) shall be asserted when the justification persistence state machine is in the OOF state. See clause 6.2.4.2.

6.2.4.2.2 Use

(A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk).

dLOJ (A_Sk): [ES803-6] clause 5.4.1.2 (AP0/S4_A_Sk).

6.2.4.2.3 Cross reference

nLOJ: Defined in clause 6.1.9.4.

6.2.5 Payload type supervision

Payload type supervision checks that compatible adaptation functions are used at the source and the sink.

6.2.5.1 Payload composition and payload mismatch defect (dPLM)

The dPLM shall be detected within a maximum period of 100 ms in the absence of bit errors.

The dPLM shall be cleared within a maximum period of 100 ms in the absence of bit errors.

The defect detection process and its operation during the presence of bit errors is for further study.

The defect shall be suppressed during the receipt of AI_TSF.

6.2.5.1.1 Model

Defects

dPLM (A_Sk): The Payload Mismatch defect (dPLM) is asserted when the Payload Mismatch anomaly (nPLM) is asserted, else it is deasserted. nPLM and dPLM is specified in clause 6.2.5.1.

6.2.5.1.2 Use

dPLM (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.2.5.1.3 Cross reference

nPLM: Defined in clause 6.1.15.1 (DCAP-1 CMI) and 6.1.15.2 (VC4 C2 payload type).

dPLM: Used in clause 6.3.1.1 (aAIS), 6.4.5.1 (cPLM), 6.4.6.1 (cAIS).

6.2.6 Maintenance signal supervision

Maintenance signal supervision is concerned with the detection of maintenance indications in the signal.

6.2.6.1 Alarm Indication Signal defect (dAIS)

The Alarm Indication Signal (AlS) is an adapted information signal. It is generated to replace the normal traffic signal when it contains a defect condition in order to prevent consequential downstream failures being declared and alarms being raised. Within DTM channels is the AIS encoded into a dedicated DTM AIS special marker.

AIS insertion in the sink direction is controlled as follows: every atomic function inserts AIS on locally detected defects only, with one of the defects being incoming AIS from upstream atomic functions.

The AIS exists in two forms, those generated by the DTM services and those generated by the DTM network. The causes of DTM network AIS is those relating to generic transmission of the channel where as the causes for an DTM service AIS is specific to that service.

The DTM network AIS is caused by dLOS, dLOF, dLOJ and other forms of transmission path supervision.

The DTM service AIS is caused by ingress side dLOS, dLOF etc. as well as receiver mapping problems. AIS generation may also occur at the egress side, which however do not generate a DTM service AIS but may result in service specific AIS handling just as the received and detected AIS will result in.

6.2.6.1.1 Model

Defects

dAIS (A_Sk): The Alarm Indication Signal defect (dAIS) is asserted when the Alarm Indication Signal anomaly (nAIS) is asserted for more than three consecutive DTM frames, else it is deasserted. See clause 6.2.6.1.

6.2.6.1.2 Use

dAIS (A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.2.6.1.3 Cross reference

nAIS: Defined in clause 6.1.5.1.

dAIS: Used in clause 6.3.1.1 (aAIS) and 6.4.6.1 (cAIS).

6.3 Consequent action filter f2

This clause describes the consequent actions that can be generated by an atomic function within an NE as a result of anomalies/defects.

After a defect (see note) is detected, one or more of the following consequent actions may be requested:

- all-ONEs (AIS) insertion;
- generation of "Server Signal Fail (SSF)" signal;
- generation of "Trail Signal Fail (TSF)" signal;
- generation of "Trail Signal Degrade (TSD)" signal.

Table 8: Consequent action request generation in trail termination, adaptation and connection functions

Termination sink	Adaptation sink	Connection
aAIS	aAIS	
aTSF	aSSF	
	dLOJ	

Figure 15 shows how the aAIS consequent action request signals control the associated consequent actions: insertion of Alarm Indication Signal (AIS). Figure 15 also shows the location of aSSF, aTSF and aTSD consequent action requests.

Detected defects cause the insertion of the Alarm Indication Signal (AIS) in Trail Termination sink functions. Detected defects cause the insertion of the Alarm Indication Signal (AIS) in adaptation sink functions. The reception of a Server Signal Fail (SSF) indication causes the insertion of Alarm Indication Signal (AIS) in the adaptation source. Refer to clause 8.2.2.1 for details.

In case where the Alarm Indication Signal (AIS) is inserted either in a trail termination sink or in the previous adaptation sink function.

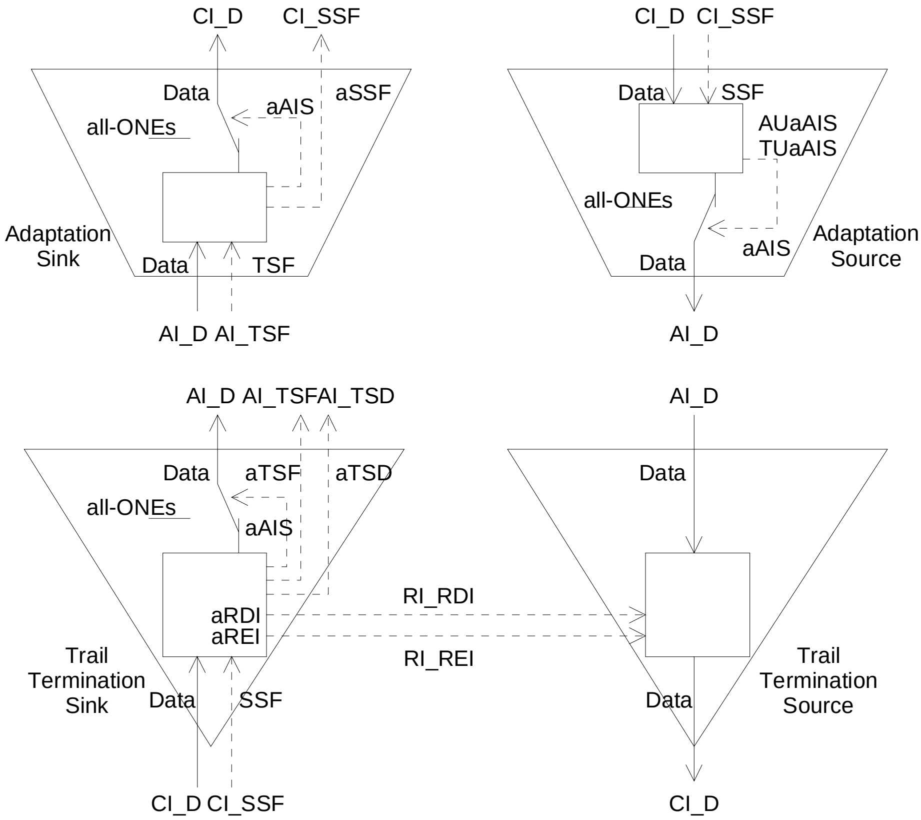


Figure 15: Consequent Action control: AIS

The behaviour of PDH path layer connection functions if an output is not connected to one of the inputs is for further study.

6.3.1 Maintenance signal supervision

Individual network layer management

When managing network layers is in isolation, i.e. when no information is available from the server layer, then the layer manager can not rely on failure reports from the server layers to obtain an accurate overview of the fault status of its incoming signals. As most trail termination functions do not detect incoming AIS to report a server layer fault, the layer and its manager have to be informed of such fault by means of the server signal fail signal/report.

On reception of an SSF failure, the layer manager may initiate a re-routing of the associated traffic via its layer connection functions.

Severity control of protection reports

The severity of a maintenance alarm is often related to the interruption of a traffic signal. If the signal is interrupted, a prompt maintenance alarm is to be activated.

When that traffic signal is transmitted via a protected trail or protected subnetwork connection, interruption of the signal in either the working or protection trail "does not affect" the transport of the signal over the protected trail. The protection function selects the other trail. If, however, both working and protection trail experience a fault, the transport of the signal is interrupted.

In the first case, a deferred maintenance alarm is to be activated, while in the second case a prompt maintenance alarm is required.

The (protection) trail termination function immediately following the (protection) connection function reports the fault status of the protected signal. If the signal output by the (protection) connection function contains Alarm Indication Signal (AIS), the protection failed and a prompt maintenance alarm is typically activated. The protection may have failed due to a double fault condition, or a single fault condition and an external protection switch request forcing the protection switch to select the failed trail.

6.3.1.1 Alarm Indication Signal (AIS)

The Alarm Indication Signal (AIS) replaces the received signal under detected defect conditions in order to prevent downstream failures being declared and alarms being raised. Refer to clause 7.5 for a description of the application and the insertion control.

6.3.1.1.1 Model

Consequent action

aAIS (TT_Sk): The Alarm Indication Signal action (aAIS) is asserted when the Alarm Indication Signal defect (dAIS) or the Loss Of Signal defect (dLOS) is asserted, else it is deasserted. See clause 6.3.1.1.

aAIS ← dAIS or dLOS.

aAIS (A_So): The Alarm Indication Signal action (aAIS) is asserted when the Server Signal Fail (SSF) is asserted, else it is deasserted. See clause 6.3.1.1.

aAIS ← CI_SSF.

aAIS (A_Sk): The Alarm Indication Signal action (aAIS) is asserted when the Payload Mismatch defect (dPLM) is asserted, the Loss OF Alignment defect (dLOA), the Alarm Indication Signal defect (dAIS)/Trail Signal Fail (AI_TSF) is asserted or the Not Active (NACT) is asserted, else it is deasserted. See clause 6.3.1.1.

aAIS ← dPLM or dLOA or dAIS/AI_TSF or NACT.

6.3.1.1.2 Use

aAIS (TT_Sk): Clause X (_TT_Sk).

aAIS (A_So): [ES803-6] clause 5.4.1.1 (AP0/S4_A_So) and 5.4.2.1 (AP0/S3_A_So).

aAIS (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.3.1.1.3 Cross reference

dLOS: Defined in clause 6.2.1.1.

dLOA: Defined in clause 6.2.4.1 (dLOF) and 6.2.4.2 (dLOJ).

dPLM: Defined in clause 6.2.5.1.

dAIS: Defined in clause 6.2.6.1.

6.3.1.2 Server Signal Fail (SSF)

The CI_SSF signal (generated by the adaptation sink function) informs the next downstream function of the "signal fail" condition of the associated data signal (which contains, due to that "signal fail" condition, the Alarm Indication Signal (AIS) pattern).

The CI_SSF signal, when connected to a connection function with protection functionality, represents the Signal Fail (SF) conditions.

CI_SSF signals are used to forward the defect condition of the server to the client in the next (sub-) layer, to:

- prevent defect detection in layers without incoming AIS detectors in trail termination sink functions;

- report the server signal fail condition in layers without incoming AIS detectors in trail termination sink functions;
- control the AIS insertion in adaptation source functions;
- initiate protection switching/restoration in the (protection-)connection function.

6.3.1.2.1 Model

Consequent action

aSSF (A_Sk): The Server Signal Fail action (aSSF) is asserted when the Path Label Mismatch defect (dPLM) is asserted, the Alarm Indication Signal defect (dAIS)/Trail Signal Fail (AI_TSF) is asserted or the Loss Of Alignment defect (dLOA) is asserted. See clause 6.3.1.2.

aSSF ← dPLM or dAIS/AI_TSF or dLOA.

NOTE 1: In case the adaptation function does not detect the AIS defect, the dAIS term will be replaced by AI_TSF generated by the previous TT_Sk.

NOTE 2: The term dLOA is the general indication for dLOF, dLOM or dLOP whichever is applicable.

6.3.1.2.2 Use

aSSF (A_Sk): Clause 7.4.1.2 (M1/PL1_A_Sk), 8.4.1.2 (PL1/BP_A_Sk), 8.4.2.2 (S4/BP_A_Sk), 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk). [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.3.1.3 Trail Signal Fail (TSF)

The AI_TSF signal (generated by a trail termination sink function) informs the next downstream function(s) of the "signal fail" condition of the associated data signal (which contains, due to that "signal fail" condition, the Alarm Indication Signal (AIS) pattern).

The AI_TSF signal, when connected to a connection function with protection functionality, represents a Signal Fail (SF) conditions.

AI_TSF signals are used to forward the defect condition of the trail to the:

- adaptation sink function, to control Alarm Indication Signal (AIS) insertion in the function, when the function does not perform AIS defect detection;
- protection connection function in the trail protection sub layer, to initiate trail protection switching in that function;
- connection function in the same layer which performs a non-intrusively monitored protection scheme, to initiate protection switching in that function. Refer to clause 5.8.

6.3.1.3.1 Model

Consequent action

aTSF (TT_Sk): The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted, the Loss Of Signal defect (dLOS) is asserted or the Trace Identifier Mismatch defect (dTIM) is asserted. See clause 6.3.1.3.

aTSF ← CI_SSF or dLOS or dTIM.

6.3.1.3.2 Use

aTSF (TT_Sk): Clause 7.3.1.2 (M1_TT_Sk), 8.3.1.2 (PL1_TT_Sk), 9.3.1.2 (BP_TT_Sk), 9.3.2.2 (BPP_TT_Sk), 10.3.1.2 (TS_TT_Sk), 10.3.2.2 (TSP_TT_Sk), 10.3.3.2 (TST_TT_Sk), 11.3.1.2 (CH1_TT_Sk), 11.3.2.2 (CH1P_TT_Sk), 11.3.3.2 (CH2_TT_Sk) and 11.3.3.4 (CH2P_TT_Sk).

6.3.2 Additional actions

This clause contains additional actions for more specific uses.

6.3.2.1 8B10B Error Detection

The 8B10B block code causes error detection to be first on the code group (the block) and then possibly on the combinations of code groups.

6.3.2.1.1 Model

Consequent action

aCGF (TT_Sk): The Code Group Fail action (aCGF) is asserted when the Code Group Fail anomaly (nCGF) is asserted. See clause 6.3.2.1.

aCGF ← nCGF.

6.3.2.1.2 Use

aCGF (TT_Sk): Clause 8.3.1.2 (PL1_TT_Sk).

6.3.2.2 8B10B bit alignment control

The 8B10B block code system involves bit alignment by a lower layer than the state of encoding. During stable conditions the bit alignment is disabled for the benefit of stability and it is enabled when loss of alignment seems probable.

6.3.2.2.1 Model

Consequent action

aEN_FS (A_Sk): The Enable Frame Signal action (aEN_FS) is asserted when the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.2.2.

aEN_FS ← dLOF.

6.3.2.2.2 Use

aEN_FS (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.3.2.3 Port state

The availability of a physical interface (a port) can be achieved by output an additional signal over the management interface providing the aggregated error conditions of that physical interface.

6.3.2.3.1 Model

Consequent action

aTSF (A_Sk): The Trail Signal Fail action (aTSF) is asserted when the Loss Of Frame defect (dLOF) is asserted, the Trail Signal Fail (AI_TSF) is asserted or the Not Active (NACT) is asserted. See clause 6.3.2.3.

aTSF ← dLOF or AI_TSF or NACT

6.3.2.3.2 Use

aTSF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk) and 8.4.2.2 (S4/BP_A_Sk).

6.4 Defect correlations/Fault cause filter f3

Defect correlations according to [G.806, clause 6.4].

A fault may cause multiple defect detectors to be activated. To determine, from the activated defects, which fault is present, the activated defects are correlated to obtain the fault cause.

Table 9: Fault Causes per atomic function

Termination sink	Adaptation sink	Connection
cLOS	cPLM	
cDEG	cLOF	
cSSF	cLOJ	
	cAIS	

The cZZZ fault causes (correlated defects) shall be activated if the expression is true. cZZZ shall be deactivated if the expression is false.

6.4.1 Continuity supervision

The continuity supervision fault cause filter establish which fault cause the problem.

6.4.1.1 Loss of Signal cause (cLOS)

The Loss of Signal cause (cLOS) indicate when the failure where due to the loss of signal power.

6.4.1.1.1 Model

Defect correlation

cLOS (TT_Sk): The Loss Of Signal cause (cLOS) is asserted when the Monitoring (MON) is asserted and the Loss Of Signal defect (dLOS) is asserted. See clause 6.4.1.1.

cLOS ← MON and dLOS.

6.4.1.1.2 Use

cLOS (TT_Sk): Clause 7.3.1.2 (M1_TT_Sk).

6.4.1.1.3 Cross reference

dLOS: Defined in clause 6.2.1.1.

cLOS: Used in clause 6.6.1.1 (fLOS).

6.4.2 Void

6.4.3 Signal quality supervision

The signal quality supervision fault cause filter detects the signal quality cause of a failure.

6.4.3.1 Degraded signal cause (cDEG)

The Degraded signal cause (cDEG) indicates when the failure where due to the degrades signal quality.

6.4.3.1.1 Model

Defect correlation

cDEG (TT_Sk/A_Sk): The Degraded signal cause (cDEG) is asserted when Monitoring (MON) is asserted, the Trace Identifier Mismatch defect (dTIM) is deasserted and the Degraded signal defect (dDEG) is asserted. See clause 6.4.3.1.

cDEG ← MON and (not dTIM) and dDEG.

6.4.3.1.2 Use

cDEG (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH2/AP1_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.4.3.1.3 Cross reference

dDEG: Defined in clause 6.2.3.2.

cDEF: Used in clause 6.6.1.2 (fDEG).

6.4.4 Alignment supervision

The alignment supervision fault cause filter detects the alignment cause of a failure.

6.4.4.1 Loss of Frame cause (cLOF)

The Loss of Frame cause (cLOF) indicates when the failure where due to the loss of frame synchronization of an alignment process.

6.4.4.1.1 Model

Defect correlation

cLOF (A_Sk): The Loss Of Frame cause (cLOF) is asserted when the Loss Of Alignment defect (dLOA) is asserted, the Alarm Indication Signal defect (dAIS)/Trail Signal Fail (AI_TSF) is deasserted, the Payload Mismatch defect (dPLM) is deasserted and the Monitoring (MON) is asserted. See clause 6.4.4.1.

cLOF ← dLOF and (not dAIS/AI_TSF) and (not dPLM) and MON.

6.4.4.1.2 Use

cLOF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk), 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.4.4.1.3 Cross reference

cLOF: Used in clause 6.6.1.5 (fLOF).

6.4.4.2 Loss of Justification cause (cLOJ)

The Loss of Justification cause (cLOJ) indicates when the failure where due to the loss of a justification frame synchronization of a justification process.

6.4.4.2.1 Model

Defect correlation

cLOJ (A_Sk): The Loss Of Justification cause (cLOJ) is asserted when the Loss Of Justification defect (dLOJ) is asserted, the Alarm Indication Signal defect (dAIS)/Trail Signal Fail (AI_TSF) is deasserted, the Payload Mismatch defect (dPLM) is deasserted and the Monitoring (MON) is asserted. See clause 6.4.4.2.

cLOJ ← dLOJ and (not dAIS/AI_TSF) and (not dPLM) and MON

6.4.4.2.2 Use

cLOJ (A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.4.4.2.3 Cross reference

cLOJ: Used in clause 6.6.1.6 (fLOJ).

6.4.5 Payload type supervision

The payload supervision fault cause filter detects the payload type cause of a failure.

6.4.5.1 Payload Mismatch cause (cPLM)

The Payload Mismatch cause (cPLM) indicates when the failure is due to the mismatch in the payload type of data with supervised payload type associated (i.e. CMI field in DCAP-1).

6.4.5.1.1 Model

Defect correlation

cPLM (A_Sk): The Payload Mismatch cause (cPLM) is asserted when the Payload Mismatch defect (dPLM) is asserted and the Trail Signal Failure (AI_TSF) is deasserted. See clause 6.4.5.1.

cPLM ← dPLM and (not AI_TSF)

6.4.5.1.2 Use

cPLM (A_Sk): clause 8.4.2.2 (S4/BP_A_Sk).

6.4.5.1.3 Cross reference

dPLM: Defined in clause 6.2.5.1.

6.4.6 Maintenance signal supervision

The maintenance signal supervision cause filter detects the maintenance signal cause of a failure.

6.4.6.1 Alarm Indication Signal cause (cAIS)

It shall be provisionable to report AIS as a fault cause. This is controlled by means of the parameter AIS_reported. The default shall be AIS_Reported = false.

NOTE: By default, AIS as such is not reported. Instead trail terminations shall report (as an option) that the server (layer) failed to pass the signal (Server Signal Fail) if they receive the all-ONEs (AIS) signal. This reduces the declaration of "AIS failures" to one failure (fSSF) at the Trail Termination NE. No failures are generated at intermediate nodes in the (long) trail. Refer to clause 7.7.2.

6.4.6.1.1 Model

Defect correlation

cAIS (A_Sk): The Alarm Indication Signal cause (cAIS) is asserted when the Alarm Indication Signal defect (dAIS) is asserted, the Trail Signal Failure (AI_TSF) is deasserted, the Payload Mismatch defect (dPLM) is deasserted and Alarm Indication Signal Reported (AIS_Reported) is asserted. See clause 6.4.6.1.

cAIS ← dAIS and (not AI_TSF) and (not dPLM) and AIS_Reported.

6.4.6.1.2 Use

cAIS (A_Sk): Clause 8.4.2.2 (S4/BP_A_Sk).

6.4.6.1.3 Cross reference

dPLM: Defined in clause 6.2.5.1.

dAIS: Defined in clause 6.2.6.1.

cAIS: Used in clause 6.6.1.3 (fAIS).

6.4.6.2 Server Signal Fail cause (cSSF)

It shall be provisionable to report SSF as a fault cause. This is controlled by means of the parameter SSF_reported. The default shall be SSF_Reported = false.

6.4.6.2.1 Model

Defect correlation

cSSF (TT_Sk): The Server Signal Fail cause (cSSF) is asserted when Monitoring (MON) is asserted, the Server Signal Fail (CI_SSF) is asserted and the Server Signal Fail Reported (SSF_Reported) is asserted. See clause 6.4.6.2.

cSSF ← MON and CI_SSF and SSF_Reported.

8B10B:

cOSF (A_Sk): The Ordered Set Fail cause (cOSF) is asserted when either the Ordered Set Fail anomaly (nOSF) or Code Group Fail (AI_CGF) is asserted, the Trail Signal Fail (AI_TSF) is deasserted and Monitoring (MON) is asserted. See clause 6.4.6.2.

cSSF ← (nOSF or AI_CGF) and (not AI_TSF) and MON

6.4.6.2.2 Use

cSSF (TT_Sk): Clause 8.3.1.2 (PL1_TT_Sk), 9.3.1.2 (BP_TT_Sk), 9.3.2.2 (BPP_TT_Sk), 10.3.1.2 (TS_TT_Sk), 10.3.2.2 (TSP_TT_Sk), 10.3.3.2 (TST_TT_Sk), 11.3.1.2 (CH1_TT_Sk), 11.3.2.2 (CH1P_TT_Sk), 11.3.3.2 (CH2_TT_Sk) and 11.3.4.2 (CH2P_TT_Sk).

cSSF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk).

6.4.6.2.3 Cross reference

nOSF: Defined in clause 6.1.4.1.

6.4.6.3 Trail Signal Fail cause (cTSF)

The Trail Signal Fail cause (cTSF) indicates when the failure is due to a trail supervision signal indication.

6.4.6.3.1 Model

Defect correlation

cTSF (A_Sk): The Trail Signal Fail cause (cTSF) is asserted when Monitoring (MON) is asserted, the Trail Signal Fail (AI_TSF) is asserted and the Trail Signal Fail Reported (TSF_Reported) is asserted. See clause 6.4.6.3.

cTSF ← MON and AI_SSF and TSF_Reported.

6.4.6.3.2 Use

cTSF (A_Sk): Clause 8.4.1.2 (PL1/BP_A_Sk), 8.4.2.2 (S4/BP_A_Sk) and 11.4.3.2 (CH1/AP2_A_Sk).

6.5 One second performance monitoring filters

Table 10: Performance monitoring in atomic functions

Termination sink	Adaptation sink	Connection	Adaptation source
pN_EBC			pFJ
pN_DS			

6.5.1 Signal Quality supervision - f11 (pN_EBC)

Signal quality supervision monitors the performance of a trail. If the performance falls below a certain threshold this might activate a defect.

6.5.1.1 Error Detection Code

Bit errors in a signal are detectable by checking the signal's associated Error Detection Check (EDC) for violations. Examples of EDCs are the SDH BIP-N and 2 Mbit/s CRC-4.

The existence of an Near-end Error Block defect (dN_EB), shall be applied to the Near-end Errored Block Count (N_EBC) counter. This N_EBC counter shall count the errored blocks during one second intervals. At the end of the interval the count equals pN_EBC.

The performance monitoring one second periods (clause 8.4) are the one second interval boundaries.

6.5.1.1.1 Model

Performance monitoring

pN_EBC (TT_Sk/A_Sk): The Near-end Error Block Count performance (pN_EBC) is the sum of Near-end Errored Blocks defects (dN_EB) during a second. See clause 6.5.1.1.

pN_EBC $\leftarrow \sum$ dN_EB.

6.5.1.1.2 Use

pN_EBC (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.5.1.1.3 Cross reference

dN_EB: Defined in clause 6.2.3.1.

pN_EBC: Used in clause 6.1.4.2 (nDSP).

6.5.2 Signal Quality supervision - f12 (pN_DS)

Every second with at least one occurrence of aTSF (i.e. CI_SSF, dAIS or dTIM) shall be indicated as a Near-end Defect Second (pN_DS).

pN_DS $\leftarrow$ aTSF.

6.5.2.1 Model

Performance monitoring

pN_DS (TT_Sk/A_Sk): The Near-end Defect Second performance (pN_DS) is the existence of at least one occurrence of Trail Signal Failure action (aTSF) during a second. See clause 6.5.2.1.

pN_DS $\leftarrow$ aTSF

6.5.2.2 Use

pN_DS (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.5.3 Frequency Justification performance counters (pFJ)

Frequency justification may require supervision in order to detect excess justification due to degraded incoming signal frequency offset or stability.

6.5.3.1 Positive frequency justification performance counter (pFJ+)

Holds the total number of positive frequency justifications done during a 1 second period.

6.5.3.1.1 Model

Performance monitoring

pFJ+ (A_So): The Positive Frequency Justification performance (pFJ+) is the number of positive frequency justifications anomalies (nFJ+) that has occurred during 1 second. See clause 6.5.3.1.

pFJ+ $\leftarrow \Sigma$ nFJ+.

6.5.3.1.2 Use

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So) and [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

6.5.3.1.3 Cross reference

nFJ+: Defined in clause 6.1.8.1 (DCAP-0), 6.1.8.2 (DCAP-1) and 6.1.8.3 (DCAP-2).

pFJ+: Used in clause 6.8.5.2 (FJ+(t-10)).

6.5.3.2 Negative frequency justification performance counter (pFJ-)

Holds the total number of negative frequency justifications done during a 1 second period.

6.5.3.2.1 Model

Performance monitoring

pFJ- (A_So): The Negative Frequency Justification performance (pFJ-) is the number of negative frequency justifications anomalies (nFJ-) that has occurred during 1 second. See clause 6.5.3.2.

pFJ- $\leftarrow \Sigma$ nFJ-

6.5.3.2.2 Use

(A_So): Clause 11.4.3.1 (CH1/AP2_A_So) and [ES803-6] clause 5.4.1.1 (AP0/S4_A_So).

6.5.3.2.3 Cross reference

nFJ-: Defined in clause 6.1.8.1 (DCAP-0), 6.1.8.2 (DCAP-1) and 6.1.8.3 (DCAP-2).

pFJ-: Used in clause 7.8.5.2 (FJ-(t-10)).

6.6 Fault management

The equipment management function within the network element performs a persistency check on the fault causes before it declares a fault cause a failure. The fault causes are generated by the atomic function fault management process (clause 8.2). A severity is associated with each alarm.

The failure is reported via the agent process (output failure report) and by means of alarms (audible and visible indicators). Typically, alarms can be divided into unit level alarms, NE level alarms and station alarms.

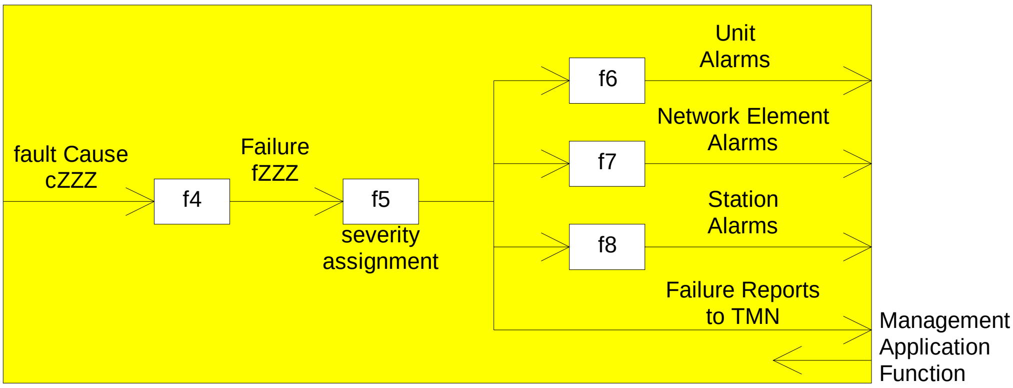


Figure 16: Fault management inside EMF function

Table 11: Fault management filter functions

Filter	Function
f4	integration of fault causes into failures
f5	assign severity to failure
f6	translation of failures into Unit alarms
f7	translation of failures into Network Element alarms (e.g. severity)
f8	translation of failures into station alarms & alarm disconnect control

6.6.1 Failure filter f4

A transmission failure shall be declared if the fault cause persists continuously for 2,5 ± 0,5 s. The failure shall be cleared if the fault cause is absent continuously for 10 ± 0,5 s.

The failure change (declaration/clearing) shall be time stamped. The time stamp shall indicate the start of the fault cause to failure integration time. The time stamp shall have an accuracy of 1 second relative to the NE-RTC.

A generic list of failures is shown in table 12.

Table 12: Failures declared per atomic function

Termination sink	Adaptation sink	Connection
fLOS	fAIS	
fDEG	fLOF	
fSSF	fLOJ	
	fPLM	

6.6.1.1 Loss Of Signal fault (fLOS)

6.6.1.1.1 Model

Defect correlation

fLOS (TT_Sk): The Loss Of Signal fault (fLOS) is asserted when the Loss Of Signal cause (cLOS) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOS have been deasserted for $10 \pm 0{,}5$ s.
See clause 6.6.1.1.

6.6.1.1.2 Use

fLOS (TT_Sk): Clause X (_TT_Sk).

6.6.1.1.3 Cross reference

cLOS: Defined in clause 6.4.1.1.

6.6.1.2 Degraded signal fault (fDEG)

6.6.1.2.1 Model

Defect correlation

fDEG (TT_Sk/A_Sk): The Degraded signal fault (fDEG) is asserted when the Degraded signal cause (cDEG) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cDEG have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.2.

6.6.1.2.2 Use

fDEG (TT_Sk/A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.6.1.2.3 Cross reference

cDEG: Defined in clause 6.4.3.1.

6.6.1.3 Alarm Indication Signal fault (fAIS)

6.6.1.3.1 Model

Defect correlation

fAIS (A_Sk): The Alarm Indication Signal fault (fAIS) is asserted when the Alarm Indication Signal cause (cAIS) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cAIS have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.3.

6.6.1.3.2 Use

fAIS (A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.6.1.3.3 Cross reference

cAIS: Defined in clause 6.4.6.1.

6.6.1.4 Server Signal Fail fault (fSSF)

6.6.1.4.1 Model

Defect correlation

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s.
See clause 6.6.1.4.

6.6.1.4.2 Use

fSSF (TT_Sk): Clause 9.3.1.2 (BP_TT_Sk), 9.3.2.2 (BPp_TT_Sk), 10.3.1.2 (TS_TT_Sk), 10.3.2.2 (TSp_TT_Sk), 10.3.3.2 (TSt_TT_Sk).

6.6.1.4.3 Cross reference

cSSF: Defined in clause 6.4.6.2.

6.6.1.5 Loss Of Frame alignment fault (fLOF)

6.6.1.5.1 Model

Defect correlation

fLOF (A_Sk): The Loss Of Frame alignment fault (fLOF) is asserted when the Loss Of Frame cause (cLOF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOF have been deasserted for $10 \pm 0{,}5$ s.
See clause 6.6.1.5.

6.6.1.5.2 Use

fLOF (A_Sk): Clause 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.6.1.5.3 Cross reference

cLOF: Defined in clause 6.4.4.1.

6.6.1.6 Loss Of Justification fault (fLOJ)

6.6.1.6.1 Model

Defect correlation

fLOJ (A_Sk): The Loss Of Justification fault (fLOF) is asserted when the Loss Of Justification cause (cLOJ) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOJ have been deasserted for $10 \pm 0{,}5$ s.
See clause 6.6.1.6.

6.6.1.6.2 Use

fLOJ (A_Sk): [ES803-6] Clause 5.4.1.2 (AP0/S4_A_Sk) and 5.4.2.2 (AP0/S3_A_Sk).

6.6.1.6.3 Cross reference

cLOJ: Defined in clause 6.4.4.2.

6.6.1.7 Payload Mismatch fault (fPLM)

6.6.1.7.1 Model

Defect correlation

fPLM (A_Sk): The Payload Mismatch fault (fPLM) is asserted when the Payload Mismatch cause (cPLM) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cPLM have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.7.

6.6.1.7.2 Use

fPLM (A_Sk): Clause X (_A_Sk).

6.6.1.7.3 Cross reference

cPLM: Defined in clause 6.4.5.1.

6.6.2 Severity assignment filter f5

A severity is used to indicate the management perception of the severity of a fault which could depend on the service dependency of the fault. See EN 301 167 [EN167].

NOTE: Two severity schemes are being used. One based on the ITU-T Recommendations X series which has the severity elements: critical, major, minor and warning. The other based on the ITU-T Recommendation M.20 [M20] which has the severity elements: Prompt Maintenance Alarm (PMA), Deferred Maintenance Alarm (DMA) and Maintenance Event Information (MEI).

6.6.3 Replaceable unit alarm filter f6

There are so many preferences amongst the public network operators, standardization of the unit alarms is not possible at the moment.

NOTE: The role of this interface within management procedures should be reviewed in light of increased functionality of the Q interface.

6.6.4 Network element alarm filter f7

There are so many preferences amongst the public network operators, standardization of the network element alarms is not possible at the moment.

NOTE: The role of this interface within management procedures should be reviewed in light of increased functionality of the Q interface.

6.6.5 Station alarm filter f8

There are so many preferences amongst the public network operators, standardization of the network element alarms is not possible at the moment.

NOTE: The role of this interface within management procedures should be reviewed in light of increased functionality of the Q interface.

6.7 Network Element - Real Time Clock (NE-RTC) Function

Symbol

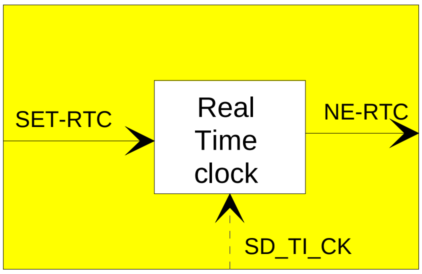


Figure 17: NE RTC function

Interfaces

Table 13: NE-RTC input and output signals

Input(s)	Output(s)
SET-RTC	NE-RTC
SD_TI_CK	

Processes

The real time clock is a logical entity within the NE which provides date and time information to equipment management functions within the NE.

The real time clock shall have a resolution of 1 second.

The date shall be represented as YYYY-MM-DD according to ISO 8601 [ISO8601] and be "year 2000" compliant. The time shall be represented as hh:mm:ss according to ISO 8601 [ISO8601] (UTC implied by format). The combined date and time shall be represented as YYYY-MM-DDThh:mm:ss (:ss may be dropped when :00 is implied by synchronism and it is explicitly declared when it may be done) according to ISO 8601 [ISO 8601] (UTC implied by format).

On receipt of the SET-RTC command, the real time clock shall be set to the YYYY-MM-DDThh:mm:ss specified by the SET-RTC command.

On a regular basis, the RTC is to be realigned with UTC. This realignment period should be determined such that the correction is less than ±10 s to prevent that all active PMFs declare suspect intervals.

NOTE 1: Other systems applications may require tighter timing requirements and therefore override this timing requirement, which is only the requirement for performance monitoring purposes.

NOTE 2: The RTC is assumed to be in UTC and not a local time zone. This is to overcome with cross time-zone issues for large geographical networks.

The real time clock may be a free running clock or may be locked to any available clock source (e.g. equipment clock SD_TI_CK).

NOTE 3: It is recommended that a continuous time transfer strategy is implemented, such as that of the IETF NTPv3.

The stability of the real time clock shall be such that in any 24 hour period (where a SET-RTC command has not been received), the RTC shall not have deviated by more than ±2 s from the 24 hour period of a UTC.

NOTE 4: This relates approximately to the maximum frequency offset of a ±50 ppm undisciplined clock oscillator.

When a SET-RTC command is received, the error between the Management command at the input to the NE (figure 18) and the resultant NE-RTC time shall be within ±1 s.

NOTE 5: The relationship and timing transfer between the management command at the input to the NE and the resultant SET-RTC command is beyond the scope of the present document.

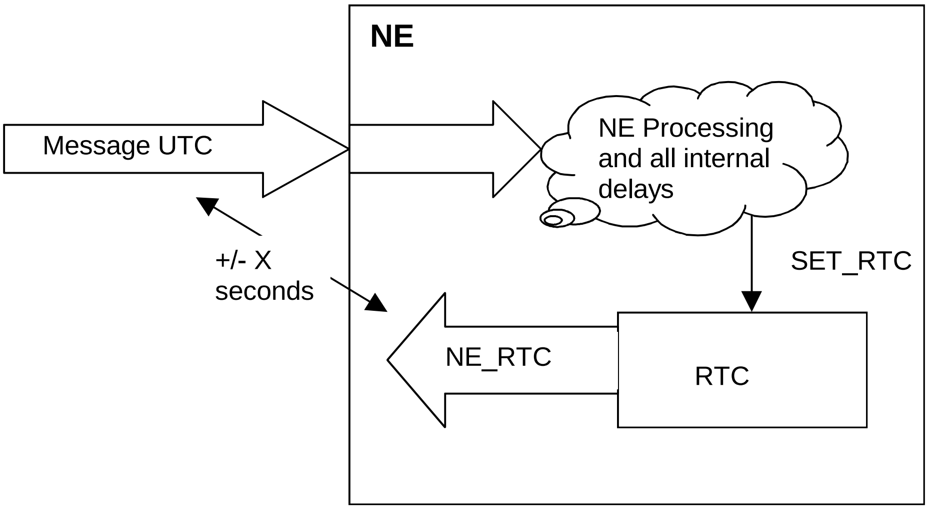


Figure 18: NE_RTC and UTC relation

6.8 Performance Monitoring Functions

The EMF performance monitoring process collects the event counts associated with:

- the trail performance parameters Errored Seconds (ES), Severely Errored Seconds (SES), Background Block Error (BBE) and Unavailable Time (UAT)/Unavailable Second (UAS);
- the link connection performance parameter Frequency Justification (FJ).

It processes the event counts to derive the performance parameters, and stores these performance events in registers. Such information can be used to sectionalize faults and to locate sources of intermittent errors, and/or determine the quality of the service.

Figure 19 presents an overview of the Performance Monitoring Functions (PMF) within the EMF. The shaded boxes are PMFs defined in the present document. The intermediate ellipses represent the interconnect options between the PMFs. The Equipment Functional Specification (EFS) defines which (sub)set of PMFs is (to be) supported by the equipment, as well as the quantity of each PMF.

NOTE 1: For the case where the number of transport atomic functions exceed the number of performance monitoring resources, selection may be indicated by "performance monitoring connection functions", or by alternative means. This is outside the scope of the present document. For the case where a such selectivity is not present or is not required, the interconnect is predefined and can be represented in the EFS by explicit interconnections between PMFs and atomic functions.

The NPME function determines on a per second basis the number of near-end background block errors (BBE), and whether an ES and/or SES occurred.

The AvFu function determines whether a one second is uni-directionally available or unavailable, and passes through the (ES, SES, BBE) input signal's value for seconds in available time. The input signal value in seconds in unavailable time is not output, instead the value "0" is output.

The delay function delays the input signal (which is not subject to "availability" processing) by 10 s to align it with the performance monitoring time base which is 10 s delayed from the time of day.

The 15 m function accumulates the input values (from i.e. ES, SES, BBE, FJ+, FJ-, TSE) over periods of 15 min. The function contains 1, 17 or 97 15 min registers: one current and 0, 16 or 96 recent registers for history length of none, short and long respectively. The 24h function accumulates the input signal values over periods of 24 hours. The function contains 1, 2 or 31 24 hour registers: one current and 0, 1 or 30 recent register for history length of none, short and long respectively. The history length mode is common to all history functions.

The ThrFs and ThrFd functions can be used to generate an autonomous event report (a threshold report) when the count in the current 15m/24h register to which it is connected reaches or exceeds the provisioned threshold value. In addition, the ThrFd function generates a reset threshold report when the count at the end of a 15m period has not crossed a provisioned reset threshold.

The inputs to the performance monitoring process - the Performance Monitoring primitives (MI_pXXX) - are one second counts of:

- errored blocks (pX_EBC), defect second (pX_DS) generated by termination sink functions;
- frequency justification events (pFJ+, pFJ-) generated by adaptation sink functions.

NOTE 2: "X" represents near-end (X = N).

These primitives are passed from the Atomic Functions (AFs) to the Equipment Management Function (EMF) for further processing.

The Performance monitoring timing function outputs the 1 second indication (MI_1second) towards the atomic functions to perform the 1 second counting of the performance primitives pXXX.

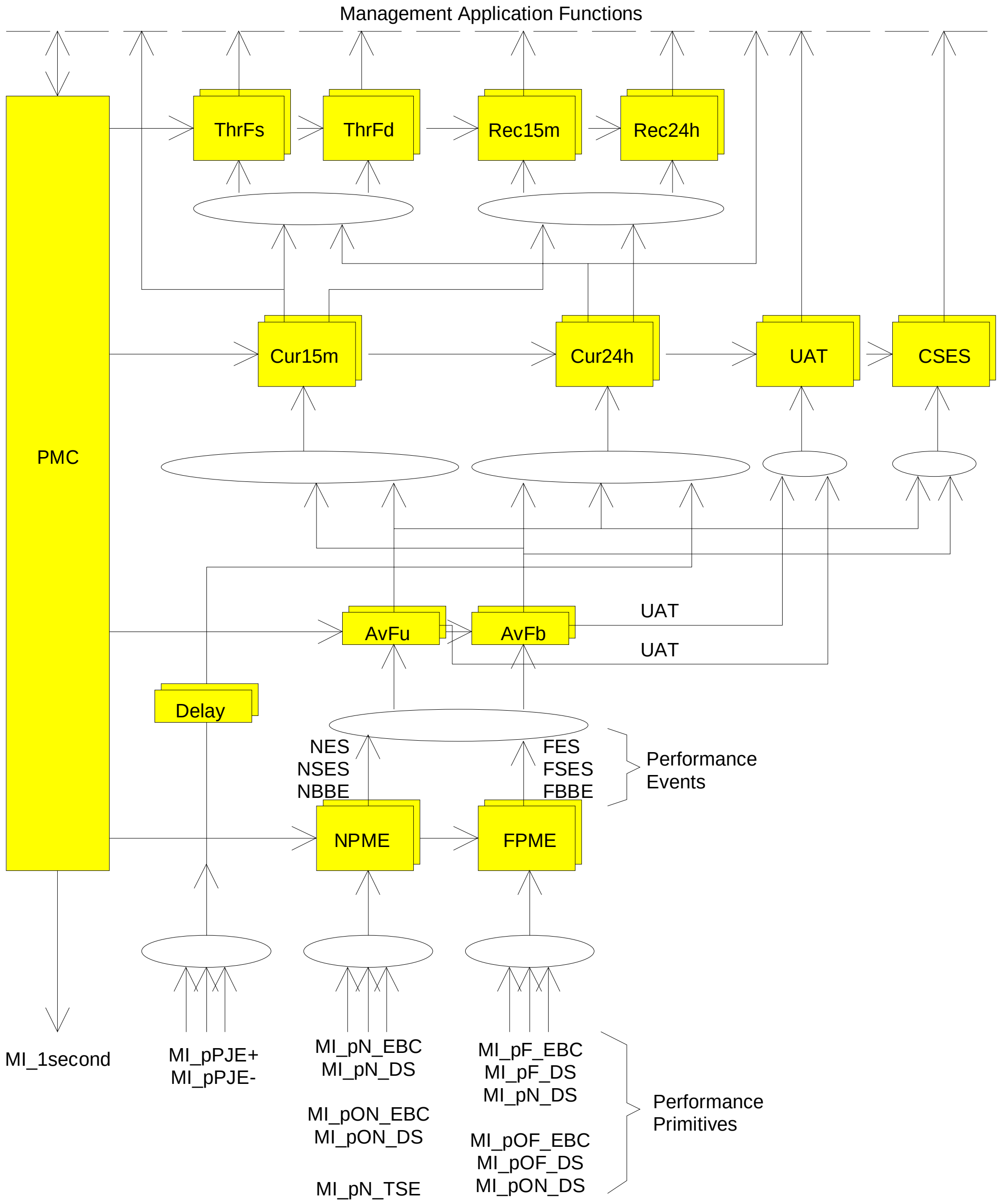


Figure 19: Overview of Performance Monitoring functions and their input/output relations

Performance monitoring functions connect to the higher layer management functions. Those functions are defined in ES 201 803-2-1 [ES803-2-1], ES 201 803-2-2 [ES803-2-2] and other related standards. The present document addresses performance monitoring from an equipment point of view. EN 301 167 [EN167] describes the performance monitoring from a network point of view.

6.8.1 Performance monitoring clock function PMC

Symbol:

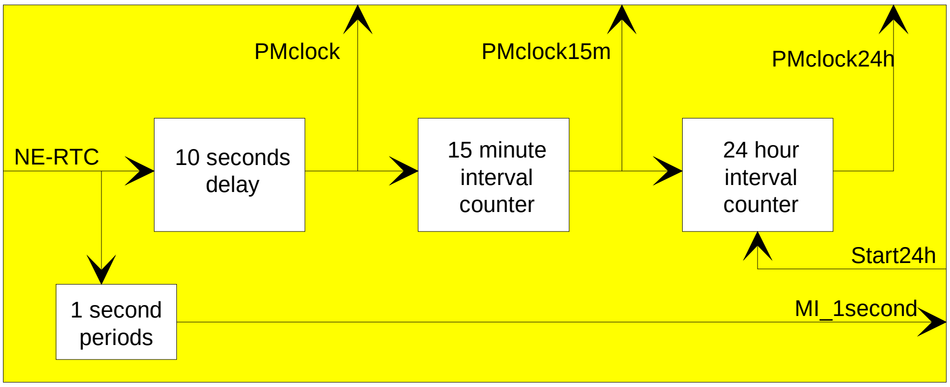


Figure 20: PM clock function

Interfaces

Table 14: PM clock function input and output signals

Input(s)	Output(s)
NE-RTC	PMclock
Start24h	PMclock15m
	PMclock24h
	MI_1second

Processes

The function generates the clock signals associated with the performance monitoring processing in the atomic functions and the performance monitoring functions within a network element.

1 second periods: this function shall generate the 1second signal at the end of each 1 second period as indicated by the NE real time clock (NE-RTC).

10 s delay: for performance monitoring purposes, the NE-RTC shall be delayed by 10 s (PMclock) for the purpose to accommodate the effects (a 10 second delay) associated with the unavailable time calculation.

15 min interval counter: this process generates the 15 min period indications (PMclock15m) which are aligned with the end of each quarter of an hour period (00:00, 15:00, 30:00, 45:00) with respect to PMclock. The start of a period is equal to the end of the previous period. If the NE-RTC is not preset, each 15 min period spans 900 one second periods.

24 hour interval counter: this process generates the 24 hour period indications (PMclock24h) which are aligned with the end of a quarter of an hour period (00:00:00, 00:15:00, 00:30:00, … 23:45:00) with respect to PMclock. The start of a period is equal to the end of the previous period. If the NE-RTC is not preset, each 24 hour period spans 86 400 one second periods.

For 24-hour data specifically, the NE may be instructed (Start24h) on when to begin measurement of the 24 hour period for the purpose of reporting data. The NE shall be able to begin the measurement at the start of any 15 min period (refer to clause 2.3.3.3 of ITU-T Recommendation M.2120 [M2120]) (default shall be 00:00 on the PMclock).

6.8.2 Performance monitoring events functions

6.8.2.1 Near-end performance monitoring event function (NPME)

Symbol

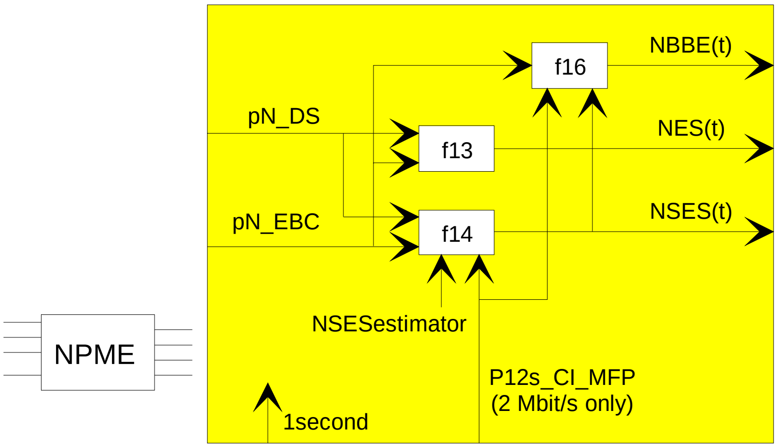


Figure 21: Near-end performance monitoring event function symbol and process diagram

Interfaces

Table 15: NPME input and output signals

Input(s)	Output(s)
MI_pN_DS	NBBE
MI_pN_EBC	NES
MI_1second	NSES

Processes

This function determines on a per second basis the number of near-end Background Block Errors (BBE), and whether an ES and/or SES occurred.

The EBC and DS performance monitoring primitive signals received from a transport atomic function are the inputs for the determination of the performance events BBE, ES, SES.

For the case a DS input is not connected, DS shall be assumed to be false. For the case a EBC input is not connected, EBC shall be assumed to be "0".

Figure 21 presents the processes and their interconnect within the Near-end Performance Monitoring Event (NPME) atomic performance monitoring function.

SES Estimator: the Near-end SES estimator value is network layer specific and shall be as specified in table 5.

Table 16: SES Estimators

Layer	Rate/Application	SES estimator
M1	1Gbps	2 400
M2	VC4	2 400
M2	VC4-4c	2 400
M2	VC4-16c	2 400
M2	VC4-64c	2 400
M2	VC4-256c	2 400
CHn	SDI 270 Mbps	300
CHn	ASI (R_{TS} < 6,016 Mbps)	TBD
CHn	ASI (R_{TS} >= 6,016 Mbps)	TBD
CHn	DLE/DLT	TBD
CHn	IPOD	TBD
CHn	PDH P11 (DS1/T1)	TBD
CHn	PDH P12 (E1)	TBD
CHn	PDH P22 (E2)	TBD
CHn	PDH P31 (E3)	TBD
CHn	PDH P32 (DS3)	TBD
CHn	PDH P4 (E4/DS4NA)	TBD
CHn	VC4	2 400
CHn	VC4-4c	2 400
CHn	VC4-16c	2 400
CHn	VC4-64c	2 400
CHn	VC4-256c	2 400

6.8.2.1.1 Model

Long term performance monitoring

NES/f13: a Near-end Errored Second (NES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ 1; i.e.:

NES ← (pN_DS = true) or (pN_EBC ≥ 1).

NSES/f14: a Near-end Severely Errored Second (NSES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ NSESestimator (Near-end SESestimator); i.e.:

- NSES ← (pN_DS = true) or (pN_EBC ≥ NSESestimator).

NOTE: The NSESestimator value depends on the network layer this NPME function is connected to.

NBBE/f16: the Near-end Background Block Error (NBBE) performance monitoring event signal shall equal pN_EBC if the NSES of that second is not set. Otherwise, NBBE shall be zero.

6.8.2.1.2 Use

NES/f13, NSES/f14 & NBBE/f16: Clauses 11.4.2.2 (CH1/AP1_A_Sk), 11.4.3.2 (CH1/AP2_A_Sk) and 11.4.6.2 (CH2/AP1_A_Sk).

6.8.2.2 Uni-directional availability filter function (AvFu)

Symbol

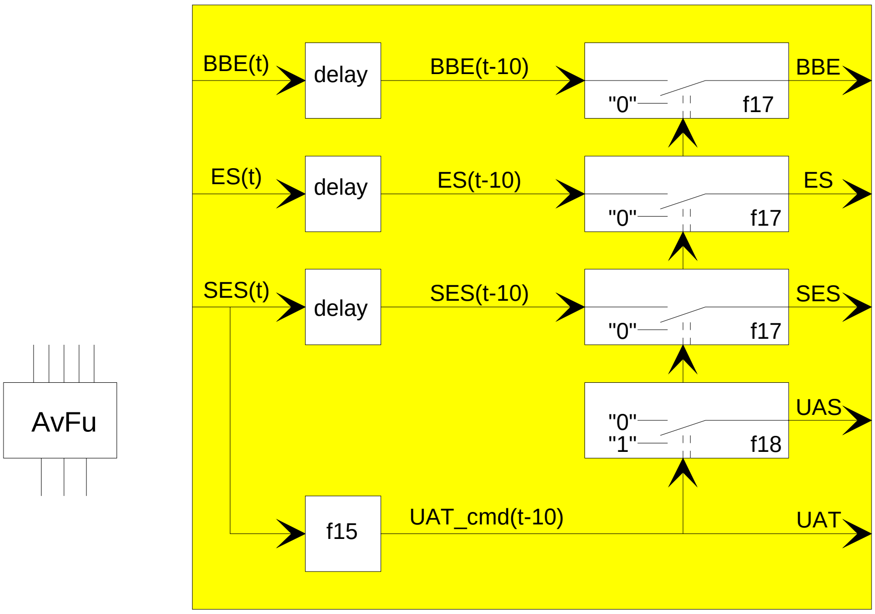


Figure 22: Uni-directional availability filter function symbol and process diagram

Interfaces

Table 17: AvFu input and output signals

Input(s)	Output(s)
BBE(t)	BBE
ES(t)	ES
SES(t)	SES
	UAS
	UAT

Processes

This function determines whether a one second is uni-directionally available or unavailable, and passes through the (ES, SES, BBE) input signal's value for s in available time. The input signal value in s in unavailable time is not output, instead the value "0" is output. This function is applicable for near-end, far-end, near-end outgoing and far-end outgoing information processing.

NOTE: UATcmd indicates (functionally) if a second is available or unavailable.

Based on the SES event indications, the start and end of UAT is determined. The BBE, ES and SES information is delayed by 10 s to maintain alignment in time of this information and the UAT indication (UATcmd).

For the case the BBE(t) input is not connected, BBE(t) shall be assumed to be "0". For the case the ES(t) input is not connected, ES(t) shall be assumed to be "0". For the case the SES(t) input is not connected, SES(t) shall be assumed to be "0".

f15: unavailable Time command (UAT_cmd) shall be set if ten consecutive SESs are detected. UAT_cmd shall be cleared after ten contiguous seconds not being SES.

A change of the UAT_cmd shall be reported.

delay: the BBE, ES and SES event signals shall be delayed by 10 s to align them with the UATcmd signal for further processing in the history atomic performance monitoring functions.

f17: the BBE(t-10), ES(t-10) and SES(t-10) event signals shall be output in available time; i.e. if UATcmd is false. Otherwise, the value "0" shall be output.

f18: in available time (i.e. if UATcmd is false), the value "0" shall be output via UAS. Otherwise (UATcmd is true), the value "1" shall be output.

6.8.3 Performance monitoring history functions

6.8.3.1 Current 15 m register function

Symbol

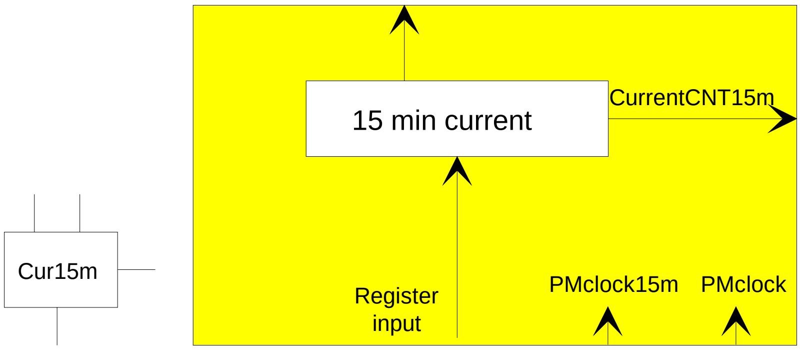


Figure 23: Current 15 min register process symbol and process diagram

Interfaces

Table 18: Current 15m input and output signals

Input(s)	Output(s)
RegisterInput	CurrentCNT15m
PMclock15m	SuspectFlag
PMclock	ElapsedTime

Processes

This function accumulates the RegisterInput values over periods of 15 min.

NOTE 1: The effect of the administrativeState attribute defined in the information model on the behaviour of the current 15 min register process is for further study.

Current register: the 15 min current register shall accumulate the content of the register with the RegisterInput value. The current register shall be large enough to accumulate all integer numbers from zero to a particular maximum value, which determines the minimum register size for that parameter. The maximum value shall be at least the nominal count of an interval. When the maximum value of the register is reached, the register shall remain at that maximum value until it is reset, or transferred.

NOTE 2: Current data may be lost during failure conditions within the equipment and its power feeding.

The size of the current register shall be able to accommodate at least the counts as specified in table 12:

Table 19: 15 min register minimum size

Layer	Rate/Application	Current register size			
		ES	BBE (see note 1)	SES (see note 2)	UAS
M1	1Gb/s	900	2 160 000	810	900
M2	VC4				
M2	VC4-4c				
M2	VC4-16c				
M2	VC4-64c				
M2	VC4-256c				
CHn	SDI 270 Mb/s		270 000		
CHn	ASI		TBD		
CHn	DLE/DLT		TBD		
CHn	IPOD		TBD		
CHn	PDH P11 (DS1/T1)		TBD		
CHn	PDH P12 (E1)		TBD		
CHn	PDH P22 (E2)		TBD		
CHn	PDH P31 (E3)		TBD		
CHn	PDH P32 (DS3)		TBD		
CHn	PDH P4 (E4/DS4NA)		TBD		
CHn	VC4		2 160 000		
CHn	VC4-4c				
CHn	VC4-16c				
CHn	VC4-64c				
CHn	VC4-256c				

NOTE 1: The maximum number of background block errors is obtained when the SES estimator is set to the number of blocks per second (e.g. 8 000 for RSn). In that case the maximum number of background block errors per second is equal to the number of blocks per second minus 1.
For the case the SES estimator is 30 % of the EBs per second, the maximum number of background block errors is equal to 30 % of blocks per second minus 1. E.g. for a VC-4 with 8 000 blocks per second, the maximum number of background block errors per second is 30 % $\times$ 8 000 - 1 = 2 399. Per 15 min period, the maximum number of BBEs is 900 x 2 399 = 2 159 100.

NOTE 2: SES will be counted as long as it is not in unavailable time. This explains the deviation of 10 % of the maximum number of seconds. To avoid unavailable time after each ninth second, a second should follow in which the SES threshold is not reached.

Current register suspect indication: the current register suspect flag will be set to true to indicate that the data stored in the register is incomplete or invalid for the current accumulation interval. The suspect flag shall be set to true under the following conditions:

- elapsed time deviates more than 10 s of the nominal time (900); this includes a preset of the real time clock to a value deviating more than 10 s from the current time, lost PM data in equipment, and initialization of 15min register.

NOTE 3: This allows for small corrections to the real time clock without marking periods as suspected.

Current register elapsed time: the current register shall contain an elapsed time indication, indicating the number of seconds of the current interval for which the performance indicator is processed into the performance parameter. The current register elapsed time shall be able to indicate at least the elapsed time of the nominal interval; i.e. 900 s. When the maximum value of an elapsed time register is reached, the register shall remain at that maximum value until it is reset, or transferred.

End of accumulation period: at the end of the 15 min accumulation period, the contents of the current register shall be transferred to the recent register and then the current register shall be initialized before the start of the next 15 min accumulation period.

NOTE 4: "Zero suppression" is a technique to reduce the amount of information to be communicated from the NE to the network element management system. In the past this communication reduction technique has been associated with the storage of PM information within the NE. Such relation is not necessarily present, and as such is not specified in the present document. The zero suppression technique is assumed to be a characteristic of the information exchange process between NE and EMS and is defined within the information model.

If the NE-RTC (and consequently the PMclock) is set to a time outside the current interval, the end of the 15 min accumulation period shall be assumed, and the actions as specified above shall be performed.

Initialization of current register at start of 15 min period: the time stamp shall be as specified under current register time stamp, elapsed time shall be "0", suspect indication shall be "false", and current register count shall be "0".

Report current register: it shall be possible to report the value of the current register when requested.

Current 15 min register initialization: at connection of the 15 min register input (i.e. at start of processing), the current register shall be initialized as follows: elapsed time is "0", suspect indication is "false", and register count is "0".

6.8.3.2 Recent 15m register function

Symbol

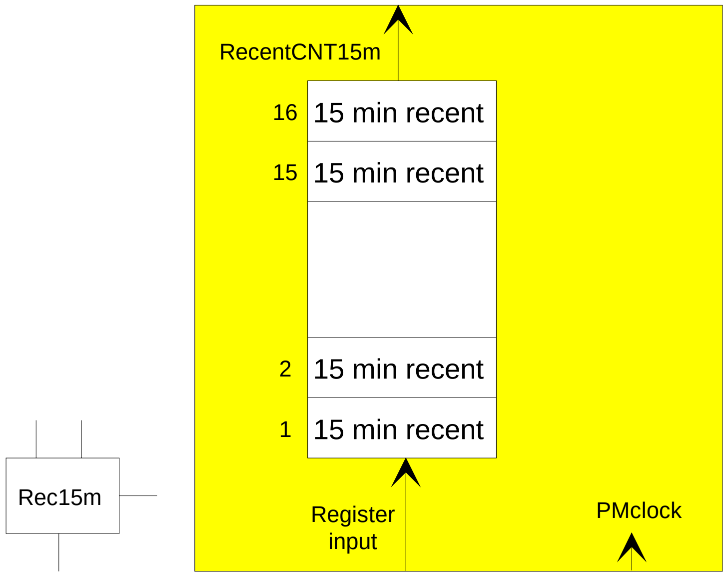


Figure 24: Recent 15 min register process symbol and process diagram

Interfaces

Table 20: Recent 15m input and output signals

Input(s)	Output(s)
RegisteInput	RecentCNT15m [1:16]
PMclock15m	SuspectFlag
PMclock	ElapsedTime

Processes

This function stores the RegisterInput values in one of the 16/96 recent registers.

Recent registers: at the end of the current 15 min period, the current register input data shall be transferred to the recent #1 register. Before the data is transferred, any data in the recent #i (i = 2...15/95) registers shall be transferred to the recent #(i+1) registers. The data in recent #16/96 register shall be discarded.

Recent register time stamp: the recent register shall contain a time stamp indicating the end of the recent interval. The time stamp shall indicate an end time at ¼ hour intervals (YYYY-MM-DDThh:mm according to ISO 8601 [ISO8601]). The time stamp shall have an accuracy of 1 second relative to the NE-RTC.

Pre-setting the NE-RTC shall have no effect on the time stamp in the recent registers.

Report recent registers: it shall be possible to report the value of the 16/96 recent registers when requested.

Recent 15 min register initialization: at connection of the 15 min register input (i.e. at start of processing), the 16/96 recent registers shall be initialized as follows: time stamp is 0000-00-00T00:00, elapsed time is "0", suspect indication is "true", and register count is "0".

6.8.3.3 Current 24h register function

Symbol

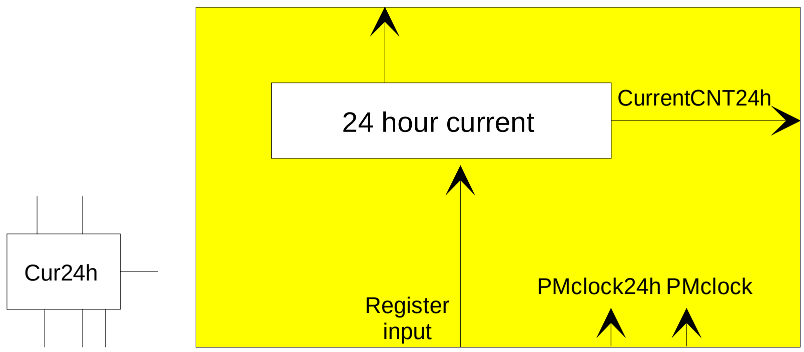


Figure 25: Current 24 hour register process symbol and process diagram

Interfaces

Table 21: Current 24h input and output signals

Input(s)	Output(s)
RegisterInput	CurrentCNT24h
PMclock24h	SuspectFlag
PMclock	ElapsedTime

Processes

This function accumulates the RegisterInput values over periods of 24 hours.

NOTE 1: The effect of the administrativeState attribute defined in the information model on the behaviour of the current 24 hour register process is for further study.

Current register: the 24 hour current register shall accumulate the content of the register with the RegisterInput value. The current register shall be large enough to accumulate all integer numbers from zero to a particular maximum value, which determines the minimum register size for that parameter.

The maximum value shall be at least the nominal count of an interval.

NOTE 2: Although all event counts should (ideally) be actual for the 24 hour filtering periods, it is recognized that it might be desirable to limit register sizes.

When the maximum value of the register is reached, the register shall remain at that maximum value until it is reset, or transferred.

NOTE 3: Current data may be lost during failure conditions within the equipment and its power feeding.

NOTE 4: It is up to the NE implementation to update the register counts. It is not required that it be done on a second by second basis. An update once every 15 min would be sufficient.

The maximum counts of a nominal 24 hour period are specified in table 22:

Table 22: 24 hour register minimum size

Layer	Rate/Application	Current register size				
		ES	**BBE (see note 1)**	**SES (see note 2)**	**UAS**	**FJ**
M1	1 Gb/s	86 400	207 360 000	77 760	86 400	-
M2	VC4					-
M2	VC4-4c					-
M2	VC4-16c					-
M2	VC4-64c					-
M2	VC4-256c					-
CHn	SDI 270 Mb/s		25 920 000			-
CHn	ASI		TBD			-
CHn	DLE/DLT		TBD			-
CHn	IPOD		TBD			-
CHn	PDH P11 (DS1/T1)		TBD			-
CHn	PDH P12 (E1)		TBD			-
CHn	PDH P22 (E2)		TBD			-
CHn	PDH P31 (E3)		TBD			-
CHn	PDH P32 (DS3)		TBD			-
CHn	PDH P4 (E4/DS4NA)		TBD			-
CHn	VC4		207 360 000			-
CHn	VC4-4c					-
CHn	VC4-16c					-
CHn	VC4-64c					-
CHn	VC4-256c					-

NOTE 1: The maximum number of background block errors is obtained when the SES estimator is set to the number of blocks per second (e.g. 8 000 for RSn). In that case the maximum number of background block errors per second is equal to the number of blocks per second minus 1.
For the case the SES estimator is 30 % of the EBs per second, the maximum number of background block errors is equal to 30 % of blocks per second minus 1. E.g. for a VC-4 with 8 000 blocks per second, the maximum number of background block errors per second is 30 % x 8 000 - 1 = 2 399. Per 24 hour period, the maximum number of BBEs is 86 400 x 2 399 = 207 273 600.

NOTE 2: SES will be counted as long as it is not in unavailable time. This explains the deviation of 10 % of the maximum number of seconds. To avoid unavailable time after each ninth second, a second should follow in which the SES threshold is not reached.

Current register suspect indication: the current register suspect flag will be set to true to indicate that the data stored in the register is incomplete or invalid for the current accumulation interval. The suspect flag shall be set to true under the following conditions:

- elapsed time deviates more than 10 s of the nominal time (86 400); this includes a preset of the real time clock to a value deviating more than 10 s from the current time, lost PM data in equipment, and initialization of 24h register.

NOTE 5: This allows for small corrections to the real time clock without marking periods as suspected.

Current register elapsed time: the current register shall contain an elapsed time indication, indicating the number of seconds of the current interval for which the performance indicator is processed into the performance parameter. The current register elapsed time shall be able to indicate at least the elapsed time of the nominal interval; i.e. 86 400 s. When the maximum value of an elapsed time register is reached, the register shall remain at that maximum value until it is reset, or transferred.

End of accumulation period: at the end of the 24 hour accumulation period, the contents of the current register shall be transferred to the recent register and then the current register shall be initialized before the start of the next 24 hour accumulation period.

If the NE-RTC (and consequently the PMclock) is set to a time outside the current interval, the end of the 24 hour accumulation period shall be assumed, and the actions as specified above shall be performed.

Initialization of current register at start of 24 hour period: the elapsed time shall be "0", suspect indication shall be "false", and current register count shall be "0".

Report current register: it shall be possible to report the value of the current register when requested.

Current 24 hour register initialization: at connection of the 24 hour register input (i.e. at start of processing), the current register shall be initialized as follows: elapsed time is "0", suspect indication is "false", and register count is "0".

6.8.3.4 Recent 24h register function

Symbol

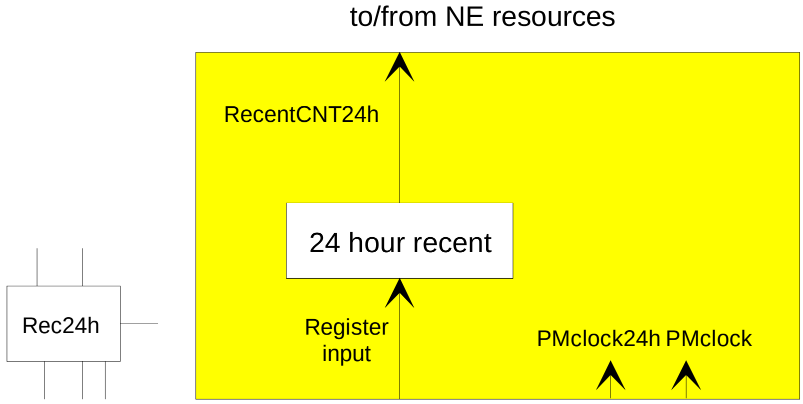


Figure 26: Recent 24 hour register process symbol and process diagram

Interfaces

Table 23: Recent 24h input and output signals

Input(s)	Output(s)
RegisterInput	RecentCNT24h
PMclock24h	SuspectFlag
PMclock	ElapsedTime

Processes

This function stores the RegisterInput value in the recent register.

Recent register: at the end of the current 24 hour period, the current register input data shall be transferred to the recent register. Before the data is transferred, any data in the recent register shall be discarded.

Recent register time stamp: the recent register shall contain a time stamp indicating the end of the recent interval. The time stamp shall indicate an end time at ¼ hour intervals (YYYY-MM-DDThh:mm according to ISO 8601 [ISO8601]). The time stamp shall have an accuracy of 1 second relative to the NE-RTC.

Report recent registers: it shall be possible to report the value of the recent register when requested.

Pre-setting the NE-RTC shall have no effect on the time stamp in the recent register.

Recent 24 hour register initialization: at connection of the 24 hour register input (i.e. at start of processing), the recent register shall be initialized as follows: time stamp is 0000-00-00T00:00, elapsed time is "0", suspect indication is "true", and register count is "0".

6.8.3.5 Begin/End of UAT event generation function

Symbol

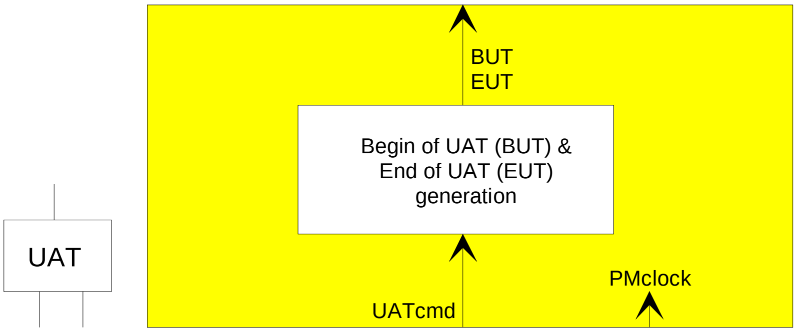


Figure 27: Begin/End of UAT event generation symbol and process diagram

Interfaces

Table 24: Begin/End of UAT event generation input and output signals

Input(s)	Output(s)
UATcmd	BUT
PMclock	EUT

Processes

The Begin/End of UAT event generation process (figure 27) will generate events indicating UAT state changes.

NOTE: The effect of the administrativeState attribute defined in the information model on the behaviour of the BUT/EUT event generation process is for further study.

If UATcmd is activated, a timestamped Begin of UAT (BUT) event shall be generated. If UATcmd clears, a timestamped End of UAT (EUT) event shall be generated. The timestamp shall indicate YYYY-MM-DDThh:mm according to ISO 8601 [ISO8601]. The time stamp shall have an accuracy of 1 second relative to the NE-RTC.

The BUT and EUT events shall be reported and logged via the Management Application Function.

6.8.3.6 CSES log function

Symbol

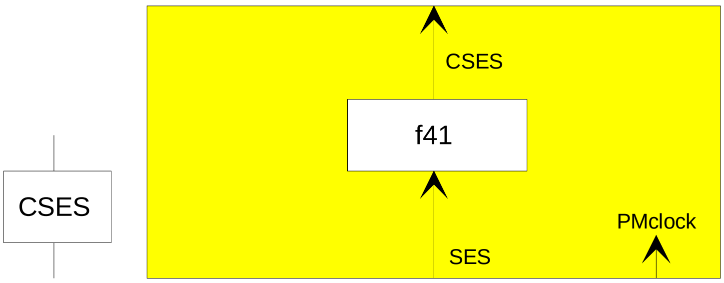


Figure 28: CSES symbol and process diagram

Interfaces

Table 25: CSES input and output signals

Input(s)	Output(s)
SES	CSES
PMclock	

Processes

f41: the function shall determine if a SES is part of a CSES as specified in the CSES process depicted in figure 28. A CSES period is a period of N consecutive SESs, which are not within a period of unavailable time. While the error burst may be on the border of two consecutive seconds, N = 2 is not considered as consecutive SESs. Therefore N is to be ≥ 3. While 10 consecutive SESs result in UAT, the maximum length of a CSES period is 9 s. This is assumed in figure 29 ("CNT == 3") and the fact that the SES input signal has passed through the Availability Filter function forcing SES indications to zero during a period of UAT.

The function shall generate a timestamped CSES event when a CSES period is detected. The timestamp shall indicate the start of the CSES period in YYYY-MM-DDThh:mm according to ISO 8601 [ISO8601].

NOTE: The effect of the administrativeState attribute defined in the information model on the behaviour of the CSES event generation process is for further study.

The CSES events shall be reported and logged via the Management Application Function.

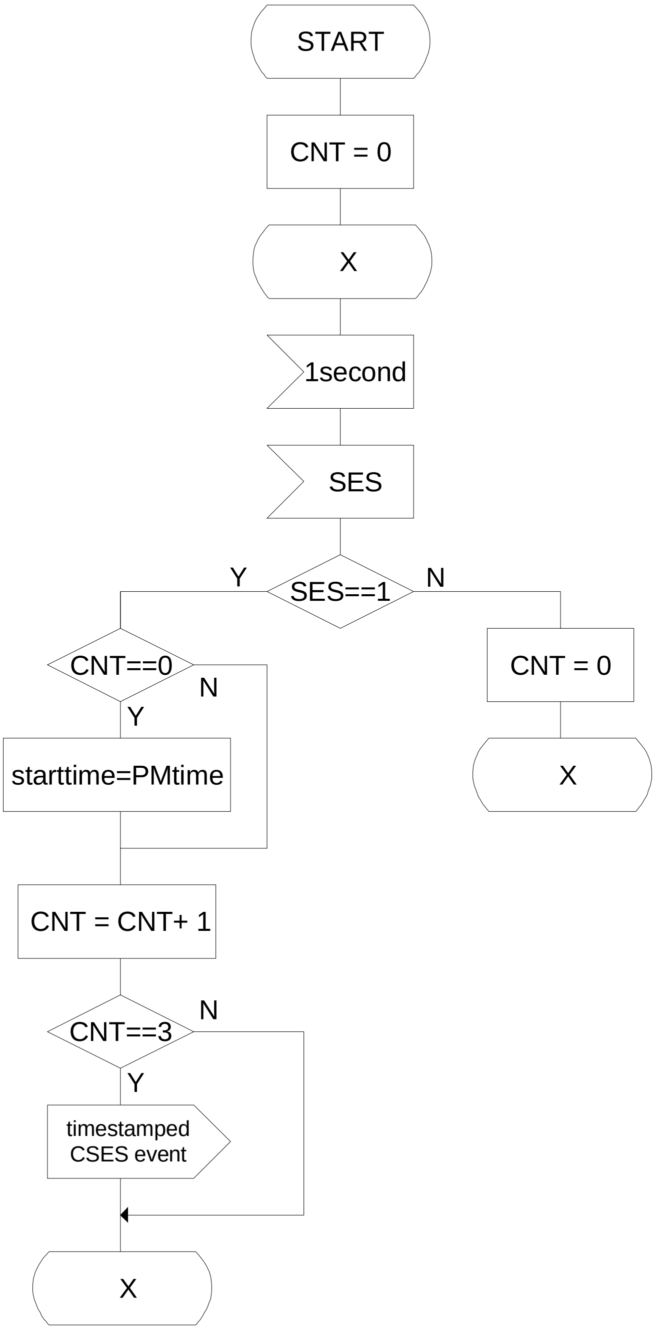


Figure 29: CSES process

6.8.4 Performance monitoring thresholding functions

A thresholding mechanism can be used to generate an autonomous event report when the performance of a transport entity falls below a predetermined level. The general strategy for the use of thresholds is described in ITU-T Recommendation M.20 [M20]. Specific information is contained in ITU-T Recommendations M.2100 [M2100], M.2101 [M2101], M.2120 [M2120] and EN 301 167 [EN167].

Two threshold mechanisms are defined:

- TR only - one threshold value is defined; if the event count reaches or exceeds the threshold value, the threshold state is set to true and a threshold report is generated. The threshold state is implicitly reset (to false) at the end of the accumulation period. This mechanism is applicable for 15 min and 24 hour accumulation periods;

- TR-RTR - two threshold values (set, reset) are defined; if the event count reaches or exceeds the set threshold value and the threshold state is false, the threshold state is set to true and a threshold report is generated. If the threshold state is true, the threshold state is reset (to false) and a reset threshold report is generated at the end of a following accumulation period in which the event count is less than or equal to the reset threshold value and there was not an unavailable period in the accumulation period. This mechanism is applicable for 15 min accumulation periods.

6.8.4.1 Single level thresholding function (ThrFs)

Symbol

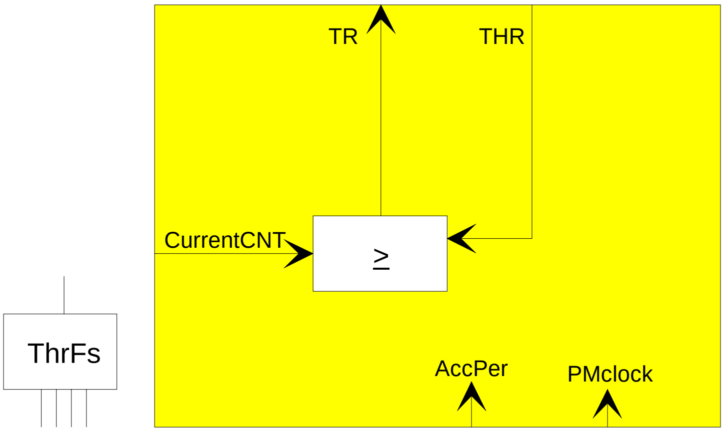


Figure 30: Single level thresholding function process symbol and process diagram

Interfaces

Table 26: ThrFs input and output signals

Input(s)	Output(s)
CurrentCNT	TR
PMclock	
AccPer	
THR	

Processes

A single level thresholding mechanism can be used to generate an autonomous event report when the performance of a transport entity falls below a predetermined level. This mechanism is applicable for 15 min and 24 hour accumulation periods.

The TR only process shall operate as specified in figure 30. The threshold state shall be set to true if the event count reaches or exceeds the threshold value and the threshold state is false. If the threshold state is true, the threshold state shall be reset to false at either the end of the accumulation period, or when the threshold value is changed within the current accumulation period to a value which is larger than the current event count.

If the threshold state is false, the threshold state shall be set to true when the threshold (THR) value is modified to a value that is less or equal the current event count. If the threshold state is true, the threshold state shall be set to false when the threshold value is modified to a value that is larger than the current event count.

A threshold report (TR) shall be generated when the threshold state changes from false to true.

A threshold can be crossed at any second within the accumulation period. The function shall detect a 15-min threshold crossing within 1 min of its occurrence, and a 24 hour threshold crossing within 15 min of its occurrence. The 15 min threshold report shall indicate the PM-second in which the threshold is reached or exceeded. The 24 hour threshold report shall indicate the moment of threshold crossing detection (that might be up to 15-min after the actual threshold crossing). The time stamp shall have a resolution of 1 second relative to the NE-RTC.

When a threshold is crossed, the function shall not automatically reset the register, but shall continue to the end of the accumulation period.

The detailed functioning of the threshold mechanisms is explained in EN 301 167 [EN167] and in clause 2.3 of ITU-T Recommendation M.2120 [M2120]. Refer to clause 4.5.14 for a specification of 15 min and 24 hour TR and RTR threshold ranges and defaults.

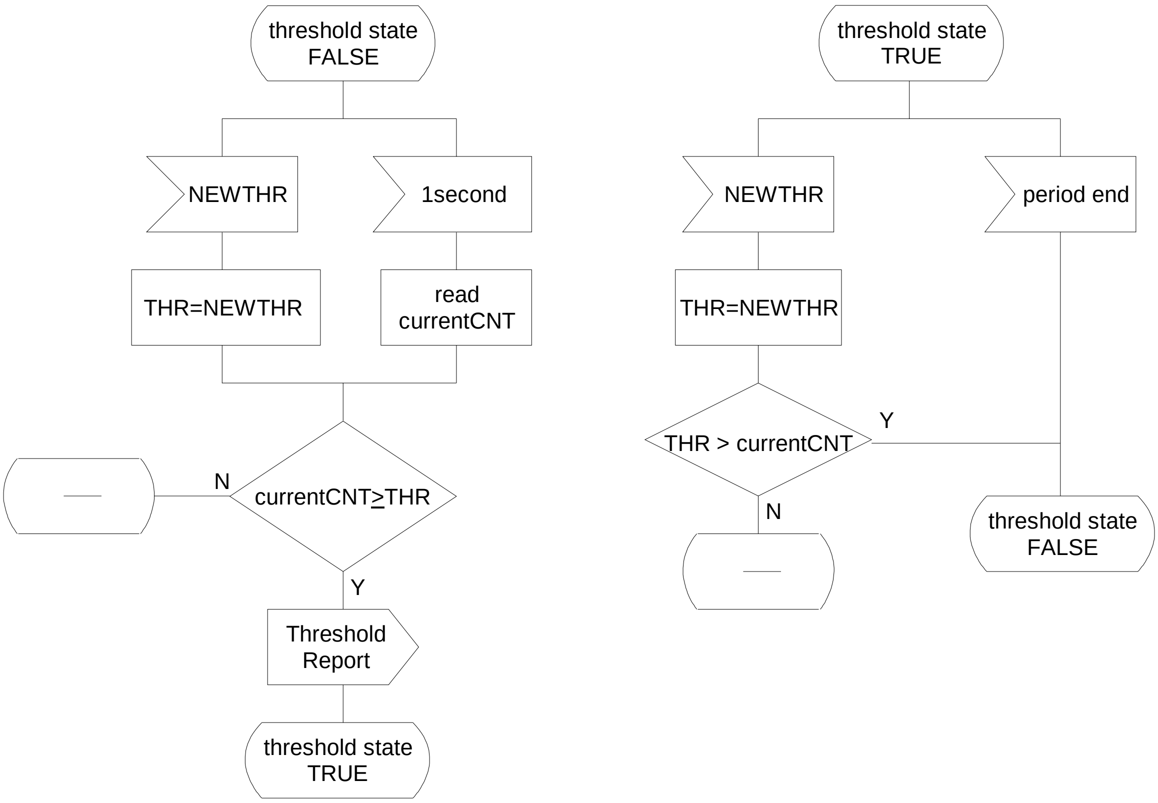


Figure 31: TR only process

6.8.4.2 Dual level thresholding function (ThrFd)

Symbol

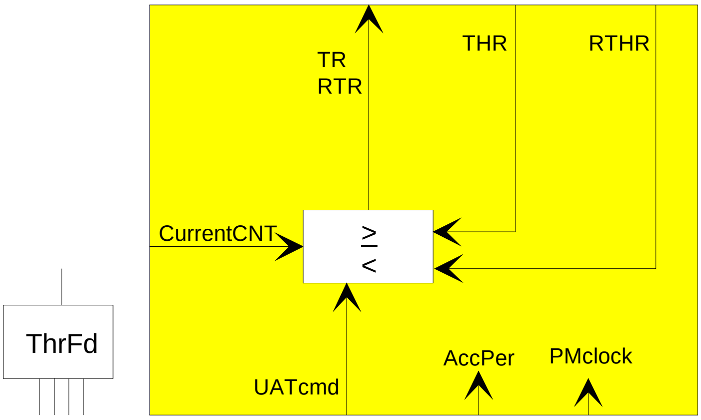


Figure 32: Dual level thresholding function process symbol and process diagram

Interfaces

Table 27: ThrFd input and output signals

Input(s)	Output(s)
CurrentCNT	TR
PMclock	RTR
THR	
RTHR	
UATcmd	

Processes

A two level thresholding mechanism can be used to generate autonomous event reports when the performance of a transport entity falls below a predetermined level and subsequently recovers. This mechanism is applicable for 15 min accumulation periods.

The TR/RTR process shall operate as specified in figure 32. The threshold state shall be set to true if the event count reaches or exceeds the set threshold value and the threshold state is false. If the threshold state is true, the threshold state shall be reset to false at the end of a (following) accumulation period in which the event count is less than or equal to the reset threshold value and there was not an unavailable period (UATcmd is true) in the accumulation period.

If the threshold state is false, the threshold state shall be set to true when the threshold (THR) value is modified to a value that is less or equal the current event count. If the threshold state is true, the threshold state shall be maintained on a change of the threshold (THR) value.

A threshold report (TR) shall be generated when the threshold state changes from false to true. A reset threshold report (RTR) shall be generated when the threshold state changes from true to false.

A set threshold can be crossed at any second within the accumulation period. The function shall recognize a 15-min threshold crossing within 1 min of its occurrence. The threshold report (TR) and reset threshold report (RTR) shall indicate the moment of crossing and shall have an accuracy of 1 second relative to the NE-RTC.

When a set threshold is crossed, the function shall not automatically reset the register, but shall continue to the end of the accumulation period.

The detailed functioning of the threshold mechanisms is explained in EN 301 167 [EN167] and in clause 2.3 of ITU-T Recommendation M.2120 [M2120]. Refer to clause 4.5.14 for a specification of 15 min and 24 hour TR and RTR threshold ranges and defaults.

NOTE: ITU-T Recommendation M.2120 [M2120] does not specify that the occurrence of an UAT period prevents the generation of RTR. As such there is a discrepancy between the behaviour defined by ITU-T Recommendation M.2120 [M2120] and EN 301 167 [EN167].

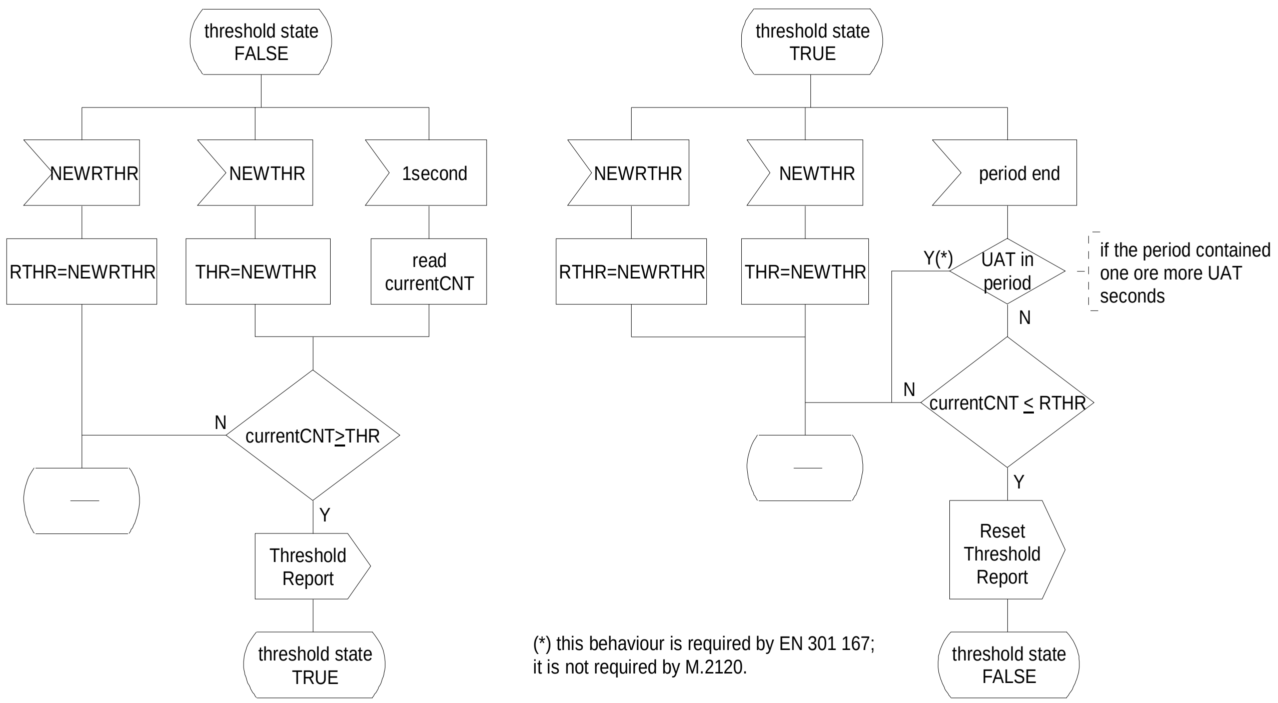


Figure 33: TR/RTR process

6.8.5 Performance monitoring packages

With the PMFs defined above, a number of performance monitoring packages (PM compound functions) are defined. These represent the performance monitoring specifications in ITU-T Recommendations M.2101 [M2101]. Other packages - including a different set of PMFs - can be defined also; examples of some of those other packages are presented in annex B.

6.8.5.1 ITU-T Recommendations M.2101 Near-end maintenance (uni-directional) package

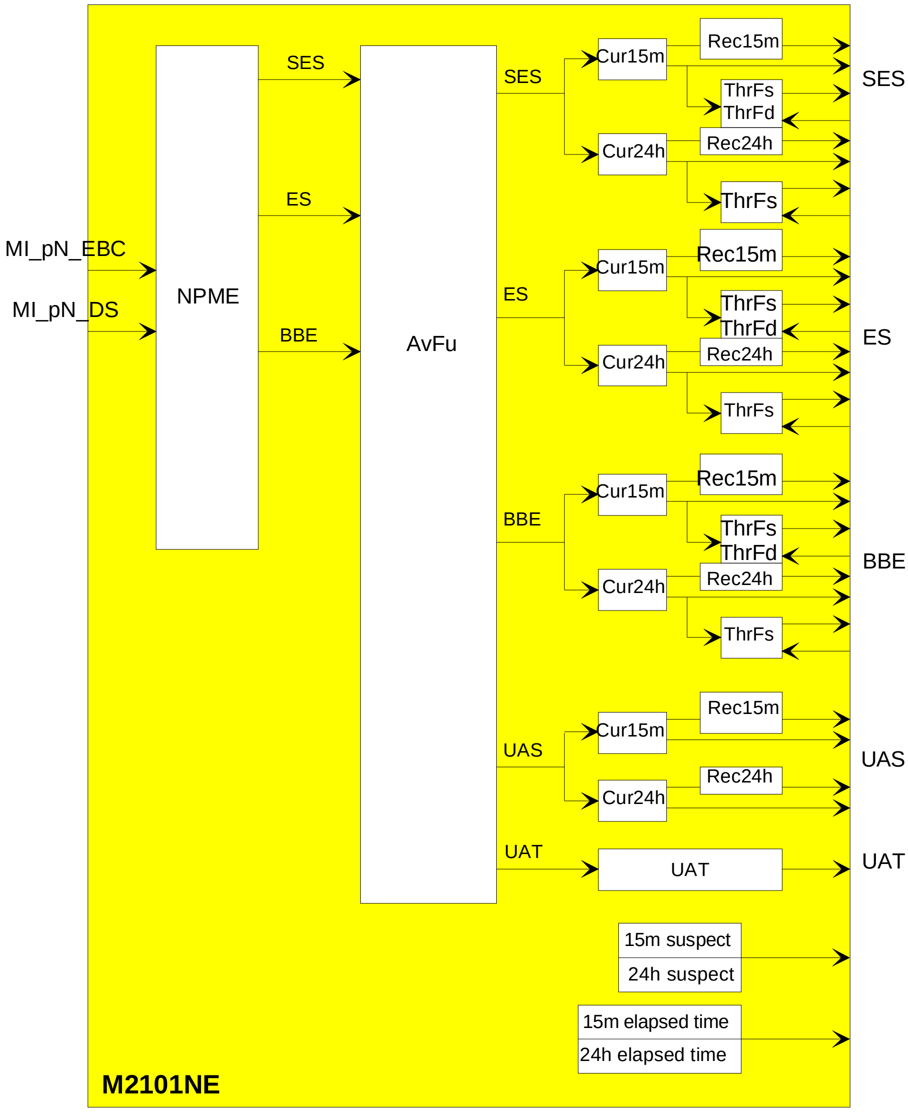


Figure 34: M.2101 near-end performance monitoring

The M.2101 near-end (A/Z direction) maintenance (uni-directional) package (M2101NE) for SDH (figure 34) shall compute UAS, ES, SES, and BBE over periods of 15 min and 24 hour for one direction of transmission using near-end information (A/Z).

The package can be used at trail termination points to monitor the quality in the incoming direction, and at connection points (via a non-intrusive monitor) to monitor the quality of the trail portion in the incoming direction of the signal passing through.

UAT events shall be computed and logged.

During a period of unavailable time the counting of BBEs, ESs, and SESs is stopped.

Performance event (BBE, ES, SES) counts shall be monitored for a threshold crossing; 15 min with either the single or dual thresholding and 24 hour with single thresholding.

6.8.5.2 Frequency Justification package

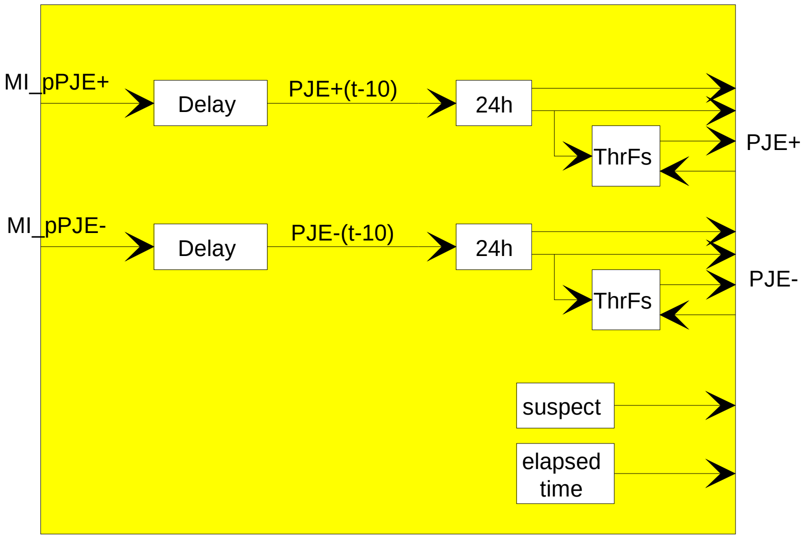


Figure 35: FJ performance monitoring

The Frequency Justification package shall compute FJ+ and FJ- over periods of 24 hour.

Performance event (FJ+, FJ-) counts shall be monitored for a 24 hour single level threshold crossing.

6.8.5.2.1 Model

Long term performance monitoring

FJ+(t-10) (A_So): The delayed positive Frequency Justification performance counter (FJ+(t-10)) is the 10 second delayed value of the positive Frequency Justification performance counter (pFJ+). See clause 6.8.5.2.

FJ-(t-10) (A_So): The delayed negative Frequency Justification performance counter (FJ-(t-10)) is the 10 second delayed value of the negative Frequency Justification performance counter (pFJ-). See clause 6.8.5.2.

6.8.5.2.2 Use

FJ+(t-10) (A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

FJ-(t-10) (A_So): Clause 11.4.3.1 (CH1/AP2_A_So).

6.8.5.2.3 Cross reference

pFJ+: Defined in clause 6.5.3.1.

pFJ-: Defined in clause 6.5.3.2.

6.9 Configuration Management Functions

See information model standard [ES803-14].

6.10 Management Application Functions

See information model standard [ES803-14].

7 Media layer (Mn)

The Media layer type 1 (M1) (see figure 36) will provide the optical physical interface used for the 8B10B encoded code groups of the Physical Link layer type 1 (PL1). The bit clock transfer and recovery is provided. Code group alignment is performed.

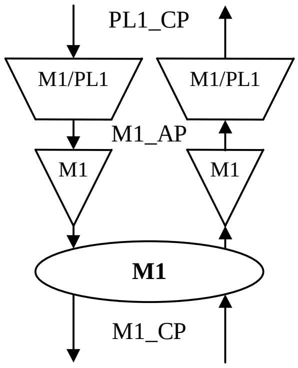


Figure 36: DTM Media Layer 1 atomic functions

7.1 Access point information

7.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is an optical bit stream as specified in [ES803-3].

7.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is an electrical bit stream as specified in [ES803-3].

7.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is

- the trail termination function port mode M1_TT_Sk_MI_PM
- the trail termination function loss of signal cause M1_TT_Sk_MI_cLOS
- the adaptation function loss of frame cause M1/PL1_A_Sk_MI_cLOF

7.1.4 Timing Information

Not applicable. No specific timing information is specified for this layer.

7.2 Connection function (Mn_C)

Not applicable.

7.3 Trail Termination functions

7.3.1 Media Trail Termination function (M1_TT)

The Media type 1 Trail Terminators signal conditions the 8B10B bit stream to and from the electrical and optical domain. Continuation supervision is performed in order to detect the Loss Of Signal (LOS) in order for higher layers to avoid incorrect process and management to get correct cause of error.

7.3.1.1 Media Trail Termination Source function (M1_TT_So)

Symbol

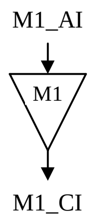


Figure 37: Media Trail Termination Source (M1_TT_So)

Interfaces

Table 28: M1_TT_So Input and output signals

Input(s)	Output(s)
M1_AI_D	M1_CI_D

Processes and anomalies

The signal conditioning of the M1_AP_D for transmission over the optical medium at M1_CI_D according to [ES803-3] clause 7. See clause 6.1.1.1.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

None.

Fault management

None.

Long term performance monitoring

None.

7.3.1.2 Media Trail Termination Sink function (M1_TT_Sk)

Symbol

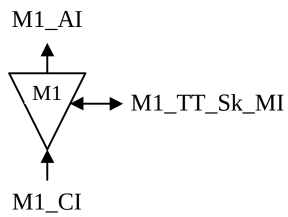


Figure 38: Media Trail Termination Sink (M1_TT_Sk)

Interfaces

Table 29: M1_TT_Sk Input and output signals

Input(s)	Output(s)
M1_CI_D	M1_AI_D
M1_TT_Sk_MI_PM	M1_AI_TSF
	M1_TT_Sk_MI_cLOS

Processes and anomalies

The signal conditioning of the optical signal at M1_CI_D and conversion into the digital format of AI_D. The signal conditioning includes an Automatic Gain Control (AGC) loop which monitors the average signal level of the received optical signal at M1_CI_D. See [ES803-3] clause 7. See clause 6.1.1.1.

nLOS: The average signal level is being monitored (by the signal conditioning Automatic Gain Control loop). The Loss Of Signal anomaly (nLOS) is asserted when the monitored signal level is below the LOS threshold level. See clause 6.1.2.1.

NOTE: The reaction time for a complete loss of signal is due to the AGC loop reaction time.

PM: The Port Mode (PM) state machine process according to clause 6.1.18.2.

MON: The Monitor signal (MON) is asserted when the Port Mode (PM) state machine is in its MON state. See clause 6.1.18.2.

Defects

dLOS: The Loss Of Signal defect (dLOS) is asserted when the Loss of Signal anomaly (nLOS) have been asserted, else it is deasserted. See clause 6.2.1.1.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Loss Of Signal defect (dLOS) is asserted. See clause 6.3.1.3.

aTSF ← dLOS.

Defect correlation

cLOS: The Loss Of Signal cause (cLOS) is asserted when the Monitoring (MON) is asserted and the Loss Of Signal defect (dLOS) is asserted. See clause 6.4.1.1.

cLOS ← MON and dLOS.

Performance monitoring

None.

Output mapping

M1_AI_D ← AI_D.

M1_AI_TSF ← aTSF.

M1_TT_Sk_MI_cLOS ← cLOS.

Fault management

fLOS (TT_Sk): The Loss Of Signal fault (fLOS) is asserted when the Loss Of Signal cause (cLOS) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cLOS have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.1.

Long term performance monitoring

None.

7.4 Adaptation functions

7.4.1 Media Adaptation function (M1/PL1_A)

7.4.1.1 Media Adaptation Source function (M1/PL1_A_So)

Symbol

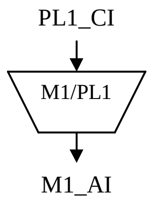


Figure 39: Media Adaptation Source (M1/PL1_A_So)

Interfaces

Table 30: M1/PL1_A_So Input and output signals

Input(s)	Output(s)
PL1_CI_D	M1_AI_D
PL1_CI_CK	

Processes and anomalies

The smoothing of the received clock (CI_CK) in order to ensure a maximum output jitter of 0.1 UI as specified in [ES803-3] clause 8. See clause 6.1.11.1.

The multiplexing of bits in PL1_CI_D into the bitstream of M1_AI_D. The bit multiplexing is according to [ES803-3] clause 8. See clause 6.1.13.1.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

None.

Fault management

None.

Long term performance monitoring

None.

7.4.1.2 Media Adaptation Sink function (M1/PL1_A_Sk)

Symbol

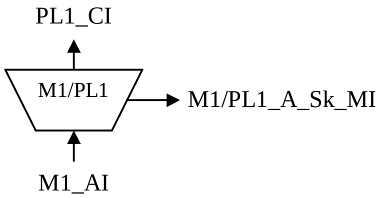


Figure 40: Media Adaptation Sink (M1/PL1_A_Sk)

Interfaces

Table 31: M1/PL1_A_Sk Input and output signals

Input(s)	Output(s)
M1_AI_D	PL1_CI_D
M1_AI_TSF	PL1_CI_CK
PL1_CI_EN_FS	PL1_CI_FS
	PL1_CI_SSF
	M1/PL1_A_Sk_MI_cLOF

Processes and anomalies

The timing recovery from AI_D to form the regenerated clock (CI_CK) as specified in [ES803-3] clause 8.
See clause 6.1.10.1.

The bit alignment is achieved by detection of the comma sequence (1111100) in the M1_AI_D bitstream. The alignment is enabled by CI_EN_FS. The bit alignment is according to [ES803-3] clause 8. See clause 6.1.9.1.

sFS: If a comma sequence is detected and CI_EN_FS is asserted, then the Frame Start signals (sFS) is asserted, else is sFS deasserted. See [ES803-3] clause 8. See clause 6.1.9.1.

The demultiplexing of the bitstream M1_AI_D into the code group bits of PL1_CI_D. The demultiplexing is aligned when EN_FS is asserted. The bit demultiplexing is according to [ES803-3] clause 8. See clause 6.1.13.1.

Defects

None.

Consequent actions

aSSF: The Server Signal Fail action (aSSF) is asserted when the Trail Signal Fail (AI_TSF) is asserted.
See clause 6.3.1.2.

aSSF ← AI_TSF

Defect correlation

None.

Performance monitoring

None.

Output mapping

PL1_CI_FS ← sFS.

PL1_CI_SSF ← aSSF.

M1/PL1_a_Sk_MI_cLOF ← cLOF.

Fault management

None.

Long term performance monitoring

None.

8 Physical Link layer (PLn)

The Physical Link layer type-n (PLn) (see figure 41 and 42) will provide the transport of the Bypass layer (BP) TDM frames.

The Physical Link layer type-1 (PL1) (see figure 41) will provided the transport of the Bypass layer (BP) TDM frames using 8B10B encoding (see [ES803-3]). It will encode the frame and slots into 8B10B code groups, which are sent over the Media layer. The DTM synchronization signal is transported using the start of frame marker.

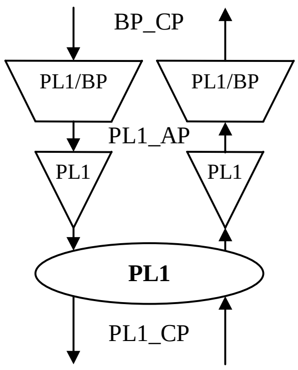


Figure 41: DTM Physical Link layer 1 atomic functions

The SDH Higher order path section (see figure 42) provides adaptation for higher speeds PDH, ATM, HDLC, FDDI and DTM signals and multiplexing adaptation for the SDH lower order path section. The DTM signal adaptation provides for transport of Bypass layer TDM frames over SDH (see [ES803-4]).

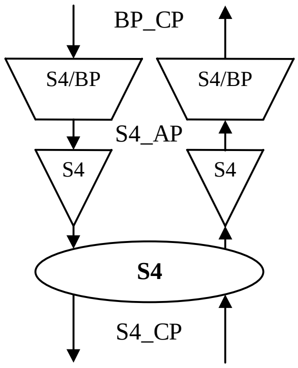


Figure 42: SDH Higher order path layer/DTM Physical Link layer 2 atomic functions

8.1 Access point information

8.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is defined in [ES803-3] and [ES803-4].

8.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is defined in [ES803-3] and [ES803-4].

8.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is defined in [ES803-3] and [ES803-4].

8.1.4 Timing Information

Not applicable. No specific timing information is specified for this layer.

8.2 Connection function (PLn_C)

Not applicable.

8.3 Trail Termination functions

8.3.1 Physical Link 1 Trail Termination function (PL1_TT)

8.3.1.1 Physical Link 1 Trail Termination Source function (PL1_TT_So)

Symbol

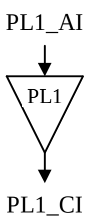


Figure 43: Physical Link 1 Trail Termination Source (PL1_TT_So)

Interfaces

Table 32: PL1_TT_So Input and output signals

Input(s)	Output(s)
PL1_AI_D	PL1_CI_D
PL1_AI_CK	PL1_CI_CK

Processes and anomalies

The 8B10B encoding of PL1_AI_D into the 10 bit code group form of PL1_CI_D according to [ES803-3] clause 9.5.2. See clause 6.1.7.1.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

None.

Fault management

None.

Long term performance monitoring

None.

8.3.1.2 Physical Link 1 Trail Termination Sink function (PL1_TT_Sk)

Symbol

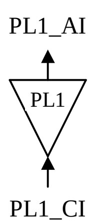


Figure 44: Physical Link 1 Trail Termination Sink (PL1_TT_Sk)

Interfaces

Table 33: PL1_TT_Sk Input and output signals

Input(s)	Output(s)
PL1_CI_D	PL1_AI_D
PL1_CI_CK	PL1_AI_CK
PL1_CI_FS	PL1_AI_FS
PL1_CI_SSF	PL1_AI_TSF
PL1_AI_EN_FS	PL1_AI_CGF

Processes and anomalies

The 8B10B decoding of the 10 bit code group form of PL1_CI_D into the 8+1 bit code group form of PL1_AI_D according to [ES803-3] clause 9.5.2. See clause 6.1.7.1.

nCGF (TT_Sk): The Code Group Fail anomaly (nCGF) is asserted when the received 10 bit code group form of PL1_CI_D does not form a legal DTM 8B10B code group according to [ES803-3] clause 9.4.4. See clause 6.1.4.1.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.3.1.3.

aTSF ← CI_SSF.

aCGF: The Code Group Fail action (aCGF) is asserted when the Code Group Fail anomaly (nCGF) is asserted. See clause 6.3.2.1.

aCGF ← nCGF.

Defect correlation

None.

Performance monitoring

None.

Output mapping

PL1_AI_CK ← PL1_CI_CK.

PL1_AI_FS ← PL1_CI_FS.

PL1_AI_TSF ← aTSF.

PL1_AI_CGF ← aCGF.

Fault management

None.

Long term performance monitoring

None.

8.4 Adaptation functions

8.4.1 Physical Link 1 adaptation function (PL1/BP_A)

8.4.1.1 Physical Link 1 Adaptation Source function (PL1/BP_A_So)

Symbol

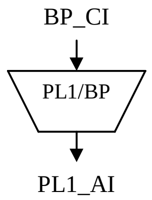


Figure 45: Physical Link 1 Adaptation Source (PL1/BP_A_So)

Interfaces

Table 34: PL1/BP_A_So Input and output signals

Input(s)	Output(s)
BP_CI_D	PL1_AI_D
BP_CI_CK	PL1_AI_CK
BP_CI_FS	

Processes and anomalies

The encoding of data, special markers (Idle, PS and AIS) as received from BP_CI_D, Fill generation and frame synchronization signals into slot code groups. See [ES803-3], clause 9.5. See clause 6.1.7.2.

The transmitter side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

The multiplexing of slot codegroups in BP_CI_D into the codegroup stream. The bit multiplexing is according to [ES803-3], clause 9.5. See clause 6.1.13.2.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

None.

Fault management

None.

Long term performance monitoring

None.

8.4.1.2 Physical Link 1 Adaptation Sink function (PL1/BP_A_Sk)

Symbol

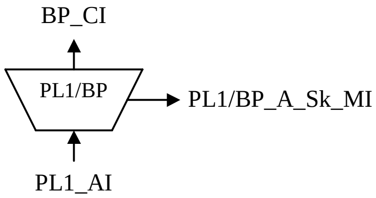


Figure 46: Physical Link 1 Adaptation Sink (PL1/BP_A_Sk)

Interfaces

Table 35: PL1/BP_A_Sk Input and output signals

Input(s)	Output(s)
PL1_AI_D	BP_CI_D
PL1_AI_CK	BP_CI_CK
PL1_AI_FS	BP_CI_FS
PL1_AI_TSF	BP_CI_SSF
PL1_AI_CGF	PL1_AI_EN_FS
PL1/BP_A_Sk_MI_AM	PL1/BP_A_Sk_MI_aTSF
PL1/BP_A_Sk_MI_PM	PL1/BP_A_Sk_MI_cOSF
PL1/BP_A_Sk_MI_1second	PL1/BP_A_Sk_MI_cLOF
	PL1/BP_A_Sk_MI_pN_EBC

Processes and anomalies

The decoding of slot code groups into data, special markers (Idle, PS, AIS) as transmitted to BP1_CI_D as well as Fill and Start Of Frame (SOF). See [ES803.3] clause 9.5. See clause 6.1.7.2.

nOSF (A_Sk): The Ordered Set Fail anomaly (nOSF) is asserted when the slot code groups form an invalid combination according to clause 9.5.2. See clause 6.1.4.1.

sFS: When a Start Of Frame (SOF) special marker has been detected, the Frame Start signal (sFS) is asserted, else the sFS is deasserted. See [ES803-3] clause 9.5.2. See clause 6.1.7.2.

sFILL: When a Fill special marker has been detected, the Fill signal (sFILL) is asserted, else the sFILL is deasserted. See [ES803-3] clause 9.5. See clause 6.1.7.2.

nFE: The Frame Error anomaly (nFE) is asserted when the Frame Start signal (sFS) has not been asserted within the time as specified in [ES803-3] clause 9.1. See clause 6.1.7.2.

The codegroup/slot alignment is achieved by detection of the Fill ordered set in the PL1_AI_D codegroup stream. The codegroup/slot alignment is achieved and maintained by a state machine process. The codegroup/slot alignment is according to [ES803-3] clause 9.6.2. See clause 6.1.9.2.

nLOSS: If the slot synchronization state machine is in the LOSS state, then the Loss Of Slot Synchronization anomaly (nLOSS) is asserted, else is nLOSS deasserted. See [ES803-3] clause 9.6.2. See clause 6.1.9.2.

The slot/frame alignment is achieved by detection of the Start Of Frame (SOF) ordered set in the slot codegroup stream. The slot/frame alignment is achieved and maintained by a state machine process. The slot/frame alignment is according to [ES803-3] clause 9.6.3. See clause 6.1.9.3.

nLOF: If the frame synchronization state machine is in the Init or Verify states, then the Loss Of Frame anomaly (nLOF) is asserted, else is nLOSS deasserted. See [ES803-3] clause 9.6.3. See clause 6.1.9.3.

The receiver side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

The demultiplexing of the codegroup stream into the slot code groups of BP1_CI_D. The demultiplexing is aligned when the Loss Of Slot Synchronization anomaly (nLOSS) is deasserted after previously been asserted. The bit demultiplexing is according to [ES803-3] clause 9.5. See clause 6.1.13.2.

AIS: The Alarm Indication Signal (AIS) insertion into CI_D instead of received data when the Alarm Indication Signal defect (dAIS) is asserted. See clause 6.1.5.1.

AM: The Administrative Mode (PM) state machine process according to clause 6.1.18.3.

NACT: The Not Active signal (NACT) is deasserted when the Administrative Mode (PM) state machine is in its ACT state, else it is asserted. See clause 6.1.18.3.

Defects

dLOF: The Loss Of Frame defect (dLOF) is asserted when the Loss Of Frame anomaly (nLOF) is asserted, else it is deasserted. See clause 6.2.4.1.

Consequent actions

aAIS (A_Sk): The Alarm Indication Signal action (aAIS) is asserted when the Loss Of Frame defect (dLOF), the Trail Signal Fail (AI_TSF) is asserted or the Not Active (NACT) is asserted. See clause 6.3.1.1.

aAIS ← dLOF or AI_TSF or NACT.

aSSF: The Server Signal Fail action (aSSF) is asserted when Trail Signal Fail (AI_TSF) is asserted or the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.1.2.

aSSF ← AI_TSF or dLOF.

aEN_FS: The Enable Frame Signal action (aEN_FS) is asserted when the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.2.2.

aEN_FS ← dLOF.

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Loss Of Frame defect (dLOF) is asserted, the Trail Signal Fail (AI_TSF) is asserted or the Not Active (NACT) is asserted. See clause 6.3.2.3.

aTSF ← dLOF or AI_TSF or NACT.

Defect correlation

cLOF: The Loss Of Frame cause (cLOF) is asserted when the Loss Of Alignment defect (dLOA) is asserted, the Alarm Indication Signal defect (dAIS) is deasserted , the Trail Signal Fail (AI_TSF) is deasserted, and the Monitoring (MON) is asserted. See clause 6.4.4.1.

cLOF ← dLOF and (not dAIS) and (not AI_TSF) and MON.

cTSF: The Trail Signal Fail cause (cTSF) is asserted when Monitoring (MON) is asserted, the Trail Signal Fail (AI_TSF) is asserted and the Trail Signal Fail Reported (TSF_Reported) is asserted. See clause 6.4.6.3.

cTSF ← MON and AI_SSF and TSF_Reported.

Performance monitoring

pN_EBC (TT_Sk/A_Sk): The Near-end Error Block Count performance (pN_EBC) is the sum of Near-end Errored Blocks defects (dN_EB) during a second. See clause 6.5.1.1.

pN_EBC ← ∑ dN_EB.

Output mapping

BP_CI_D ← CI_D.

BP_CI_CK ← CI_CK.

BP_CI_FS ← sFS.

BP_CI_SSF ← aSSF.

PL1_AI_EN_FS ← aEN_FS.

PL1/BP_A_Sk_MI_aTSF ← aTSF.

PL1/BP_A_Sk_MI_cOSF ← cOSF.

PL1/BP_A_Sk_MI_cLOF ← cLOF.

PL1/BP_A_Sk_MI_pN_EBC ← pN_EBC.

Fault management

fLOF (A_Sk): The Loss Of Frame alignment fault (fLOF) is asserted when the Loss Of Frame cause (cLOF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.5.

Long term performance monitoring

None.

8.4.2 DTM Physical Link 2/SDH Higher order path adaptation function (S4/BP_A)

8.4.2.1 DTM Physical Link 2/SDH Higher order path Adaptation Source function (S4/BP_A_So)

Symbol

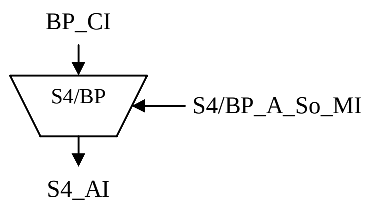


Figure 47: DTM Physical Link 1/SDH Higher order path Adaptation Source (S4/BP_A_So)

Interfaces

Table 36: S4/BP_A_So Input and output signals

Input(s)	Output(s)
BP_CI_D	S4_AI_D
BP_CI_CK	S4_AI_CK
BP_CI_FS	S4_AI_FS
BP_CI_SSF	S4_AI_TSF
S4/BP_A_So_MI_TxSL	

Processes and anomalies

The scrambling of the unscrambled octet stream into the scrambled octet stream using a self-synchronous scrambler with the polynomial $X^{43} + 1$ according to [ES803-4] clause 6.1. See clause 6.1.6.1.

The encoding of slots from BP_CI_D into the 65 bit format is performed according to [ES803-4] clause 6.3. See clause 6.1.7.3.

sFS: The S4 Frame Start (S4_AI_FS) is asserted when the Bypass layer Frame Start (BP_CI_FS) is asserted. See clause 6.1.7.3.

F2, F3, H4 and K3: These unused octets shall be generated according to [ES803-4] clause 6.1. See clause 6.1.7.4.

The transmitter side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

The multiplexing of 65 bit slot format into the unscrambled octet stream of 9 rows and 260 x n octets according to [ES803-4] clause 6.2. See clause 6.1.13.3.

The multiplexing of the scrambled octet stream and the C2, F2, F3, H4 and K3 octets to form the S4_AI_D according to [ES803-4] clause 6.1. See clause 6.1.13.4.

C2/TSL: The Trail Signal Label (TSL), as specified through MI_TxSL, shall be generated into the C2 octet according to clause 5.3.4.1 and [ES803-4] clause 6.1. See clause 6.1.15.2.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

S4_AI_D ← AI_D.

S4_AI_CK ← BP_CI_CK.

S4_AI_FS ← sFS.

S4_AI_TSF ← aTSF.

Fault management

None.

Long term performance monitoring

None.

8.4.2.2 DTM Physical Link 2/SDH Higher order path adaptation Sink function (S4/BP_A_Sk)

Symbol

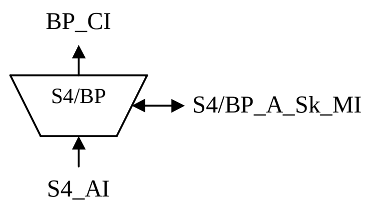


Figure 48: DTM Physical Link 2/SDH Higher order path Adaptation Sink (S4/BP_A_Sk)

Interfaces

Table 37: S4/BP_A_Sk Input and output signals

Input(s)	Output(s)
S4_AI_D	BP_CI_D
S4_AI_CK	BP_CI_CK
S4_AI_FS	BP_CI_FS
S4_AI_TSF	BP_CI_SSF
S4/BP_A_Sk_MI_ExSL	S4/BP_A_Sk_MI_AcSL
S4/BP_A_Sk_MI_AM	S4/BP_A_Sk_MI_cPLM
	S4/BP_A_Sk_MI_cAIS
	S4/BP_A_Sk_MI_cTSF
	S4/BP_A_Sk_MI_aTSF

Processes and anomalies

The descrambling of the scrambled octet stream into the unscrambled octet stream using a self-synchronous descrambler with the polynomial $X^{43}+1$ according to [ES803-4] clause 6.1. See clause 6.1.6.1.

The decoding of 65 bit format into slots, which is sent to BP_CI_D, is performed according to [ES803-4] clause 6.3. See clause 6.1.7.3.

sFS: The Bypass layer Frame Start (BP_CI_FS) is asserted when the S4 Frame Start (S4_AI_FS) is asserted. See clause 6.1.7.3.

F2, F3, H4 and K3: These unused octets is not processed according to [ES803-4] clause 6.1. See clause 6.1.7.4.

The jitter and wander attenuation of the AI_FS generating CI_FS. See clause 6.1.11.2.

The receiver side bitrate conversion in order to allow for an inter-frame gap on AI_D. See clause 6.1.12.

The demultiplexing of the unscrambled octet stream of 9 rows and 260 x n octets into the 65 bit slot format according to [ES803-4] clause 6.2. See clause 6.1.13.3.

The demultiplexing of the S4_AI_D into the scrambled octet stream and the C2, F2, F3, H4 and K3 octets according to [ES803-4] clause 6.1. See clause 6.1.13.4.

C2/TSL: The Trail Signal Label (TSL) is received in form of the C2 octet and is made available as the Accepted TSL (MI_AcSL) according to clause 5.3.4.1 and [ES803-4] clause 6.1. See clause 6.1.15.2.

nPLM: The Payload Mismatch anomaly (nPLM) is asserted when the accepted Trail Signal Label (TSL) is not equal to the Expected TSL (MI_ExSL). TSL and nPLM is specified in clause 5.3.4.1. See clause 6.1.15.2.

AIS: The Alarm Indication Signal (AIS) insertion into CI_D instead of received data when the Alarm Indication Signal defect (dAIS) is asserted. See clause 6.1.5.1.

AM: The Administrative Mode (AM) state machine process according to clause 6.1.18.3.

NACT: The Not Active signal (NACT) is deasserted when the Administrative Mode (AM) state machine is in its ACT state, else it is asserted. See clause 6.1.18.3.

Defects

dPLM: The Payload Mismatch defect (dPLM) is asserted when the Payload Mismatch anomaly (nPLM) is asserted, else it is deasserted. nPLM and dPLM is specified in clause 6.2.5.1.

Consequent actions

aSSF: The Server Signal Fail action (aSSF) is asserted when the Path Label Mismatch defect (dPLM) is asserted, the Alarm Indication Signal defect (dAIS)is asserted or the Trail Signal Fail (AI_TSF) is asserted. See clause 6.3.1.2.

aSSF ← dPLM or dAIS or AI_TSF.

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Trail Signal Fail (AI_TSF) is asserted or the Not Active (NACT) is asserted. See clause 6.3.2.3.

aTSF ← AI_TSF or NACT.

Defect correlation

cPLM: The Payload Mismatch cause (cPLM) is asserted when the Payload Mismatch defect (dPLM) is asserted and the Trail Signal Failure (AI_TSF) is deasserted. See clause 6.4.5.1.

cPLM ← dPLM and (not AI_TSF).

cAIS: The Alarm Indication Signal cause (cAIS) is asserted when the Alarm Indication Signal defect (dAIS) is asserted, the Trail Signal Failure (AI_TSF) is deasserted, the Payload Mismatch defect (dPLM) is deasserted and Alarm Indication Signal Reported (AIS_Reported) is asserted. See clause 6.4.6.1.

cAIS ← dAIS and (not AI_TSF) and (not dPLM) and AIS_Reported.

cTSF: The Trail Signal Fail cause (cTSF) is asserted when Monitoring (MON) is asserted, the Trail Signal Fail (AI_TSF) is asserted and the Trail Signal Fail Reported (TSF_Reported) is asserted. See clause 6.4.6.3.

cTSF ← MON and AI_SSF and TSF_Reported.

Performance monitoring

None.

Output mapping

BP_CI_D ← CI_D.

BP_CI_CK ← S4_AI_CK.

BP_CI_FS ← sFS.

BP_CI_SSF ← aSSF.

S4/BP_A_Sk_MI_AcSL ← MI_AcSL.

S4/BP_A_Sk_MI_aTSF ← aTSF.

S4/BP_A_Sk_MI_cPLM ← cPLM.

S4/BP_A_Sk_MI_cAIS ← cAIS.

S4/BP_A_Sk_MI_cTSF ← cTSF.

Fault management

fAIS (A_Sk): The Alarm Indication Signal fault (fAIS) is asserted when the Alarm Indication Signal cause (cAIS) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cAIS have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.3.

fPLM (A_Sk): The Payload Mismatch fault (fPLM) is asserted when the Payload Mismatch cause (cPLM) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cPLM have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.7.

Long term performance monitoring

None.

9 Bypass layer (BP)

The bypass layer (see figure 49) operates with full DTM TDM frames and supplies per slot bypass switching function, physical interface protection and mapping of channels time slot TDM frames in and out of the bypass layer TDM frames.

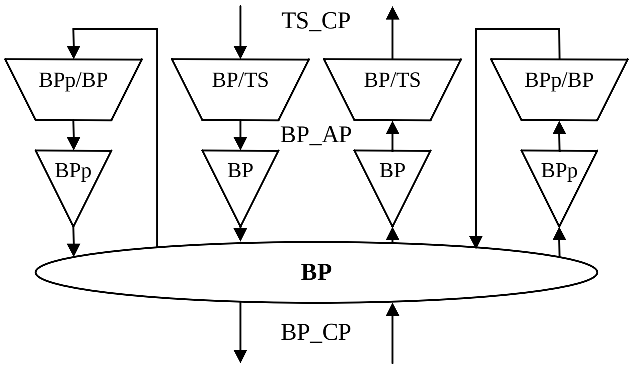


Figure 49: DTM Media Layer 1 atomic functions

The bypass layer connection function implements the bypass switch function which allows for per slot bypass/add switching while supporting independent drop functionality.

The bypass protection scheme provides a 1+1 physical interface protection. When used the ByPass (BP) connection function switches the traffic over the ByPass Protection (BPp) which is then switched over the underlying physical interfaces. The receiving BPp/BP adaptation function will control the protection switch part of the BP connection function such that switch-over can be performed on failed signal.

The time slot TDM frames is mapped in and out of the bypass layer TDM frames in either monotonic rising or arbitrary mapping (see clause 6.1.14.1). Excess slots is sourced with Idle-markers to facilitate safe change of capacity.

9.1 Access point information

9.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is:

- the bypass (and protected equivalent) TDM frame BP_CI_D and BPp_CI_D being an integer multiple of slots;
- the bypass (and protected equivalent) data clock timing BP_CI_CK and BPp_CI_CS;
- the bypass (and protected equivalent) data frame start BP_CI_FS and BPp_CI_FS;
- the bypass (and protected equivalent) data server signal fail BP_CI_SSF and BPp_CI_SSF.

9.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is:

- the bypass (and protected equivalent) TDM frame BP_AI_D and BPp_AI_D being an integer multiple of slots.
- the bypass (and protected equivalent) data clock timing BP_AI_CK and BPp_AI_CK.
- the bypass (and protected equivalent) data frame start BP_AI_FS and BPp_AI_FS.
- the bypass (and protect equivalent) data trail signal fail BP_AI_TSF and BPp_AI_TSF.

9.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is:

- the connection function drop switching slot map table BP_C_MI_SMTd;
- the connection function add/bypass switching slot map table BP_C_MI_SMTa;
- the connection function protection switching state BP_C_MI_PSS;
- the trail termination function server signal fail cause BP_TT_Sk_MI_cSSF and BPp_TT_Sk_MI_cSSF;
- the adaptation function source slot map table BP/TS_A_So_MI_SMT;
- the adaptation function sink slot map table BP/TS_A_Sk_MI_SMT.

9.1.4 Timing Information

The Timing Information (TI) of the Timing Point (TP) is:

- the bypass data clock timing indication BP_TI_CK;
- the bypass frame start timing indication BP_TI_FS.

9.2 Connection function (BP_C)

The connection function of the bypass layer provides support for dropping traffic, bypass/add switching and protection switching.

9.2.1 Drop switching

The connection function provides for drop switching of a slot in the TDM frame by allowing the switching from an incoming physical interface (or a protected one through the BPp mechanism) to a bypass trail termination. This switching is performed when the slot is marked for drop switching in the BP_C_MI_SMTd.

9.2.2 Bypass switching

The connection function provides for bypass/add switching from a TDM frame from a physical interface to that of an outgoing physical interface. When a slot in the TDM frame is marked for add in the BP_C_MI_SMTa then that slot is switched from a bypass trail termination, else that slot is switched from the incoming TDM frame. The incoming and outgoing TDM frames is grouped together to form the pair of a port [ES803-1].

9.2.3 Protection switching

The connection function provides for a 1+1 protection switching over the underlying physical interfaces. It provides a protected physical interface towards the drop and add/bypass switching.

On the source side is the protected physical interface switched through two (i.e. by splitting) the source BPp/BP adaptation function and BPp trail termination. The output of the trail terminations is then switched to the underlying real physical interfaces.

On the sink side is the real physical interfaces switched to the sink BPp trail terminators and sink BPp/BP adaptation functions. The output of the BPp/BP adaptation functions include the CI_SSF which is used to control the protection switch state. Either of the BPp/BP outputs is equally good as the active source as long as its associated CI_SSF is not asserted.

The state of the protection switch indicates which of the incoming physical interfaces (A and B).

If the BP_CI_SSF of the active physical interface becomes asserted and the BP_CI_SSF of the other physical interface is deasserted, switch to make the other physical interface the active physical interface.

If the BP_CI_SSF of the active physical interface becomes asserted and the BP_CI_SSF of the other physical interface is deasserted, do not switch active physical interface.

For the active physical interface shall BP_CI_D, BP_CI_CK, BP_CI_FS and BP_CI_TSF be switched to the associated BP trail terminator.

The state of the protection switch is mapped to the management signal BP_C_MI_PSS.

9.3 Trail Termination functions

9.3.1 Bypass Trail Termination function (BP_TT)

The bypass trail termination provides the supervision of a channel over a bypass trail.

9.3.1.1 Bypass Trail Termination Source function (BP_TT_So)

Symbol

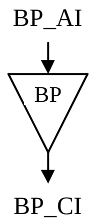


Figure 50: Bypass Trail Termination Source (BP_TT_So)

Interfaces

Table 38: BP_TT_So Input and output signals

Input(s)	Output(s)
BP_AI_D	BP_CI_D
BP_AI_CK	BP_CI_CK
BP_AI_FS	BP_CI_FS
BP_AI_TSF	BP_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

BP_CI_D ← BP_AI_D.

BP_CI_CK ← BP_AI_CK.

BP_CI_FS ← BP_AI_FS.

BP_CI_SSF ← BP_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

9.3.1.2 Bypass Trail Termination Sink function (BP_TT_Sk)

Symbol

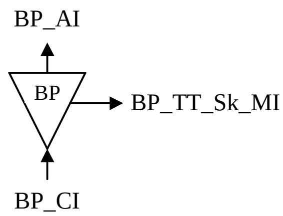


Figure 51: Bypass Trail Termination Sink (BP_TT_Sk)

Interfaces

Table 39: BP_TT_Sk Input and output signals

Input(s)	Output(s)
BP_CI_D	BP_AI_D
BP_CI_CK	BP_AI_CK
BP_CI_FS	BP_AI_FS
BP_CI_SSF	BP_AI_TSF
	BP_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted, else it is deasserted. See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted, else it is deasserted. See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

BP_AI_D ← BP_CI_D.

BP_AI_CK ← BP_CI_CK.

BP_AI_FS ← BP_CI_FS.

BP_AI_TSF ← aTSF.

BP_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

9.3.2 Bypass Protection Trail Termination function (BPp_TT)

The bypass protection trail termination provides the supervision of a channel over a bypass protected trail.

9.3.2.1 Bypass Protection Trail Termination Source function (BPp_TT_So)

Symbol

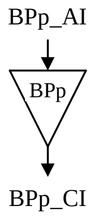


Figure 52: Bypass Protection Trail Termination Source (BPp_TT_So)

Interfaces

Table 40: BPP_TT_So Input and output signals

Input(s)	Output(s)
BPp_AI_D	BPp_CI_D
BPp_AI_CK	BPp_CI_CK
BPp_AI_FS	BPp_CI_FS
BPp_AI_TSF	BPp_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

BPp_CI_D ← BPp_AI_D.

BPp_CI_CK ← BPp_AI_CK.

BPp_CI_FS ← BPp_AI_FS.

BPp_CI_SSF ← BPp_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

9.3.2.2 Bypass Protection Trail Termination Sink function (BPp_TT_Sk)

Symbol

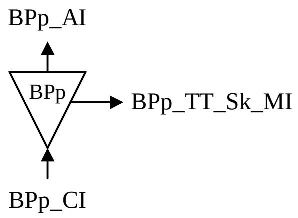


Figure 53: Bypass Protection Trail Termination Sink (BPp_TT_Sk)

Interfaces

Table 41: BPp_TT_Sk Input and output signals

Input(s)	Output(s)
BPp_CI_D	BPp_AI_D
BPp_CI_CK	BPp_AI_CK
BPp_CI_FS	BPp_AI_FS
BPp_CI_SSF	BPp_AI_TSF
	BPp_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted, else deasserted. See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted, else deasserted. See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

BPp_AI_D ← BPp_CI_D.

BPp_AI_CK ← BPp_CI_CK.

BPp_AI_FS ← BPp_CI_FS.

BPp_AI_TSF ← aTSF.

BPp_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

9.4 Adaptation functions

9.4.1 Bypass Adaptation function (BP/TS_A)

The bypass adaptation function provides the mapping of channel TDM frames of the time slot layer in and out of the bypass layer TDM frame. Any excess slots will have Idle-marker generated.

9.4.1.1 Bypass Adaptation Source function (BP/TS_A_So)

Symbol

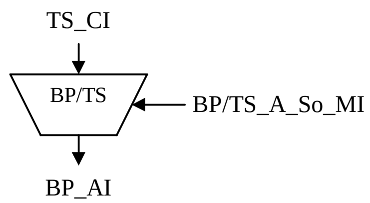


Figure 54: Bypass Adaptation Source (BP/TS_A_So)

Interfaces

Table 42: BP/TS_A_So Input and output signals

Input(s)	Output(s)
TS_CI_D	BP_AI_D
TS_CI_CK	BP_AI_CK
TS_CI_FS	BP_AI_FS
TS_CI_SSF	BP_AI_TSF
BP/TS_A_So_MI_SMT	

Processes and anomalies

The TDM slot assignment of slots in the TS_CI_D TDM frame to the BP_AI_D TDM frame slots according to a slot-to-slot mapping given by the management slot table BP/TS_A_So_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.1.

The excess TDM slots in the BP_AI_D TDM frame which have no mapping from the TS_CI_D TDM frame shall continuously (once per frame and slot position) be sent an Idle-marker. A BP_AI_D TDM slot is marked as an excess slot in the management slot table BP/TS_A_So_MI_SMT. See clause 6.1.14.1.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

BP_AI_CK ← TS_CI_CK.

BP_AI_FS ← TS_CI_FS.

BP_AI_TSF ← TS_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

9.4.1.2 Bypass Adaptation Sink function (BP/TS_A_Sk)

Symbol

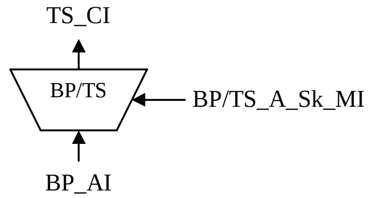


Figure 55: Bypass Adaptation Sink (BP/TS_A_Sk)

Interfaces

Table 43: BP/TS_A_Sk Input and output signals

Input(s)	Output(s)
BP_AI_D	TS_CI_D
BP_AI_CK	TS_CI_CK
BP_AI_FS	TS_CI_FS
BP_AI_TSF	TS_CI_SSF
BP_TI_CK	
BP_TI_FS	
BP/TS_A_Sk_MI_SMT	

Processes and anomalies

The TDM slot access of slots in the BP_AI_D TDM frame to the TS_CI_D TDM frame for the channel according to a slot-to-slot mapping given by the management slot table BP/TS_A_Sk_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.1.

The excess TDM slots in the TS_CI_D TDM frame which have no mapping from the BP_AI_D TDM frame shall continuously (once per frame and slot position) be send an Idle-marker. A TS_CI_D TDM slot is marked as an excess slot in the management slot table BP/TS_A_Sk_MI_SMT. See clause 6.1.14.1.

The elastic buffer to transfer the mapped slots into the time domain of BP_TI_CK and BP_TI_FS.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_CI_CK ← BP_TI_CK.

TS_CI_FS ← BP_TI_FS.

TS_CI_SSF ← BP_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

9.4.2 Bypass Protection Adaptation function (BPp/BP_A)

The bypass protection adaptation function provides the empty adaptation for protection.

9.4.2.1 Bypass Protection Adaptation Source function (BPp/BP_A_So)

Symbol

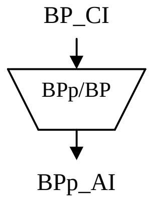


Figure 56: Bypass Protection Adaptation Source (BPp/BP_A_So)

Interfaces

Table 44: BPp/BP_A_So Input and output signals

Input(s)	Output(s)
BP_CI_D	BPP_AI_D
BP_CI_CK	BPP_AI_CK
BP_CI_FS	BPP_AI_FS
BP_CI_SSF	BPP_AI_TSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

BPp_AI_D ← BP_CI_D.

BPp_AI_CK ← BP_CI_CK.

BPp_AI_FS ← BP_CI_FS.

BPp_AI_TSF ← BP_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

9.4.2.2 Bypass Protection Adaptation Sink function (BPp/BP_A_Sk)

Symbol

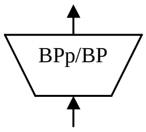


Figure 57: Bypass Protection Adaptation Sink (BPp/BP_A_Sk)

Interfaces

Table 45: BPP/BP_A_Sk Input and output signals

Input(s)	Output(s)
BPp_AI_D	BP_CI_D
BPp_AI_CK	BP_CI_CK
BPp_AI_FS	BP_CI_FS
BPp_AI_TSF	BP_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

BP_CI_D ← BPp_AI_D.

BP_CI_CK ← BPp_AI_CK.

BP_CI_FS ← BPp_AI_FS.

BP_CI_SSF ← BPp_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10 Time Slot layer (TS)

The time slot layer (see figure 59) operates with per channel TDM frames synchronous to the DTM frame synchronization and supplies time slot switching function, protection, tunneling and mapping of channels TDM frames in and out of the time slot layer TDM frames.

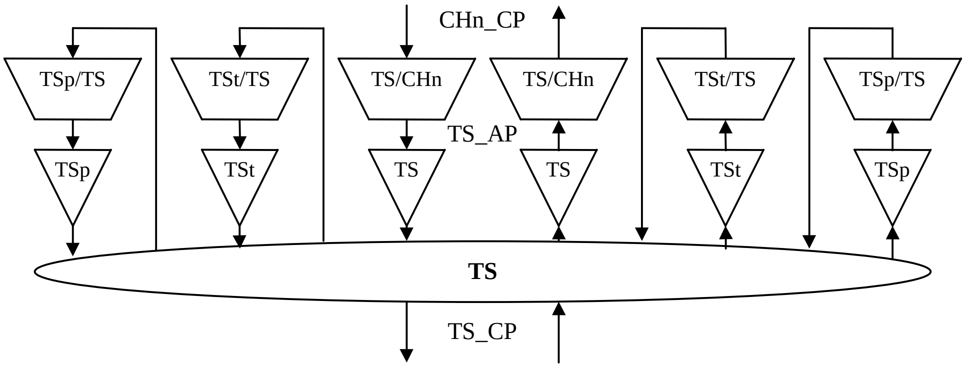


Figure 58: DTM Time Slot layer atomic functions

The time slot layer connection function implements the time slot switch function which allows for space switching while supporting independent drop functionality.

The time slot protection scheme provides a 1+1 time slot channel protection. When used the Time Slot (TS) connection function switches the traffic over the Time Slot Protection (TSp) which is then switched over the underlying physical interfaces. The receiving TSp/TS adaptation function will control the protection switch part of the TS connection function such that switch-over can be performed on failed signal.

The time slot tunneling provides a method of grouping a number of channels into a common channel. It is achieved by setting up a tunneling channel into which other time slot channels is mapped.

The channel TDM frames is mapped in and out of the time slot layer TDM frames in either synchronous or asynchronous mapping depending on the channel layer type.

10.1 Access point information

10.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is:

- the time slot (and protection and tunneling equivalents) TDM frame TS_CI_D, TSp_CI_D and TSt_CI_D being an integer multiple of slots;
- the time slot (and protection and tunneling equivalents) data clock timing TS_CI_CK, TSp_CI_CK and TSt_CI_CK;
- the time slot (and protection and tunneling equivalents) data frame start TS_CI_FS, TSp_CI_FS and TSt_CI_FS;
- the time slot (and protection and tunneling equivalents) data trail signal fail TS_CI_SSF, TSp_CI_SSF and TSt_CI_SSF.

10.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is:

- the time slot (and protection and tunneling equivalents) TDM frame TS_AI_D, TSp_AI_D and TSt_AI_D being an integer multiple of slots;
- the time slot (and protection and tunneling equivalents) data clock timing TS_AI_CK, TSp_AI_CK and TSt_AI_CK;
- the time slot (and protection and tunneling equivalents) data frame start TS_AI_FS, TSp_AI_FS and TSt_AI_FS;
- the time slot (and protection and tunneling equivalents) data trail signal fail TS_AI_SSF, TSp_AI_SSF and TSt_AI_SSF.

10.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is:

- the connection function drop switching time slot channel map table TS_C_MI_CMTd;
- the connection function space switching time slot channel map table TS_C_MI_CMTs;
- the connection function protection switching state TS_C_MI_PSS;
- the connection function tunneling switching time slot channel map table TS_C_MI_CMTt;
- the trail termination function server signal fail cause TS_TT_Sk_MI_cSSF, TSp_TT_Sk_MI_cSSF and TSp_TT_Sk_MI_cSSF;
- the adaptation function source tunneling slot map table TSt/TS_A_So_MI_SMT;
- the adaptation function sink tunneling slot map table TSt/TS_A_Sk_MI_SMT.

10.1.4 Timing Information

None.

10.2 Connection function (TS_C)

The connection function of the time slot layer provides support for dropping traffic, space switching, protection switching and tunneling.

10.2.1 Drop switching

The connection function provides for drop switching of a channel by allowing the switching from an incoming channel (or a protected or tunnelled one through the TSp and TSt mechanisms) to a bypass trail termination. This switching is performed when the slot is marked for drop switching in the TS_C_MI_CMTd.

10.2.2 Space switching

The connection function provides for space switching of time slot channels TDM frame from a incoming channel, a protected channel, a protected channel to that of an outgoing channel. The channel source for an outgoing channel is specified in the BP_C_MI_CMTs.

10.2.3 Protection switching

The connection function provides for a 1+1 protection switching over the underlying time slot channels. It provides a protected time slot channel towards the drop, space and tunnel switching.

On the source side is the protected time slot channel switched through two (i.e. by splitting) the source TSp/TS adaptation function and TSp trail termination. The output of the trail terminations is then switched to the underlying time slot channels.

On the sink side is the time slot channel switched to the sink TSp trail terminators and sink TSp/TS adaptation functions. The output of the TSp/TS adaptation functions include the CI_SSF which is used to control the protection switch state. Either of the TSp/TS outputs is equally good as the active source as long as its associated CI_SSF is not asserted.

The state of the protection switch indicates which of the incoming physical interfaces (A and B).

If the TS_CI_SSF of the active time slot channel becomes asserted and the TS_CI_SSF of the other time slot channel is deasserted, switch to make the other time slot channel the active time slot channel.

If the TS_CI_SSF of the active time slot channel becomes asserted and the TS_CI_SSF of the other time slot channel is deasserted, do not switch active time slot channel.

For the active time slot channel shall TS_CI_D, TS_CI_CK, TS_CI_FS and TS_CI_TSF be switched to the associated TS trail terminator.

The state of the protection switch is mapped to the management signal TS_C_MI_PSS.

10.2.4 Tunnel switching

The connection function provides for tunneling switching over the underlying time slot channel. It provides a time slot channel with associated mapping to allow multiple time slot channels to be tunnelled through a single time slot channel.

On the source side is the tunnelled time slot channels switched through the source TSt/TS adaptation function and TSt trail termination. The output of the trail termination is then switched to the underlying time slot channel which may be space, protected or tunnel switched.

On the sink side is the time slot channel switched to the sink TSt trail terminator and sink TSt/TS adaptation function. The output of the TSt/TS adaptation function is provide the individual time slot channels that where tunnelled. These may be drop, protected or tunnel switched.

The tunnel switch is controlled by the management signal TS_C_MI_CMTt.

10.3 Trail Termination functions

10.3.1 Time Slot Trail Termination function (TS_TT)

The time slot trail termination provides the supervision of a time slot channel over a time slot trail.

10.3.1.1 Time Slot Trail Termination Source function (TS_TT_So)

Symbol

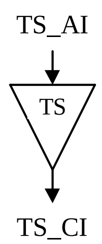


Figure 59: Time Slot Trail Termination Source (TS_TT_So)

Interfaces

Table 46: TS_TT_So Input and output signals

Input(s)	Output(s)
TS_AI_D	TS_CI_D
TS_AI_CK	TS_CI_CK
TS_AI_FS	TS_CI_FS
TS_AI_TSF	TS_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_CI_D ← TS_AI_D.

TS_CI_CK ← TS_AI_CK.

TS_CI_FS ← TS_AI_FS.

TS_CI_SSF ← TS_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.3.1.2 Time Slot Trail Termination Sink function (TS_TT_Sk)

Symbol

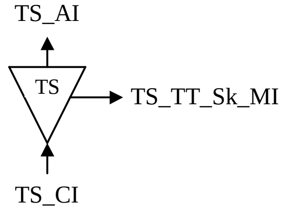


Figure 60: Time Slot Trail Termination Sink (TS_TT_Sk)

Interfaces

Table 47: TS_TT_Sk Input and output signals

Input(s)	Output(s)
TS_CI_D	TS_AI_D
TS_CI_CK	TS_AI_CK
TS_CI_FS	TS_AI_FS
TS_CI_SSF	TS_AI_TSF
	TS_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

TS_AI_D ← TS_CI_D.

TS_AI_CK ← TS_CI_CK.

TS_AI_FS ← TS_CI_FS.

TS_AI_TSF ← aTSF.

TS_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

10.3.2 Time Slot Protection Trail Termination function (TSp_TT)

The time slot protection trail termination provides the supervision of a channel over a time slot protected trail.

10.3.2.1 Time Slot Protection Trail Termination Source function (TSp_TT_So)

Symbol

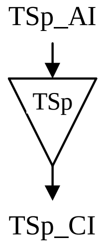


Figure 61: Time Slot Protection Trail Termination Source (TSp_TT_So)

Interfaces

Table 48: TSp_TT_So Input and output signals

Input(s)	Output(s)
TSp_AI_D	TSp_CI_D
TSp_AI_CK	TSp_CI_CK
TSp_AI_FS	TSp_CI_FS
TSp_AI_TSF	TSp_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TSp_CI_D ← TSp_AI_D.

TSp_CI_CK ← TSp_AI_CK.

TSp_CI_FS ← TSp_AI_FS.

TSp_CI_SSF ← TSp_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.3.2.2 Time Slot Protection Trail Termination Sink function (TSp_TT_Sk)

Symbol

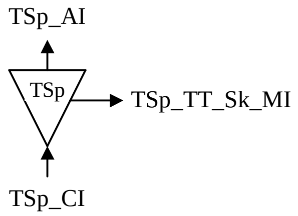


Figure 62: Time Slot Protection Trail Termination Sink (TSp_TT_Sk)

Interfaces

Table 49: TSp_TT_Sk Input and output signals

Input(s)	Output(s)
TSp_CI_D	TSp_AI_D
TSp_CI_CK	TSp_AI_CK
TSp_CI_FS	TSp_AI_FS
TSp_CI_SSF	TSp_AI_TSF
	TSp_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

TSp_AI_D ← TSp_CI_D.

TSp_AI_CK ← TSp_CI_CK.

TSp_AI_FS ← TSp_CI_FS.

TSp_AI_TSF ← aTSF.

TSp_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

10.3.3 Time Slot Tunnel Trail Termination function (TST_TT)

The time slot tunnel trail termination provides the supervision of a time slot channel over a time slot tunnel trail.

10.3.3.1 Time Slot Tunnel Trail Termination Source function (TSt_TT_So)

Symbol

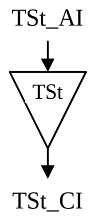


Figure 63: Time Slot Tunnel Trail Termination Source (TSt_TT_So)

Interfaces

Table 50: TSt_TT_So Input and output signals

Input(s)	Output(s)
TSt_AI_D	TSt_CI_D
TSt_AI_CK	TSt_CI_CK
TSt_AI_FS	TSt_CI_FS
TSt_AI_TSF	TSt_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TSt_CI_D ← TSt_AI_D.

TSt_CI_CK ← TSt_AI_CK.

TSt_CI_FS ← TSt_AI_FS.

TSt_CI_SSF ← TSt_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.3.3.2 Time Slot Tunnel Trail Termination Sink function (TSt_TT_Sk)

Symbol

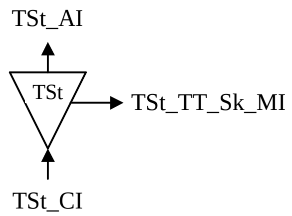


Figure 64: Time Slot Tunnel Trail Termination Sink (TSt_TT_Sk)

Interfaces

Table 51: TSt_TT_Sk Input and output signals

Input(s)	Output(s)
TSt_CI_D	TSt_AI_D
TSt_CI_CK	TSt_AI_CK
TSt_CI_FS	TSt_AI_FS
TSt_CI_SSF	TSt_AI_TSF
	TSt_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

TSt_AI_D ← TSt_CI_D.

TSt_AI_CK ← TSt_CI_CK.

TSt_AI_FS ← TSt_CI_FS.

TSt_AI_TSF ← aTSF.

TSt_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

10.4 Adaptation functions

10.4.1 Time Slot/Channel 1 Adaptation function (TS/CH1_A)

The time slot adaptation function provides the mapping of channel TDM frames of the synchronous channel layer in and out of the time slot layer TDM frame.

10.4.1.1 Time Slot/Channel 1 Adaptation Source function (TS/CH1_A_So)

Symbol

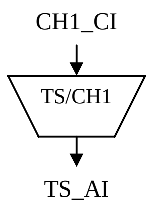


Figure 65: Time Slot/Channel 1 Adaptation Source (TS/CH1_A_So)

Interfaces

Table 52: TS/CH1_A_So Input and output signals

Input(s)	Output(s)
CH1_CI_D	TS_AI_D
CH1_CI_CK	TS_AI_CK
CH1_CI_FS	TS_AI_FS
CH1_CI_SSF	TS_AI_TSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_AI_D ← CH1_CI_D.

TS_AI_CK ← CH1_CI_CK.

TS_AI_FS ← CH1_CI_FS.

TS_AI_TSF ← CH1_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

10.4.1.2 Time Slot/Channel 1 Adaptation Sink function (TS/CH1_A_Sk)

Symbol

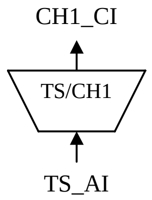


Figure 66: Time Slot/Channel 1 Adaptation Sink (TS/CH1_A_Sk)

Interfaces

Table 53: TS/CH1_A_Sk Input and output signals

Input(s)	Output(s)
TS_AI_D	CH1_CI_D
TS_AI_CK	CH1_CI_CK
TS_AI_FS	CH1_CI_FS
TS_AI_TSF	CH1_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_CI_D ← TS_AI_D.

CH1_CI_CK ← TS_AI_CK.

CH1_CI_FS ← TS_AI_FS.

CH1_CI_SSF ← TS_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.4.2 Time Slot/Channel 2 Adaptation function (TS/CH2_A)

The time slot adaptation function provides the mapping of channel TDM frames of the asynchronous channel layer in and out of the time slot layer TDM frame.

10.4.2.1 Time Slot/Channel 2 Adaptation Source function (TS/CH2_A_So)

Symbol

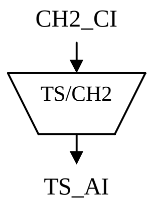


Figure 67: Time Slot/Channel 2 Adaptation Source (TS/CH2_A_So)

Interfaces

Table 54: TS/CH2_A_So Input and output signals

Input(s)	Output(s)
CH2_CI_D	TS_AI_D
CH2_CI_CK	TS_AI_CK
CH2_CI_FS	TS_AI_FS
CH2_CI_SSF	TS_AI_TSF

Processes and anomalies

The storage of CH2_CI_D slot words into an elastic store except for the case of CH2_CI_D being an Idle-marker. See clause 6.1.14.2.

The reset of the next slot in TDM frame to become the first slot upon TS_TI_FS. See clause 6.1.14.2.

The retrieval of a slot word from the elastic store and binding to the next slot in TDM frame. If there where a slot word in the elastic store, then that is sent to AI_D, else an Idle-marker is sourced to the AI_D. See clause 6.1.14.2.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_AI_D ← AI_D.

TS_AI_CK ← CH2_CI_CK.

TS_AI_FS ← CH2_CI_FS.

TS_AI_TSF ← CH2_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

10.4.2.2 Time Slot/Channel 2 Adaptation Sink function (TS/CH2_A_Sk)

Symbol

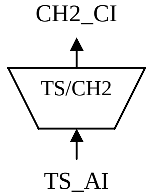


Figure 68: Time Slot/Channel 2 Adaptation Sink (TS/CH2_A_Sk)

Interfaces

Table 55: TS/CH2_A_Sk Input and output signals

Input(s)	Output(s)
TS_AI_D	CH2_CI_D
TS_AI_CK	CH2_CI_CK
TS_AI_FS	CH2_CI_FS
TS_AI_TSF	CH2_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2_CI_D ← TS_AI_D.

CH2_CI_CK ← TS_AI_CK.

CH2_CI_FS ← TS_AI_FS.

CH2_CI_SSF ← TS_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.4.3 Time Slot Protected/Time Slot Adaptation function (TSp/TS_A)

The time slot protection adaptation function provides the empty adaptation for protection.

10.4.3.1 Time Slot Protected/Time Slot Adaptation Source function (TSp/TS_A_So)

Symbol

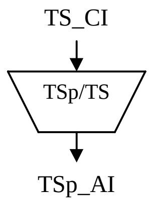


Figure 69: Time Slot Protected/Time Slot Adaptation Source (TSp/TS_A_So)

Interfaces

Table 56: TSp/TS_A_So Input and output signals

Input(s)	Output(s)
TS_CI_D	TSp_AI_D
TS_CI_CK	TSp_AI_CK
TS_CI_FS	TSp_AI_FS
TS_CI_SSF	TSp_AI_TSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TSp_AI_D ← TS_CI_D.

TSp_AI_CK ← TS_CI_CK.

TSp_AI_FS ← TS_CI_FS.

TSp_AI_TSF ← TS_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

10.4.3.2 Time Slot Protected/Time Slot Adaptation Sink function (TSp/TS_A_Sk)

Symbol

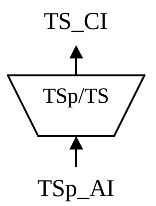


Figure 70: Time Slot Protected/Time Slot Adaptation Sink (TSp/TS_A_Sk)

Interfaces

Table 57: TSp/TS_A_Sk Input and output signals

Input(s)	Output(s)
TSp_AI_D	TS_CI_D
TSp_AI_CK	TS_CI_CK
TSp_AI_FS	TS_CI_FS
TSp_AI_TSF	TS_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_CI_D ← TSp_AI_D.

TS_CI_CK ← TSp_AI_CK.

TS_CI_FS ← TSp_AI_FS.

TS_CI_SSF ← TSp_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

10.4.4 Time Slot Tunnel/Time Slot Adaptation function (TSt/TS_A)

The time slot tunnel adaptation function provides the mapping of channel TDM frames of the time slot layer in and out of the time slot tunnel sublayer TDM frame. Any excess slots will have Idle-marker generated.

10.4.4.1 Time Slot Tunnel/Time Slot Adaptation Source function (TSt/TS_A_So)

Symbol

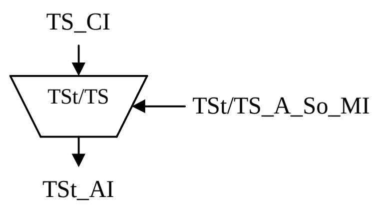


Figure 71: Time Slot Tunnel/Time Slot Adaptation Source (TSt/TS_A_So)

Interfaces

Table 58: TSt/TS_A_So Input and output signals

Input(s)	Output(s)
TS_CI_D	TSt_AI_D
TS_CI_CK	TSt_AI_CK
TS_CI_FS	TSt_AI_FS
TS_CI_SSF	TSt_AI_TSF
TSt/TS_A_So_MI_SMT	

Processes and anomalies

The TDM slot assignment of slots in the TS_CI_D TDM frame to the TSt_AI_D TDM frame slots according to a slot-to-slot mapping given by the management slot table TSt/TS_A_So_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.3.

The excess TDM slots in the TSt_AI_D TDM frame which have no mapping from the TS_CI_D TDM frame shall continuously (once per frame and slot position) be sent an Idle-marker. A TSt_AI_D TDM slot is marked as an excess slot in the management slot table TSt/TS_A_So_MI_SMT. See clause 6.1.14.3.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TSt_AI_CK ← TS_CI_CK.

TSt_AI_FS ← TS_CI_FS.

TSt_AI_TSF ← TS_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

10.4.4.2 Time Slot Tunnel/Time Slot Adaptation Sink function (TSt/TS_A_Sk)

Symbol

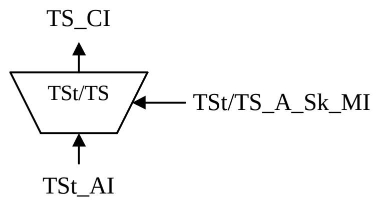


Figure 72: Time Slot Tunnel/Time Slot Adaptation Sink (TSt/TS_A_Sk)

Interfaces

Table 59: TSt/TS_A_Sk Input and output signals

Input(s)	Output(s)
TSt_AI_D	TS_CI_D
TSt_AI_CK	TS_CI_CK
TSt_AI_FS	TS_CI_FS
TSt_AI_TSF	TS_CI_TSF
TSt/TS_A_Sk_MI_SMT	

Processes and anomalies

The TDM slot access of slots in the TSt_AI_D TDM frame to the TS_CI_D TDM frame for the channel according to a slot-to-slot mapping given by the management slot table TSt/TS_A_Sk_MI_SMT. The slot mapping may be either the monotonic rising or arbitrary mapping. See clause 6.1.14.3.

The excess TDM slots in the TS_CI_D TDM frame which have no mapping from the TSt_AI_D TDM frame shall continuously (once per frame and slot position) be send an Idle-marker. A TS_CI_D TDM slot is marked as an excess slot in the management slot table TSt/TS_A_Sk_MI_SMT. See clause 6.1.14.3.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

TS_CI_CK ← TSt_AI_CK.

TS_CI_FS ← TSt_AI_FS.

TS_CI_SSF ← TSt_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11 Channel layer (CH)

The channel layer (see figure 73) operates with per channel TDM frames synchronous or asynchronous to the DTM frame synchronization and supplies channel switching function, protection and mapping of channels TDM frames in and out of the time slot layer TDM frames.

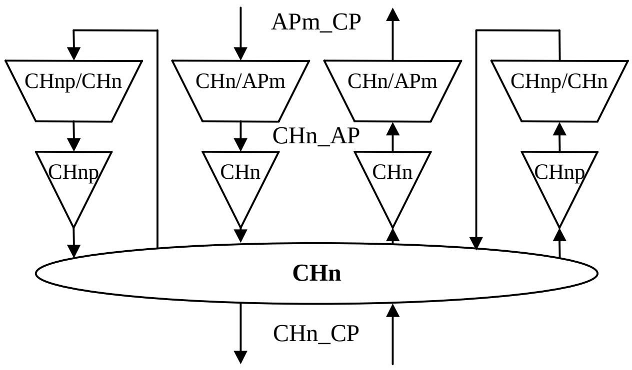


Figure 73: DTM Media Layer 1 atomic functions

The channel layer connection function implements the channel switch function which allows for space switching while supporting independent drop functionality.

The channel protection scheme provides a 1+1 channel protection. When used the Channel (CH) connection function switches the traffic over the Channel Protection (CHp) which is then switched over the underlying channels. The receiving CHp/CH adaptation function will control the protection switch part of the CH connection function such that switch-over can be performed on failed signal.

The channel TDM frames is mapped in and out of the channel layer TDM frames in any of the channel adaptation types specified in clause 12.

11.1 Access point information

11.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is:

- the channel (and protected equivalent) TDM frame CHn_CI_D and CHnp_CI_D being an integer multiple of slots;
- the channel (and protected equivalent) data clock CHn_CI_CK and CHnp_CI_CK;
- the channel (and protected equivalent) performance supervision insertion CHn_CI_PSI and CHnp_CI_PSI;
- the channel (and protected equivalent) server signal fail CHn_CI_SSF and CHnp_CI_SSF.

The Characteristic Information (CI) of the Application 0 Connection Point (CP) is:

- the application 0 data AP0_CI_D being a series of 64 bit data slot words;
- the application 0 data clock AP0_CI_CK;
- the application 0 performance supervision insertion AP0_CI_PSI;
- the application 0 idle insertion AP0_CI_II;
- the application 0 server signal fail AP0_CI_SSF.

The Characteristic Information (CI) of the Application 1 Connection Point (CP) is:

- the application 1 data AP1_CI_D being a series of 8 bit words (octets);
- the application 1 data clock AP1_CI_CK;
- the application 1 frame start AP1_CI_FS;
- the application 1 packet length field (in number of octets) AP1_CI_LEN;
- the application 1 channel multiplexing identifier AP1_CI_CMI;
- the application 1 priority AP1_CI_PRI;
- the application 1 server signal fail AP0_CI_SSF.

The Characteristic Information (CI) of the Application 2 Connection Point (CP) is:

- the application 2 data AP2_CI_D being a series of bits;
- the application 2 data clock AP2_CI_CK;
- the application 2 server signal fail AP2_CI_SSF.

11.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is:

- the channel (and protected equivalent) TDM frame CHn_AI_D and CHnp_AI_D being an integer multiple of slots;
- the channel (and protected equivalent) data clock CHn_AI_CK and CHnp_AI_CK;
- the channel (and protected equivalent) performance supervision insertion CHn_AI_PSI and CHnp_AI_PSI;
- the channel (and protected equivalent) trail signal fail CHn_AI_TSF and CHnp_AI_TSF.

11.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is:

- the connection function drop switching channel map table CH_C_MI_CMTd;
- the connection function space switching channel map table CH_C_MI_CMTs;
- the connection function protection switching state CH_C_MI_PSS;
- the trail termination function server signal fail cause CH1_TT_Sk_MI_cSSF, CH1p_TT_Sk_MI_cSSF, CH2_TT_Sk_MI_cSSF and CH2p_TT_Sk_MI_cSSF;
- the adaptation function loss of frame cause CH1/AP1_A_Sk_MI_cLOF, CH1/AP2_A_Sk_MI_cLOF and CH2/AP1_A_Sk_MI_cLOF;
- the adaptation function degraded signal cause CH1/AP1_A_Sk_MI_cDEG, CH1/AP2_A_Sk_MI_cDEG and CH2/AP1_A_Sk_MI_cDEG;
- the adaptation function near end errored block count performance CH1/AP1_A_Sk_MI_pN_EBC, CH1/AP2_A_Sk_MI_pN_EBC and CH2/AP1_A_Sk_MI_pN_EBC;
- the adaptation function near end defect second performance CH1/AP1_A_Sk_MI_pN_DS, CH1/AP2_A_Sk_MI_pN_DS and CH2/AP1_A_Sk_MI_pN_DS;
- the adaptation function positive frequency justification performance CH1/AP2_A_So_MI_pFJ+;
- the adaptation function negative frequency justification performance CH1/AP2_A_So_MI_pFJ-.

11.1.4 Timing Information

The Timing Information (TI) of the Timing Point (TP) is:

- the adaptation function data clock timing information CH1/AP1_A_So_TI_CK, CH1/AP2_A_So_TI_CK and CH2/AP2_A_So_TI_CK;
- the adaptation function frame start timing information CH1/AP2_A_So_TI_FS.

11.2 Connection function (CHn_C)

The connection function of the channel layer provides support for dropping traffic, space switching and protection switching.

11.2.1 Drop switching

The connection function provides for drop switching of a channel by allowing the switching from an incoming channel (or a protected one through the CHp mechanism) to a channel trail termination. This switching is performed when the slot is marked for drop switching in the CH_C_MI_CMTd.

11.2.2 Space switching

The connection function provides for space switching of channels TDM frame from a incoming channel, a protected channel, a protected channel to that of an outgoing channel. The channel source for an outgoing channel is specified in the CH_C_MI_CMTs.

11.2.3 Protection switching

The connection function provides for a 1+1 protection switching over the underlying channels. It provides a protected channel towards the drop, space switching.

On the source side is the protected channel switched through two (i.e. by splitting) the source CHp/CH adaptation function and CHp trail termination. The output of the trail terminations is then switched to the underlying channels.

On the sink side is the channel switched to the sink CHp trail terminators and sink CHp/CH adaptation functions. The output of the CHp/CH adaptation functions include the CI_SSF which is used to control the protection switch state. Either of the CHp/CH outputs is equally good as the active source as long as its associated CI_SSF is not asserted.

The state of the protection switch indicates which of the incoming physical interfaces (A and B).

If the CH_CI_SSF of the active time slot channel becomes asserted and the CH_CI_SSF of the other time slot channel is deasserted, switch to make the other time slot channel the active time slot channel.

If the CH_CI_SSF of the active time slot channel becomes asserted and the CH_CI_SSF of the other time slot channel is deasserted, do not switch active time slot channel.

For the active time slot channel shall CH_CI_D, CH_CI_CK, CH_CI_FS and CH_CI_TSF be switched to the associated TS trail terminator.

The state of the protection switch is mapped to the management signal CH_C_MI_PSS.

11.3 Trail Termination functions

11.3.1 Channel 1 Trail Termination function (CH1_TT)

Provides the synchronous channel supervision.

11.3.1.1 Channel 1 Trail Termination Source function (CH1_TT_So)

Symbol

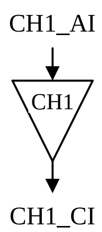


Figure 74: Channel 1 Trail Termination Source (CH1_TT_So)

Interfaces

Table 60: CH1_TT_So Input and output signals

Input(s)	Output(s)
CH1_AI_D	CH1_CI_D
CH1_AI_CK	CH1_CI_CK
CH1_AI_PSI	CH1_CI_PSI
CH1_AI_TSF	CH1_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_CI_D ← CH1_AI_D.

CH1_CI_CK ← CH1_AI_CK.

CH1_CI_PSI ← CH1_AI_PSI.

CH1_CI_SSF ← CH1_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.3.1.2 Channel 1 Trail Termination Sink function (CH1_TT_Sk)

Symbol

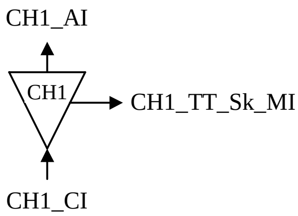


Figure 75: Channel 1 Trail Termination Sink (CH1_TT_Sk)

Interfaces

Table 61: CH1_TT_Sk Input and output signals

Input(s)	Output(s)
CH1_CI_D	CH1_AI_D
CH1_CI_CK	CH1_AI_CK
CH1_CI_PSI	CH1_AI_PSI
CH1_CI_SSF	CH1_AI_TSF
	CH1_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.3.1.3.

aTSF ← CI_SSF

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted. See clause 6.4.6.2.

cSSF ← CI_SSF

Performance monitoring

None.

Output mapping

CH1_AI_D ← CH1_CI_D.

CH1_AI_CK ← CH1_CI_CK.

CH1_AI_FS ← CH1_CI_FS.

CH1_AI_TSF ← aTSF.

CH1_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

11.3.2 Channel 1 Protection Trail Termination function (CH1p_TT)

Provides the synchronous protected channel supervision.

11.3.2.1 Channel 1 ProtectionTrail Termination Source function (CH1p_TT_So)

Symbol

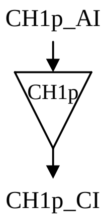


Figure 76: Channel 1 Protection Trail Termination Source (CH1p_TT_So)

Interfaces

Table 62: CH1p_TT_So Input and output signals

Input(s)	Output(s)
CH1p_AI_D	CH1p_CI_D
CH1p_AI_CK	CH1p_CI_CK
CH1p_AI_PSI	CH1p_CI_PSI
CH1p_AI_TSF	CH1p_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1p_CI_D ← CH1p_AI_D.

CH1p_CI_CK ← CH1p_AI_CK.

CH1p_CI_PSI ← CH1p_AI_PSI.

CH1p_CI_SSF ← CH1p_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.3.2.2 Channel 1 Protection Trail Termination Sink function (CH1p_TT_Sk)

Symbol

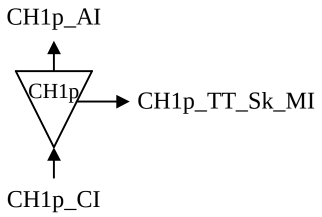


Figure 77: Channel 1 Protection Trail Termination Sink (CH1p_TT_Sk)

Interfaces

Table 63: CH1p_TT_Sk Input and output signals

Input(s)	Output(s)
CH1p_CI_D	CH1p_AI_D
CH1p_CI_CK	CH1p_AI_CK
CH1p_CI_PSI	CH1p_AI_PSI
CH1p_CI_SSF	CH1p_AI_TSF
	CH1p_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

CH1p_AI_D ← CH1p_CI_D.

CH1p_AI_CK ← CH1p_CI_CK.

CH1p_AI_FS ← CH1p_CI_FS.

CH1p_AI_TSF ← aTSF.

CH1p_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

11.3.3 Channel 2 Trail Termination function (CH2_TT)

Provides the asynchronous channel supervision.

11.3.3.1 Channel 2 Trail Termination Source function (CH2_TT_So)

Symbol

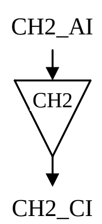


Figure 78: Channel 2 Trail Termination Source (CH2_TT_So)

Interfaces

Table 64: CH2_TT_So Input and output signals

Input(s)	Output(s)
CH2_AI_D	CH2_CI_D
CH2_AI_CK	CH2_CI_CK
CH2_AI_PSI	CH2_CI_PSI
CH2_AI_TSF	CH2_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2_CI_D ← CH2_AI_D.

CH2_CI_CK ← CH2_AI_CK.

CH2_CI_PSI ← CH2_AI_PSI.

CH2_CI_SSF ← CH2_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.3.3.2 Channel 2 Trail Termination Sink function (CH2_TT_Sk)

Symbol

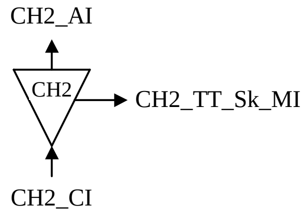


Figure 79: Channel 2 Trail Termination Sink (CH2_TT_Sk)

Interfaces

Table 65: CH2_TT_Sk Input and output signals

Input(s)	Output(s)
CH2_CI_D	CH2_AI_D
CH2_CI_CK	CH2_AI_CK
CH2_CI_PSI	CH2_AI_PSI
CH2_CI_SSF	CH2_AI_TSF
	CH2__TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

CH2_AI_D ← CH2_CI_D.

CH2_AI_CK ← CH2_CI_CK.

CH2_AI_FS ← CH2_CI_FS.

CH2_AI_TSF ← aTSF.

CH2_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

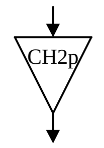
11.3.4 Channel 2 Protection Trail Termination function (CH2p_TT)

Provides the asynchronous protected channel supervision.

11.3.4.1 Channel 2 Protection Trail Termination Source function (CH2p_TT_So)

Symbol

CH2p_AI



CH2p_CI

Figure 80: Channel 2 Protection Trail Termination Source (CH2p_TT_So)

Interfaces

Table 66: CH2p_TT_So Input and output signals

Input(s)	Output(s)
CH2p_AI_D	CH2p_CI_D
CH2p_AI_CK	CH2p_CI_CK
CH2p_AI_PSI	CH2p_CI_PSI
CH2p_AI_TSF	CH2p_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2p_CI_D ← CH2p_AI_D.

CH2p_CI_CK ← CH2p_AI_CK.

CH2p_CI_PSI ← CH2p_AI_PSI.

CH2p_CI_SSF ← CH2p_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.3.4.2 Channel 2 Protection Trail Termination Sink function (CH2p_TT_Sk)

Symbol

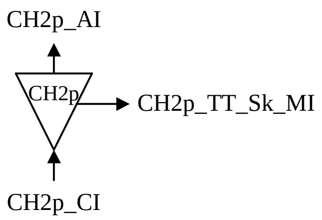


Figure 81: Channel 2 Protection Trail Termination Sink (CH2p_TT_Sk)

Interfaces

Table 67: CH2p_TT_Sk Input and output signals

Input(s)	Output(s)
CH2p_CI_D	CH2p_AI_D
CH2p_CI_CK	CH2p_AI_CK
CH2p_CI_PSI	CH2p_AI_PSI
CH2p_CI_SSF	CH2p_AI_TSF
	CH2p_TT_Sk_MI_cSSF

Processes and anomalies

None.

Defects

None.

Consequent actions

aTSF: The Trail Signal Fail action (aTSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.3.1.3.

aTSF ← CI_SSF.

Defect correlation

cSSF: The Server Signal Fail cause (cSSF) is asserted when the Server Signal Fail (CI_SSF) is asserted.
See clause 6.4.6.2.

cSSF ← CI_SSF.

Performance monitoring

None.

Output mapping

CH2p_AI_D ← CH2p_CI_D.

CH2p_AI_CK ← CH2p_CI_CK.

CH2p_AI_FS ← CH2p_CI_FS.

CH2p_AI_TSF ← aTSF.

CH2p_TT_Sk_MI_cSSF ← cSSF.

Fault management

fSSF (TT_Sk): The Server Signal Fail fault (fSSF) is asserted when the Server Signal Fail cause (cSSF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cSSF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.4.

Long term performance monitoring

None.

11.4 Adaptation functions

11.4.1 Channel 1/Application 0 Adaptation function (CH1/AP0_A)

The channel adaptation function for application 0 provides a null-mapping (the Idle-mapping is necessary) for applications wishing a raw DTM channel access.

11.4.1.1 Channel 1/Application 0 Adaptation Source function (CH1/AP0_A_So)

Symbol

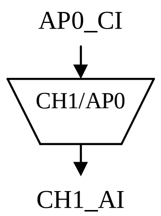


Figure 82: Channel 1/Application 0 Adaptation Source (CH1/AP0_A_So)

Interfaces

Table 68: CH1/AP0_A_So Input and output signals

Input(s)	Output(s)
AP0_CI_D	CH1_AI_D
AP0_CI_CK	CH1_AI_CK
AP0_CI_PSI	CH1_AI_PSI
AP0_CI_II	CH1_AI_TSF
AP0_CI_SSF	

Processes and anomalies

Idle: The Idle special marker insertion to AI_D instead of received signal CI_D when CI_II is asserted. See clause 6.1.7.5.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_AI_D ← AI_D.

CH1_AI_CK ← AP0_CI_CK.

CH1_AI_PSI ← AP0_CI_PSI.

CH1_AI_TSF ← AP0_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.1.2 Channel 1/Application 0 Adaptation Sink function (CH1/AP0_A_Sk)

Symbol

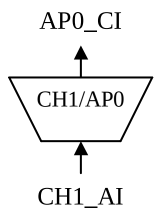


Figure 83: Channel 1/Application 0 Adaptation Sink (CH1/AP0_A_Sk)

Interfaces

Table 69: CH1/AP0_A_Sk Input and output signals

Input(s)	Output(s)
CH1_AI_D	AP0_CI_D
CH1_AI_CK	AP0_CI_CK
CH1_AI_PSI	AP0_CI_PSI
CH1_AI_TSF	AP0_CI_II
	AP0_CI_SSF

Processes and anomalies

Idle: The Idle Indication signal (sII) is asserted when the AI_D is detected to be an Idle special marker, else it is deasserted. See clause 6.1.7.5.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

AP0_CI_D ← CH1_AI_D.

AP0_CI_CK ← CH1_AI_CK.

AP0_CI_PSI ← CH1_AI_PSI.

AP0_CI_II ← sII.

AP0_CI_SSF ← CH1_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.4.2 Channel 1/Application 1 Adaptation function (CH1/AP1_A)

The channel adaptation function for application 1 provides a packet transport over DTM channels.

11.4.2.1 Channel 1/Application 1 Adaptation Source function (CH1/AP1_A_So)

Symbol

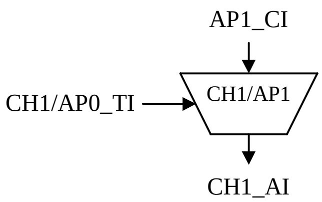


Figure 84: Channel 1/Application 1 Adaptation Source (CH1/AP1_A_So)

Interfaces

Table 70: CH1/AP1_A_So Input and output signals

Input(s)	Output(s)
AP1_CI_D	CH1_AI_D
AP1_CI_CK	CH1_AI_CK
AP1_CI_FS	CH1_AI_PSI
AP1_CI_LEN	CH1_AI_TSF
AP1_CI_CMI	
AP1_CI_PRI	
AP1_CI_SSF	
CH1/AP1_A_So_TI_CK	

Processes and anomalies

Idle: The Idle special marker insertion to AI_D instead of received signal CI_D when CI_II is asserted.
See clause 6.1.7.5.

The continuous monitoring of transmit buffer fill level in order do perform frequency justifications. See clause 6.1.8.5.

The performance of negative justification when the transmit buffer has no data for transmission, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.5.

sCRC32: The generation of a CRC-32 checksum signal (sCRC32) of the data slot words of CI_D/AI_D.
See clause 6.1.4.1 and 12.

sDCAP1s: The generation of a DCAP-1 slot word checksum (sDCAP1s) of the AI_D according to clause 12.2. See clause 6.1.4.1.

The DCAP-1 transmitter statemachine according to clause 12.2.3.1 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clause 6.1.9.5 and 12.2.3.1.

sDCAP1h: The multiplexing resulting in the DCAP-1 header signal (sDCAP1h) from the static values of clause 12.2.2.1, the channel multiplexing identifier CI_CMI, the packet length (in octets) indicated by CI_LEN, the priority CI_PRI, the DCAP-1 slot word checksum signal (sDCAP1s) and with the C and T bits asserted. See clause 6.1.4.5, 6.1.13.7 and 12.2.

sDCAP1t: The multiplexing resulting in the DCAP-1 trailer signal (sDCAP1t) from the static values of clause 12.2.2.3, the CRC-32 checksum signal (sCRC32), the DCAP-1 slow word checksum signal (sDCAP1s) and C bit enabled. See clause 6.1.13.7 and 12.2.

The multiplexing into the AI_D of the DCAP-1 headers signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clause 6.1.9.5 and 6.1.13.7.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_AI_D ← AI_D.

CH1_AI_CK ← CH2/AP1_A_So_TI_CK.

CH1_AI_PSI ← deasserted.

CH1_AI_TSF ← AP0_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.2.2 Channel 1/Application 1 Adaptation Sink function (CH1/AP1_A_Sk)

Symbol

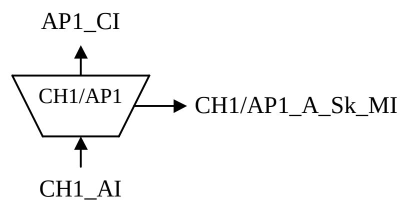


Figure 85: Channel 1/Application 1 Adaptation Sink (CH1/AP1_A_Sk)

Interfaces

Table 71: CH1/AP1_A_Sk Input and output signals

Input(s)	Output(s)
CH1_AI_D	AP1_CI_D
CH1_AI_CK	AP1_CI_CK
CH1_AI_PSI	AP1_CI_FS
CH1_AI_TSF	AP1_CI_LEN
	AP1_CI_CMI
	AP1_CI_PRI
	AP1_CI_SSF
	CH1/AP1_A_Sk_MI_cLOF
	CH1/AP1_A_Sk_MI_cDEG
	CH1/AP1_A_Sk_MI_pN_EBC
	CH1/AP1_A_Sk_MI_pDS

Processes and anomalies

nN_EB: The Near-end Errored Block anomaly (nN_EB) is asserted when the DCAP-1 slot word checksum of the AI_D according to clause 12.2 does not match the DCAP-1 slow word checksum signal (sDCAP1s) for either the DCAP-1 header or trailer, or when the CRC-32 checksum of the data slot words of CI_D/AI_D does not match the CRC-32 checksum signal (sCRC32) as the encoded checksum . See clauses 6.1.4.1 and 12.

nDSP: The Degrades Signal Period anomaly (nDSP) is asserted when the Near-end Error Block Counter performance (pN_EBC) is above or equal to the Degraded Threshold (DEGTHR), else it shall be deasserted. See clause 6.1.4.2.

The DCAP-1 receiver statemachine according to clause 12.2.3.2 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clauses 6.1.9.5 and 12.2.3.2.

nLOF: The receiver statemachine asserts the Loss Of Frame anomaly (nLOF) whenever it is in out of sync state. See clauses 6.1.9.5 and 12.2.3.2.

The demultiplexing of AI_D into the DCAP-1 header signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clause 6.1.9.5 and 6.1.13.7.

sDCAP1h: The demultiplexing of the DCAP-1 header signal (sDCAP1h) to the channel multiplexing identifier CI_CMI, the packet length CI_LEN, the priority CI_PRI and the DCAP-1 slot word checksum signal (sDCAP1s). See clauses 6.1.13.7 and 12.2.

sDCAP1t: The demultiplexing of the DCAP-1 trailer signal (sDCAP1t) to the CRC-32 checksum signal (sCRC32) and the DCAP-1 slot word checksum signal (sDCAP1s). See clauses 6.1.13.7 and 12.2.

Defects

dN_EB: The Near-end Errored Block defect (dN_EB) is asserted when one or more Near-end Errored Block anomalies (nN_EB) have occurred during the period of a block. See clause 6.2.3.1.

dN_EB ← nN_EB

dDEG: The Degraded signal defect (dDEG) is asserted when M consecutive Degrade Signal Period defects (dDSP) has been asserted and it shall be deasserted when M consecutive Degrade Signal Period anomaly (nDSP) has been deasserted. See clause 6.2.3.2.

dLOF: The Loss Of Frame defect (dLOF) is asserted when the Loss Of Frame anomaly (nLOF) is asserted, else it is deasserted. See clauses 6.2.4.1 and 12.2.

Consequent actions

aSSF: The Server Signal Fail action (aSSF) is asserted when the Trail Signal Fail (AI_TSF) is asserted or the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.1.2.

aSSF ← AI_TSF or dLOF.

Defect correlation

cDEG: The Degraded signal cause (cDEG) is asserted the Degraded signal defect (dDEG) is asserted, else it is deasserted. See clause 6.4.3.1.

cDEG ← dDEG.

cLOF: The Loss Of Frame cause (cLOF) is asserted when the Loss Of Alignment defect (dLOA) is asserted, the Trail Signal Fail (AI_TSF) is deasserted. See clause 6.4.4.1.

cLOF ← dLOF and (not AI_TSF).

Performance monitoring

pN_EBC: The Near-end Error Block Count performance (pN_EBC) is the sum of Near-end Errored Blocks defects (dN_EB) during a second. See clause 6.5.1.1.

pN_EBC ← ∑ dN_EB.

pN_DS: The Near-end Defect Second performance (pN_DS) is the existence of at least one occurrence of Trail Signal Failure action (aTSF) during a second. See clause 6.5.2.1.

pN_DS ← aTSF

Output mapping

AP1_CI_D ← CI_D.

AP1_CI_CK ← CH1_AI_CK.

AP1_CI_FS ← sDCAPht.

AP1_CI_LEN ← CI_LEN.

AP1_CI_CMI ← CI_CMI.

AP1_CI_PRI ← CI_PRI.

AP1_CI_SSF ← aSSF.

CH1/AP1_A_Sk_MI_cLOF ← cLOF.

CH1/AP1_A_Sk_MI_cDEG ← cDEG.

CH1/AP1_A_Sk_MI_pN_EBC ← pN_EBC.

CH1/AP1_A_Sk_MI_pDS ← pDS.

Fault management

fDEG: The Degraded signal fault (fDEG) is asserted when the Degraded signal cause (cDEG) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cDEG have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.2.

fLOF: The Loss Of Frame alignment fault (fLOF) is asserted when the Loss Of Frame cause (cLOF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.5.

Long term performance monitoring

NES/f13: a Near-end Errored Second (NES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ 1; i.e.:

- NES ← (pN_DS = true) or (pN_EBC ≥ 1).

NSES/f14: a Near-end Severely Errored Second (NSES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ NSESestimator (Near-end SESestimator); i.e.:

- NSES ← (pN_DS = true) or (pN_EBC ≥ NSESestimator).

NOTE: The NSESestimator value depends on the network layer this NPME function is connected to.

NBBE/f16: the Near-end Background Block Error (NBBE) performance monitoring event signal shall equal pN_EBC if the NSES of that second is not set. Otherwise, NBBE shall be zero.

11.4.3 Channel 1/Application 2 Adaptation function (CH1/AP2_A)

The channel adaptation function for application 2 provides a bit-stream transport over DTM channels.

11.4.3.1 Channel 1/Application 2 Adaptation Source function (CH1/AP2_A_So)

Symbol

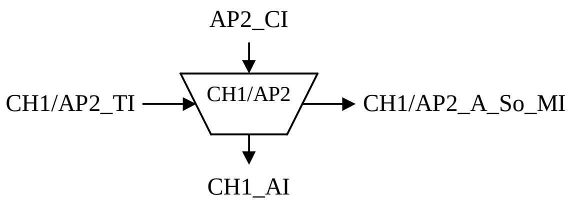


Figure 86: Channel 1/Application 2 Adaptation Source (CH1/AP2_A_So)

Interfaces

Table 72: CH1/AP2_A_So Input and output signals

Input(s)	Output(s)
AP2_CI_D	CH1_AI_D
AP2_CI_CK	CH1_AI_CK
AP2_CI_PSI	CH1_AI_PSI
CH1/AP2_A_So_TI_CK	CH1_AI_TSF
CH1/AP2_A_So_TI_FS	CH1/AP2_A_So_MI_pFJ+
	CH1/AP2_A_So_MI_pFJ-

Processes and anomalies

sBIP16: The generation of a BIP-16 checksum signal (sBIP16) of the data slot words of AI_D.
See clauses 6.1.4.1 and 12.3.

The continuous monitoring of the deviation in phase between the incoming signal and the transmitted signal is performed in order do perform frequency justifications. See clause 6.1.8.3.

The performance of positive justification when the incoming signal rate is above the nominal signal rate, by the transmission of a data in replacement of an idle-marker where positive justification is allowed. See clause 6.1.8.3.

The performance of negative justification when the incoming signal rate is below the nominal signal rate, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.3.

nFJ+: The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See clause 6.1.8.3.

nFJ-: The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See clause 6.1.8.3.

The generation of frame synchronization pattern signal (sFSP) in order to indicate the initial slot word of a multi-slot word DCAP-2 frame according to clause 12.3. See clause 6.1.9.6.

The demultiplexing/multiplexing of the bitstream to form a 61 bit data format signal (s61b) according to clause 12.3.1. See clause 6.1.13.8.

The multiplexing of the BIP-16 signal (sBIP16) to the BIP-16 serial signal (sBIP16s) according to clause 12.3.1. See clause 6.1.13.8.

The multiplexing of the positive justification control signal (sJC+) and the negative justification control signal (sJC-) into the justification control signal (sJC) according to clause 12.3.1. See clause 6.1.13.8.

The multiplexing of the payload size parameters into the payload size signal (sPS) according to clause 12.3.1. See clause 6.1.13.8.

The multiplexing of the 61 bit data format signal (s61b), the BIP-16 serial signal (sBIP16s), the frame synchronization pattern signal (sFSP), justification control signal (sJC) and payload size signal (sPS) into the AI_D according to clause 12.3.1. See clause 6.1.13.8.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

pFJ+: The Positive Frequency Justification performance (pFJ+) is the number of positive frequency justifications anomalies (nFJ+) that has occurred during 1 second. See clause 6.5.3.1.

pFJ+ $\leftarrow \Sigma$ nFJ+.

pFJ-: The Negative Frequency Justification performance (pFJ-) is the number of negative frequency justifications anomalies (nFJ-) that has occurred during 1 second. See clause 6.5.3.2.

pFJ- $\leftarrow \Sigma$ nFJ-.

Output mapping

CH1_AI_D ← AI_D.

CH1_AI_CK ← CH2/AP2_A_So_TI_CK.

CH1_AI_PSI ← deasserted.

CH1_AI_TSF ← AP2_CI_SSF.

CH1/AP2_A_So_MI_pFJ+ ← pFJ+.

CH1/AP2_A_So_MI_pFJ- ← pFJ-.

Fault management

None.

Long term performance monitoring

FJ+(t-10) (A_So): The delayed positive Frequency Justification performance counter (FJ+(t-10)) is the 10 second delayed value of the positive Frequency Justification performance counter (pFJ+). See clause 6.8.5.2.

FJ-(t-10) (A_So): The delayed negative Frequency Justification performance counter (FJ-(t-10)) is the 10 second delayed value of the negative Frequency Justification performance counter (pFJ-). See clause 6.8.5.2.

11.4.3.2 Channel 1/Application 2 Adaptation Sink function (CH1/AP2_A_Sk)

Symbol

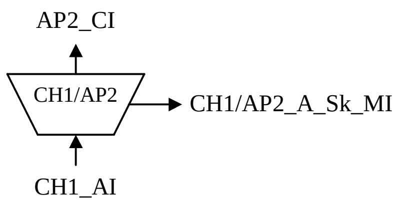


Figure 87: Channel 1/Application 2 Adaptation Sink (CH1/AP2_A_Sk)

Interfaces

Table 73: CH1/AP2_A_Sk Input and output signals

Input(s)	Output(s)
CH1_AI_D	AP2_CI_D
CH1_AI_CK	AP2_CI_CK
CH1_AI_PSI	AP2_CI_SSF
CH1_AI_TSF	CH1/AP2_A_Sk_MI_pN_EBC
	CH1/AP2_A_Sk_MI_pDS
	CH1/AP2_A_Sk_MI_cDEG
	CH1/AP2_A_Sk_MI_cLOF

Processes and anomalies

sBIP16: The generation of a BIP-16 checksum signal (sBIP16) of the data slot words of AI_D. See clauses 6.1.4.1 and 12.3.

nN_EB: The Near-end Errored Block anomaly (nN_EB) is asserted when the BIP-16 checksum of the data slot words of AI_D does not match the BIP-16 checksum signal (sBIP16) as the encoded checksum. See clauses 6.1.4.1 and 12.

nDSP: The Degrades Signal Period anomaly (nDSP) is asserted when the Near-end Error Block Counter performance (pN_EBC) is above or equal to the Degraded Threshold (DEGTHR), else it shall be deasserted. See clause 6.1.4.2.

The monitoring of frame synchronization pattern signal (sFSP) in order to identify the initial slot word of a multi-slot word DCAP-1 frame stream according to clause 12.3. See clause 6.1.9.6.

The frame synchronization state machine process of clause 12.3.1.1. See clause 6.1.9.6.

sFS: When the initial slot word is detected and the first of its data words is transmitted on CI_D shall the Frame Start signal (sFS) be asserted, else it shall be de-asserted. See clause 6.1.9.6.

nLOF: If the frame synchronization state machine is in the Out Of Frame (OOF) state, then the Loss Of Frame anomaly (nLOF) is asserted, else nLOF is deasserted. See clauses 12.3.1.1 and 6.1.9.6.

The clock smoothing process in order to reduce phase deviations on the transmitted signal. The clock smoothing must comply with the jitter and wander requirements as defined in the associated application. The resulting clock is delivered as CI_CK. See clause 6.1.11.4.

The elastic buffering of the transported signal such that the buffer output is being clocked by the smoothed clock. See clause 6.1.11.4.

The demultiplexing/multiplexing of the 61 bit data format signal (s61b) to the bitstream according clause 12.3.1. See clause 6.1.13.8.

The demultiplexing of the BIP-16 serial signal (sBIP16s) to the BIP-16 received signal (sBIP16r) according to clause 12.3.1. See clause 6.1.13.8.

The demultiplication of the justification control signal (sJC) into the positive justification control signal (sJC+) and the negative justification control signal (sJC-) according to clause 12.3.1. See clause 6.1.13.8.

The demultiplexing of the payload size signal (sPS) into the payload size parameters according to clause 12.3.1. See clause 6.1.13.8.

NOTE: This process is optional. The payload size parameters can for certain applications be implied by other parameters and the retrieval of those parameters from the stream is thus not necessary.

The demultiplexing of the AI_D into the 61 bit data format (s61b), the BIP-16 serial signal (sBIP16s), the frame synchronization pattern signal (sFSP), justification control signal (sJC) and payload size signal (sPS) according to clause 6.1.13.8.

Defects

dN_EB: The Near-end Errored Block defect (dN_EB) is asserted when one or more Near-end Errored Block anomalies (nN_EB) have occurred during the period of a block. See clause 6.2.3.1.

dN_EB ← nN_EB.

dDEG: The Degraded signal defect (dDEG) is asserted when M consecutive Degrade Signal Period defects (dDSP) has been asserted and it shall be deasserted when M consecutive Degrade Signal Period anomaly (nDSP) has been deasserted. See clause 6.2.3.2.

Consequent actions

aSSF: The Server Signal Fail action (aSSF) is asserted when the Trail Signal Fail (AI_TSF) is asserted or the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.1.2.

aSSF ← AI_TSF or dLOF.

Defect correlation

cDEG: The Degraded signal cause (cDEG) is asserted when the Degraded signal defect (dDEG) is asserted. See clause 6.4.3.1.

cDEG ← dDEG.

cLOF: The Loss Of Frame cause (cLOF) is asserted when the Loss Of Frame defect (dLOF) is asserted and the Trail Signal Fail (AI_TSF) is deasserted, else it is deasserted. See clause 6.4.4.1.

cLOF ← dLOF and (not AI_TSF).

Performance monitoring

pN_EBC: The Near-end Error Block Count performance (pN_EBC) is the sum of Near-end Errored Blocks defects (dN_EB) during a second. See clause 6.5.1.1.

pN_EBC ← ∑ dN_EB.

pN_DS: The Near-end Defect Second performance (pN_DS) is the existence of at least one occurrence of Trail Signal Failure action (aTSF) during a second. See clause 6.5.2.1.

pN_DS ← aTSF.

Output mapping

AP2_CI_D ← CI_D.

AP2_CI_CK ← CI_CK.

AP2_CI_SSF ← aSSF.

CH1/AP2_A_So_MI_cDEG ← cDEG.

CH1/AP2_A_So_MI_cLOF ← cLOF.

CH1/AP2_A_So_MI_pN_EBC ← pN_EBC.

CH1/AP2_A_So_MI_pDS ← pDS.

Fault management

fDEG: The Degraded signal fault (fDEG) is asserted when the Degraded signal cause (cDEG) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cDEG have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.2.

fLOF: The Loss Of Frame alignment fault (fLOF) is asserted when the Loss Of Frame cause (cLOF) is asserted consistently for $2,5 \pm 0,5$ s and deasserted when the cLOF have been deasserted for $10 \pm 0,5$ s. See clause 6.6.1.5.

Long term performance monitoring

NES/f13: a Near-end Errored Second (NES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ 1; i.e.:

NES ← (pN_DS = true) or (pN_EBC ≥ 1).

NSES/f14: a Near-end Severely Errored Second (NSES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ NSESestimator (Near-end SESestimator); i.e.:

- - NSES ← (pN_DS = true) or (pN_EBC ≥ NSESestimator).

NOTE 2: The NSESestimator value depends on the network layer this NPME function is connected to.

NBBE/f16: the Near-end Background Block Error (NBBE) performance monitoring event signal shall equal pN_EBC if the NSES of that second is not set. Otherwise, NBBE shall be zero.

11.4.4 Channel 1 Protection/Channel 1 Adaptation function (CH1p/CH1_A)

The channel protection adaptation function provides the empty adaptation for protection.

11.4.4.1 Channel 1 Protection/Channel 1 Adaptation Source function (CH1p/CH1_A_So)

Symbol

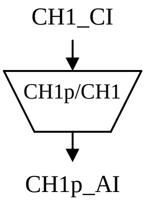


Figure 88: Channel 1 Protection/Channel 1 Adaptation Source (CH1p/CH1_A_So)

Interfaces

Table 74: CH1P/CH1_A_So Input and output signals

Input(s)	Output(s)
CH1_CI_D	CH1p_AI_D
CH1_CI_CK	CH1p_AI_CK
CH1_CI_PSI	CH1p_AI_PSI
CH1_CI_SSF	CH1p_AI_TSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1p_AI_D ← CH1_CI_D.

CH1p_AI_CK ← CH1_CI_CK.

CH1p_AI_PSI ← CH1_CI_PSI.

CH1p_AI_TSF ← CH1_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.4.2 Channel 1 Protection/Channel 1 Adaptation Sink function (CH1p/CH1_A_Sk)

Symbol

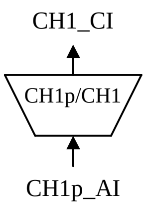


Figure 89: Channel 1 Protection/Channel 1 Adaptation Sink (CH1p/CH1_A_Sk)

Interfaces

Table 75: CH1p/CH1_A_Sk Input and output signals

Input(s)	Output(s)
CH1p_AI_D	CH1_CI_D
CH1p_AI_CK	CH1_CI_CK
CH1p_AI_PSI	CH1_CI_PSI
CH1p_AI_TSF	CH1_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_CI_D ← CH1p_AI_D.

CH1_CI_CK ← CH1p_AI_CK.

CH1_CI_PSI ← CH1p_AI_PSI.

CH1_CI_SSF ← CH1p_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.4.5 Channel 2/Application 0 Adaptation function (CH2/AP0_A)

The channel adaptation function for application 0 provides a null-mapping (the Idle-mapping is necessary) for applications wishing a raw DTM channel access.

11.4.5.1 Channel 2/Application 0 Adaptation Source function (CH2/AP0_A_So)

Symbol

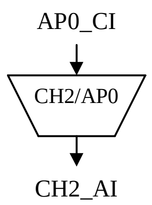


Figure 90: Channel 2/Application 0 Adaptation Source (CH2/AP0_A_So)

Interfaces

Table 76: CH2/AP0_A_So Input and output signals

Input(s)	Output(s)
AP0_CI_D	CH2_AI_D
AP0_CI_CK	CH2_AI_CK
AP0_CI_PSI	CH2_AI_PSI
AP0_CI_II	CH2_AI_TSF
AP0_CI_SSF	

Processes and anomalies

Idle: The Idle special marker insertion to AI_D instead of received signal CI_D when CI_II is asserted.
See clause 6.1.7.5.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2_AI_D ← AI_D.

CH2_AI_CK ← AP0_CI_CK.

CH2_AI_PSI ← AP0_CI_PSI.

CH2_AI_TSF ← AP0_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.5.2 Channel 2/Application 0 Adaptation Sink function (CH2/AP0_A_Sk)

Symbol

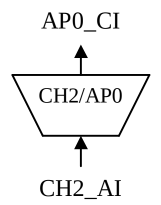


Figure 91: Channel 2/Application 0 Adaptation Sink (CH2/AP0_A_Sk)

Interfaces

Table 77: CH2/AP0_A_Sk Input and output signals

Input(s)	Output(s)
CH2_AI_D	AP0_CI_D
CH2_AI_CK	AP0_CI_CK
CH2_AI_PSI	AP0_CI_PSI
CH2_AI_TSF	AP0_CI_II
	AP0_CI_SSF

Processes and anomalies

Idle: The Idle Indication signal (sII) is asserted when the AI_D is detected to be an Idle special marker, else it is deasserted. See clause 6.1.7.5.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

AP0_CI_D ← CH2_AI_D.

AP0_CI_CK ← CH2_AI_CK.

AP0_CI_PSI ← CH2_AI_PSI.

AP0_CI_II ← sII.

AP0_CI_SSF ← CH2_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

11.4.6 Channel 2/Application 1 Adaptation function (CH2/AP1_A)

The channel adaptation function for application 1 provides a packet transport over DTM channels.

11.4.6.1 Channel 2/Application 1 Adaptation Source function (CH2/AP1_A_So)

Symbol

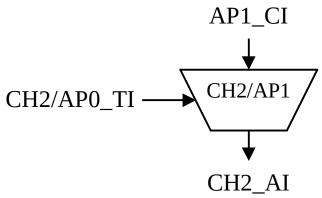


Figure 92: Channel 2/Application 1 Adaptation Source (CH2/AP1_A_So)

Interfaces

Table 78: CH2/AP1_A_So Input and output signals

Input(s)	Output(s)
AP1_CI_D	CH2_AI_D
AP1_CI_CK	CH2_AI_CK
AP1_CI_FS	CH2_AI_PSI
AP1_CI_LEN	CH2_AI_TSF
AP1_CI_CMI	
AP1_CI_PRI	
AP1_CI_SSF	
CH2/AP1_A_So_TI_CK	

Processes and anomalies

Idle: The Idle special marker insertion to AI_D instead of received signal CI_D when CI_II is asserted. See clause 6.1.7.5.

The continuous monitoring of transmit buffer fill level in order do perform frequency justifications. See clause 6.1.8.5.

The performance of negative justification when the transmit buffer has no data for transmission, by the transmission of an idle-marker in place of data where negative justification is allowed. See clause 6.1.8.5.

sCRC32: The generation of a CRC-32 checksum signal (sCRC32) of the data slot words of CI_D/AI_D. See clause 6.1.4.1 and 12.

sDCAP1s: The generation of a DCAP-1 slot word checksum (sDCAP1s) of the AI_D according to clause 12.2. See clause 6.1.4.1.

The DCAP-1 transmitter statemachine according to clause 12.2.3.1 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clause 6.1.9.5 and 12.2.3.1.

sDCAP1h: The multiplexing resulting in the DCAP-1 header signal (sDCAP1h) from the static values of clause 12.2.2.1, the channel multiplexing identifier CI_CMI, the packet length (in octets) indicated by CI_LEN, the priority CI_PRI, the DCAP-1 slot word checksum signal (sDCAP1s) and with the C and T bits asserted. See clause 6.1.4.5, 6.1.13.7 and 12.2.

sDCAP1t: The multiplexing resulting in the DCAP-1 trailer signal (sDCAP1t) from the static values of clause 12.2.2.3, the CRC-32 checksum signal (sCRC32), the DCAP-1 slow word checksum signal (sDCAP1s) and C bit enabled. See clause 6.1.13.7 and 12.2.

The multiplexing into the AI_D of the DCAP-1 headers signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clause 6.1.9.5 and 6.1.13.7.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2_AI_D ← AI_D.

CH2_AI_CK ← CH2/AP1_A_So_TI_CK.

CH2_AI_PSI ← deasserted.

CH2_AI_TSF ← AP0_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.6.2 Channel 2/Application 1 Adaptation Sink function (CH2/AP1_A_Sk)

Symbol

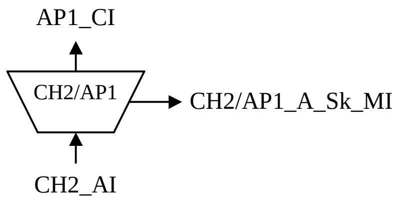


Figure 93: Channel 2/Application 1 Adaptation Sink (CH2/AP1_A_Sk)

Interfaces

Table 79: CH2/AP1_A_Sk Input and output signals

Input(s)	Output(s)
CH2_AI_D	AP1_CI_D
CH2_AI_CK	AP1_CI_CK
CH2_AI_PSI	AP1_CI_FS
CH2_AI_TSF	AP1_CI_LEN
	AP1_CI_CMI
	AP1_CI_PRI
	AP1_CI_SSF
	CH2/AP1_A_Sk_MI_cLOF
	CH2/AP1_A_Sk_MI_cDEG
	CH2/AP1_A_Sk_MI_pN_EBC
	CH2/AP1_A_Sk_MI_pDS

Processes and anomalies

nN_EB: The Near-end Errored Block anomaly (nN_EB) is asserted when the DCAP-1 slot word checksum of the AI_D according to clause 12.2 does not match the DCAP-1 slow word checksum signal (sDCAP1s) for either the DCAP-1 header or trailer, or when the CRC-32 checksum of the data slot words of CI_D/AI_D does not match the CRC-32 checksum signal (sCRC32) as the encoded checksum. See clauses 6.1.4.1 and 12.

nDSP: The Degrades Signal Period anomaly (nDSP) is asserted when the Near-end Error Block Counter performance (pN_EBC) is above or equal to the Degraded Threshold (DEGTHR), else it shall be deasserted. See clause 6.1.4.2.

The DCAP-1 receiver statemachine according to clause 12.2.3.2 generating the DCAP-1 header transmit signal (sDCAP1ht) and DCAP-1 trailer transmit signal (sDCAP1tt) being asserted during the time of header and trail respectively. See clauses 6.1.9.5 and 12.2.3.2.

nLOF: The receiver statemachine asserts the Loss Of Frame anomaly (nLOF) whenever it is in out of sync state. See clauses 6.1.9.5 and 12.2.3.2.

The demultiplexing of AI_D into the DCAP-1 header signal (sDCAP1h) when sDCAPht is asserted, the DCAP-1 trailer signal (sDCAP1t) when sDCAPtt is asserted, else CI_D. See clauses 6.1.9.5 and 6.1.13.7.

sDCAP1h: The demultiplexing of the DCAP-1 header signal (sDCAP1h) to the channel multiplexing identifier CI_CMI, the packet length CI_LEN, the priority CI_PRI and the DCAP-1 slot word checksum signal (sDCAP1s). See clause 6.1.13.7 and 12.2.

sDCAP1t: The demultiplexing of the DCAP-1 trailer signal (sDCAP1t) to the CRC-32 checksum signal (sCRC32) and the DCAP-1 slot word checksum signal (sDCAP1s). See clauses 6.1.13.7 and 12.2.

Defects

dN_EB: The Near-end Errored Block defect (dN_EB) is asserted when one or more Near-end Errored Block anomalies (nN_EB) have occurred during the period of a block. See clause 6.2.3.1.

dN_EB ← nN_EB.

dDEG: The Degraded signal defect (dDEG) is asserted when M consecutive Degrade Signal Period defects (dDSP) has been asserted and it shall be deasserted when M consecutive Degrade Signal Period anomaly (nDSP) has been deasserted. See clause 6.2.3.2.

dLOF: The Loss Of Frame defect (dLOF) is asserted when the Loss Of Frame anomaly (nLOF) is asserted, else it is deasserted. See clause 6.2.4.1 and 12.2.

Consequent actions

aSSF: The Server Signal Fail action (aSSF) is asserted when the Trail Signal Fail (AI_TSF) is asserted or the Loss Of Frame defect (dLOF) is asserted. See clause 6.3.1.2.

aSSF ← AI_TSF or dLOF.

Defect correlation

cDEG: The Degraded signal cause (cDEG) is asserted the Degraded signal defect (dDEG) is asserted, else it is deasserted. See clause 6.4.3.1.

cDEG ← dDEG.

cLOF: The Loss Of Frame cause (cLOF) is asserted when the Loss Of Alignment defect (dLOA) is asserted, the Trail Signal Fail (AI_TSF) is deasserted. See clause 6.4.4.1.

cLOF ← dLOF and (not AI_TSF).

Performance monitoring

pN_EBC: The Near-end Error Block Count performance (pN_EBC) is the sum of Near-end Errored Blocks defects (dN_EB) during a second. See clause 6.5.1.1.

pN_EBC ← ∑ dN_EB.

pN_DS: The Near-end Defect Second performance (pN_DS) is the existence of at least one occurrence of Trail Signal Failure action (aTSF) during a second. See clause 6.5.2.1.

pN_DS ← aTSF.

Output mapping

AP1_CI_D ← CI_D.

AP1_CI_CK ← CH1_AI_CK.

AP1_CI_FS ← sDCAPht.

AP1_CI_LEN ← CI_LEN.

AP1_CI_CMI ← CI_CMI.

AP1_CI_PRI ← CI_PRI.

AP1_CI_SSF ← aSSF.

CH2/AP1_A_Sk_MI_cLOF ← cLOF.

CH2/AP1_A_Sk_MI_cDEG ← cDEG.

CH2/AP1_A_Sk_MI_pN_EBC ← pN_EBC.

CH2/AP1_A_Sk_MI_pDS ← pDS.

Fault management

fDEG: The Degraded signal fault (fDEG) is asserted when the Degraded signal cause (cDEG) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cDEG have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.2.

fLOF: The Loss Of Frame alignment fault (fLOF) is asserted when the Loss Of Frame cause (cLOF) is asserted consistently for $2{,}5 \pm 0{,}5$ s and deasserted when the cLOF have been deasserted for $10 \pm 0{,}5$ s. See clause 6.6.1.5.

Long term performance monitoring

NES/f13: a Near-end Errored Second (NES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ 1; i.e.:

- NES ← (pN_DS = true) or (pN_EBC ≥ 1).

NSES/f14: a Near-end Severely Errored Second (NSES) performance monitoring event signal shall be generated if pN_DS is set or if pN_EBC ≥ NSESestimator (Near-end SESestimator); i.e.:

- NSES ← (pN_DS = true) or (pN_EBC ≥ NSESestimator).

NOTE: The NSESestimator value depends on the network layer this NPME function is connected to.

NBBE/f16: the Near-end Background Block Error (NBBE) performance monitoring event signal shall equal pN_EBC if the NSES of that second is not set. Otherwise, NBBE shall be zero.

11.4.7 Channel 2 Protection/Channel 2 Adaptation function (CH2p/CH2_A)

The channel protection adaptation function provides the empty adaptation for protection.

11.4.7.1 Channel 2 Protection/Channel 2 Adaptation Source function (CH2p/CH2_A_So)

Symbol

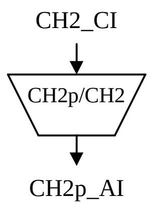


Figure 94: Channel 2 Protection/Channel 2 Adaptation Source (CH2p/CH2_A_So)

Interfaces

Table 80: CH2p/CH2_A_So Input and output signals

Input(s)	Output(s)
CH2_CI_D	CH2p_AI_D
CH2_CI_CK	CH2p_AI_CK
CH2_CI_PSI	CH2p_AI_PSI
CH2_CI_SSF	CH2p_AI_TSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH2p_AI_D ← CH2_CI_D.

CH2p_AI_CK ← CH2_CI_CK.

CH2p_AI_PSI ← CH2_CI_PSI.

CH2p_AI_TSF ← CH2_CI_SSF.

Fault management

None.

Long term performance monitoring

None.

11.4.7.2 Channel 2 Protection/Channel 2 Adaptation Sink function (CH2p/CH2_A_Sk)

Symbol

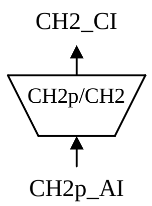


Figure 95: Channel 2 Protection/Channel 2 Adaptation Sink (CH2p/CH2_A_Sk)

Interfaces

Table 81: CH2p/CH2_A_Sk Input and output signals

Input(s)	Output(s)
CH2p_AI_D	CH2_CI_D
CH2p_AI_CK	CH2_CI_CK
CH2p_AI_PSI	CH2_CI_PSI
CH2p_AI_TSF	CH2_CI_SSF

Processes and anomalies

None.

Defects

None.

Consequent actions

None.

Defect correlation

None.

Performance monitoring

None.

Output mapping

CH1_CI_D ← CH1p_AI_D.

CH1_CI_CK ← CH1p_AI_CK.

CH1_CI_PSI ← CH1p_AI_PSI.

CH1_CI_SSF ← CH1p_AI_TSF.

Fault management

None.

Long term performance monitoring

None.

12 Channel adaptation

The channel adaptation provides generic adaptation of user traffic to DTM channels. DTM has 3 basic channel adaptations, DCAP-0, DCAP-1 and DCAP-2. Channel adaptation includes framing/packet delimiter, channel performance supervision and frequency justification. The frequency justification allows for different justification step sizes depending on which channel adaptation is being used. The application data may be either isochronous or asynchronous. Isochronous traffic may be either synchronous or asynchronous to the DTM synchronization/frame rate.

12.1 DCAP-0

The DTM Channel Adaptation Protocol 0 (DCAP-0) provides channel adaptation for the transport of data oriented in 64 bit words. No structure in the user data is assumed. The frequency justification of asynchronous and isochronous traffic is performed using the DTM channel idle marker instead of transmitting a 64 bit word. Signal failure may be transmitted end-to-end using the DTM channel AIS marker. Performance supervision of the end-to-end channel is performed by use of the DTM channel PS marker. In addition may the PS marker be used by clients as a framing delimiter.

12.1.1 Data mapping

The user data is bit-mapped into a data slot such that userdata[63:0] = slotdata[63:0] for both transmitter and receiver ends. Thus, the mapping is a straight mapping of bits.

12.1.2 Frequency justification

The frequency justification is performed by the insertion of Idle markers into the channel. Since the adaptation is forced to generate slot words for all allocated slots of the channel for each frame, all slots not holding either a data marker or PS marker must be an Idle slot.

The client data to be sent is stored in a elastic buffer. A data slot word is transmitted when 64 bit of unsent data is available in the elastic buffer. In the receiver side will the received 64 bit of data in a data slot word be put into an elastic buffer and read out as appropriate by the client layer.

When a slot word is to be sent, if there is no complete data marker to be sent, an idle marker is sent in its place. In the receiver side will any Idle markers be ignored and only the data of data markers is being included into the elastic buffer.

12.1.3 Performance Supervision

The end-to-end performance supervision of a channel is achieved by the use of a Performance Supervision marker (PS marker). The PS marker makes use of a 32-bit Cyclic Redundancy Check (CRC) which is a checksum of all the data slots since the last PS marker. The PS marker generation is under external control and is issued whenever the AI_FS signal is asserted. In the receiver side will the checksum be calculated and an anomaly be detected upon mismatching checksums.

Table 82: DCAP-0 Performance Supervision marker

bit 63-56	bit 55-48	bit 47-40	bit 39-32	bit 31-24	bit 23-16	bit 15-8	bit 7-0
type	res.		idle slots	crc-32			

The ***type*** field are reserved for type encoding of the PS-marker by transmission path.

The ***res.*** fields are reserved for future use. The fields must always be set to zero. No interpretation of these bits shall be done.

The ***idle slots*** field is the 12-bit number of idle markers transmitted since the previous PS-marker.

The ***crc-32*** field is the CRC-32 checksum of the data slot words transmitted since the last PS-marker. The CRC algorithm shall be that of clause 12.2.5.

NOTE: Please note that the checksum is not performed on non-data, i.e. slot markers such as idle, AIS and PS markers.

12.1.4 Maintenance signal supervision

The maintenance signal supervision is performed by the transmission of the Alarm Indication Signal (AIS) marker. The format of the AIS-marker is found in table 83.

Table 83: DCAP-0 Alarm Indication Signal marker

bit 63-56	bit 55-48	bit 47-40	bit 39-32	bit 31-24	bit 23-16	bit 15-8	bit 7-0
type		AIS code	res.				

The ***type*** field are reserved for type encoding of the PS-marker by transmission path.

The ***AIS code*** field is assigned according to type of AIS generation mechanism as found in table 84.

Table 84: AIS codes

Code	Meaning
0	Transmission network failure
128	Application ingress signal failure

The ***res.*** fields are reserved for future use. The fields must always be set to zero. No interpretation of these bits shall be done.

12.2 DCAP-1

The DTM Channel Adaptation Protocol 1 (DCAP-1) provides channel adaptation for the transport of data oriented in 8 bit words (octets) having a datagram or packet frame. The frequency justification of asynchronous and isochronous traffic is performed using the DTM channel idle marker instead of transmitting a 64 bit word. Signal failure may be transmitted end-to-end using the DTM channel AIS marker. Performance supervision of the end-to-end channel is performed by use of a trailer slot word. Any padding necessary to use an even multiple of 64 bits is being performed. With each packet is additional side information sent which allows for per-packet meta-data.

12.2.1 Meta-data

With each transmitted packet is additional meta-data sent which allows for per-packet treatment by the receiver. This meta data includes packet length, channel multiplexing identifier (CMI) and priority.

The packet length field is a 16 bit wide field which indicates how many octets is being transported in the packet. Certain applications may require additional (uncounted) octets. Unless such requirements is detailed in the application specification, the packet length field reflects the number of actually transmitted data octets.

NOTE 1: The length field value may reach 65535. However, the maximum length that a receiver implementation is required to tolerate is specified per application.

The channel multiplexing identifier (CMI) is a 8 bit wide field which indicates which out of 256 possible multiplexing channels a packet belongs to. The value of the CMI field indicates what type of data or which multiplexing instance is carried in the packet.

NOTE 2: The CMI interpretation may be system wide, application wide or channel wide. The exact interpretation of the CMI field is to be declared per application.

The priority field is a 2 bit wide field which indicates the priority of the packet.

NOTE 3: The priority interpretation may be system wide, application wide, channel wide or CMI wide. The exact interpretation of the priority bits is to be declared per application.

12.2.2 Data mapping

The transmission of a packet over DTM channel involves packet frame alignment, packet multiplexing, padding and performance supervision. Additional meta information is also mixed into the DTM channel.

A DCAP-1 packet frame consists of a header slot word, one or more data slot words and an optional trailer slot word.

NOTE: The optional trailer and the optional performance supervision checksum therein is strongly recommended.

The header and trailer slot words are protected with a separate checksum. The checksum is sent as a part of the respective slow words. The checksum calculation covers all fields in the slow word except the checksum field. After calculation, the checksum is written to the checksum field in the slot word. Correspondingly, at the receiver, the checksum is calculated on all fields in the slot word except the checksum and compared to the checksum field in the received slot word. The checksum is further described in clause 12.2.4.

12.2.2.1 Header

The DCAP-1 header slot word is transmitted directly before the payload of the DCAP-1 packet. The format of the slot word is shown in table 85.

Table 85: DCAP-1 header slot word

bit 63-56		bit 55-48	bit 47-40	bit 39-32	bit 31-24	bit 23-16	bit 15-8					bit 7-0
VER	res.	CMI	LENGTH		res.	PATTERN	C	R	T	PRI	res.	CHECKSUM

Type	Size	Description
VER	4 bits	version number
res.	4 bits	reserved (set to zero)
CMI	8 bits	channel multiplexing identifier
LENGTH	16 bits	payload length
res.	8 bits	reserved (set to zero)
PATTERN	8 bits	header slot word pattern
C	1 bit	CRC-32 enable flag
R	1 bit	reserved (set to zero)
T	1 bit	trailer flag
PRI	2 bits	priority flag
res.	3 bits	reserved (set to zero)
CHECKSUM	8 bits	slot word checksum

The ***ver*** field identifies the version (see table 7) of the DCAP-1 protocol instance used.

Table 86: DCAP-1 Versions

version	
0	version 1
1-15	reserved

The ***res.*** fields are reserved for future use. The fields must always be set to zero. No interpretation of these bits shall be done.

The ***PATTERN*** field identifies (see table 85) the slot word as a DCAP-1 header slot word. This field is used for synchronization of the receiver i.e., to find the DCAP-1 packet boundaries. The value of the pattern field is always set to 0xAA.

Table 87: DCAP-1 header pattern

pattern	
0xaa	DCAP-1 header slot word
all other	reserved

The ***C (crc-32 enable)*** flag (see table 85) is used to indicate that the CRC-32 field in this DCAP-1 packet's trailer slot word is valid. The CRC-32 is calculated according to clause 12.2.5.

Table 88: DCAP-1 CRC enable field

C (CRC-32 enable)	
0	CRC-32 not valid
1	CRC-32 valid

The ***T (trailer)*** flag (see table 85) indicates that a trailer slot word is appended to the DCAP-1 packet. The trailer contains a CRC-32 calculated over the data slot words of the message.

Table 89: DCAP-1 Trailer enable field

T (trailer)	
0	no trailer slot word included
1	trailer slot word included

The ***PRI*** field (see table 85) provides a means to transport priority information a per DCAP-1 packet basis. The priority information is provided to the higher layer protocols through the DCAI interface.

Table 90: DCAP-1 priority field

PRI	
0 - 3	user defined priority

The ***CMI*** field (see table 85) is used for multiplexing traffic of different higher layer protocols in the same channel.

NOTE: The CMI is for example used for multiplexing DLSP and DCP traffic on the same (control) channel.

Table 91: DCAP-1 CMI field

CMI	
0 - 255	usage defined in clause 6

The ***LENGTH*** field (see table 85) holds the DCAP-1 packet payload length in bytes. The 16-bit size of the field allows for payloads ranging from 1 byte up to 65535 bytes.

NOTE: Having a 16 bit length indicator does not mean that all equipment using DCAP-1 have to implement support for 64 kbyte DCAP-1 packets. Different DCAP-1 applications (i.e. different interworking functions) will specify different maximum length packets (MTU size).

Table 92: DCAP-1 Length field

LENGTH	
0xXXXX	payload length (in bytes)

The ***CHECKSUM*** field (see table 85) holds this header slot word's checksum, calculated according to clause 12.2.4.

Table 93: DCAP-1 header slot word checksum

CHECKSUM	
0xXX	header slot word checksum

12.2.2.2 Data

The payload of the DCAP-1 packet is divided into 64-bit DCAP-1 data slot words (see table 94).

Table 94: DCAP-1 data slot word

bit 63-56	bit 55-48	bit 47-40	bit 39-32	bit 31-24	bit 23-16	bit 15-8	bit 7-0
data							

If the number of bytes in the payload field is not a multiple of 8, the payload MUST be padded to achieve this. The padding shall be done in the last transmitted DCAP-1 data slot words. The padded bytes shall make up the least significant part of the slot word (the lower bit numbers in table 85). The number of transmitted data slot words shall be:

number of slot words = $\lceil \text{length} / 8 \rceil$

where length is the length of the payload in bytes, as specified in the header slot word's length field, and slot words is the length of the payload in 64-bit words.

12.2.2.3 Trailer

The DCAP-1 trailer slot word (see table 95) is used to transport a CRC-32 checksum, which is used for performance supervision of the data payload. By using a trailer, the calculation of the CRC-32 can be pipelined i.e., data can be transmitted during the calculation. The CRC-32 is calculated over the DCAP-1 data slot words using CRC-32 according to clause 12.2.5.

Table 95: DCAP-1 trailer slot word

bit 63-56	bit 55-48	bit 47-40	bit 39-32	bit 31-24	bit 23-16	bit 15-8		bit 7-0
CRC-32				reserved	PATTERN	C	reserved	CHECKSUM

Type	Size	Description
CRC-32	32 bits	packet payload CRC-32
reserved	8 bits	reserved (set to zero)
PATTERN	8 bits	trailer slot word pattern
C	1 bit	CRC-32 valid flag
reserved	7 bits	reserved (set to zero)
CHECKSUM	8 bits	slot word checksum

The ***CRC-32*** field (see table 95) contains the cyclic redundancy calculation of the DCAP-1 data slot words. The calculation is done using CRC-32 according to clause 12.2.5.

Table 96: DCAP-1 CRC field

CRC-32	
0xXX	payload CRC-32

The ***reserved*** fields are reserved for future use. The fields must always be set to zero. No interpretation of these bits shall be done.

The ***PATTERN*** field (see table 95) is identifies the slot word as a DCAP-1 trailer slot word. The value of the field is always set to 0x55.

Table 97: DCAP-1 trailer pattern field

pattern	
0x55	DCAP-1 trailer slot word
all other	reserved

The ***C*** flag (see table 95) is used to indicate that the CRC-32 field in this DCAP-1 trailer slot word is valid.

Table 98: DCAP-1 CRC validity field

C (CRC-32 valid)	
0	CRC-32 not valid
1	CRC-32 valid

The ***CHECKSUM*** field (see table 95) holds this trailer slot word's checksum, calculated according to clause 12.2.4.

Table 99: DCAP-1 trailer slot word checksum

checksum	
0xXX	trailer slot word checksum

12.2.3 Protocol description

DCAP-1 is a simple, one-way, message passing protocol without acknowledgements. It specifies the format of the DCAP-1 slot words (see the previous clause) making up a packet frame and the order in which the slot words are sent from transmitter to receiver. It also specifies how performance supervision is performed.

The send order over the DTM channel shall be the DCAP-1 header slot word followed by one or more (up to 8192 or whatever the application(s) allows) DCAP-1 data slot words and finally zero or one (as indicated in the header) DCAP-1 trailer slot word. Idle markers may be inserted in-between any of the slot words and in-between DCAP-1 packet frames.

12.2.3.1 Transmitter

A DCAP-1 transmitter is very straightforward. A DCAP-1 transmitter starts with waiting for a send request from the service interface (DCAI) after being initialized. When a send request is received, it is processed as follows (not necessarily in the described order):

- a DCAP-1 header slot word is prepared according to the parameters and flags received in the request. The bit fields are set to their correct values (reserved fields are set to zero) and the header slot word checksum is calculated;
- if a trailer slot word with CRC-32 shall be a payload CRC-32 calculation is initiated and performed;
- if the payload data size is not a multiple of eight bytes it is padded to become that;
- if a DCAP-1 trailer slot word shall be appended, its bit fields are initialized (pattern, c, and crc-32) and its checksum calculated.

The transmission method used by the DCAP-1 transmitter depends on what interface the underlying isochronous service provides. The most likely scenario is that it expects a full DCAP-1 message and a length indicator. Another possibility is that it expects one 64 bits slot word at the time.

The only exception to the processing described above happens when the DCAP-1 transmitter runs out of buffer space. When this occurs, the transmitter responds BLOCKED to the send request. As enough buffer space becomes available the transmitter signals ready to previously blocked users, which can start issuing send requests again.

12.2.3.2 Receiver

The DCAP-1 receiver is a bit more complicated as compared to the transmitter since it must check the received packets to conserve protocol and data integrity. When a protocol violation or data corruption is encountered it must take actions accordingly.

The DCAP-1 receiver must establish a DCAP-1 packet frame synchronization and therefore have two modes, out of sync and in sync. The receiver is not in sync when then channel reception is initiated.

When the receiver is not in sync it will examine all slot words on the incoming channel to find a legal DCAP-1 header slot word. A DCAP-1 header slot word is defined as legal when it has correct version, correct header pattern and correct checksum. When a legal DCAP-1 header slot word is detected, the receiver has established packet frame sync and the rest of the packet is parsed according to the in sync rules.

When the receiver is in sync it will parse packets. Each received header slot word must be legal for the rest of the packet to be further investigated. If a header slot word is not legal, the receiver has lost the packet frame sync and enters the not in sync state.

The meta-data of the header will be transported to the client for use and interpretation of the client.

The data slot words will be transported to the client for use and interpretation of the client. A CRC-32 checksum may be calculated of these slotwords.

If the DCAP-1 message contains a trailer slot word, the slot word checksum is calculated and compared with the received slot word checksum. If the checksums mismatch shall the packet be discarded. If the trailer contains a CRC-32 checksum shall the locally generated checksum be compared with the received checksum. If the checksums mismatch shall the packet be discarded. The non-discarded packages is sent to the client along with its meta-data.

NOTE 1: The trailer checksum errors does not cause a switch to the out of sync state, but is merely interpreted as bit errors. In the case that data has been lost, added or that undetected bit error in the header caused an incorrect length field, the out of sync detection will occur by failing to detect proper DCAP-1 headers after the completion of the flawed packet.

NOTE 2: As long as correct packet headers is received will the receiver continue to have the in sync state.

12.2.4 Slot word checksum calculation

The checksum is calculated by bit wise XOR-ing the octets of the slot word.

At the transmitter, the checksum is calculated and is copied into the checksum field in the slot word.

At the receiver the checksum is calculated in the same way as at the transmitter. The result is compared to the value in the checksum field in the incoming slot word. If there is a match, the DCAP-1 packet is forwarded to higher layer protocols. If not, an error has occurred and the appropriate action should be taken.

12.2.5 CRC calculation

The Cyclic Redundancy Check (CRC) performs the performance supervision by calculating a 32 bit checksum in the transmitter end and appending this in the DCAP-1 trailer. In the receiver side will the checksum be calculated again and compared with the transmitted checksum. The checksum is calculated for the data slot words of the DCAP-1 message.

The CRC-32 detects all single-bit errors, double-bit errors, any odd number of bit errors, any burst errors with length shorter than 32 and most large burst errors.

NOTE: It is advised to keep DCAP-1 packets no longer than 8192 octets in order to ensure the strength of the performance supervision.

The generator polynomial of the CRC-32 is:

$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$

The calculation is performed by:

1. Complement bit 63 to 32 of the first data slot.
2. Form the polynomial of M(x) where the N bits of the data slots (64 bits per slot times the number of slot words) is mapped into M(x) such that M(N-1) is bit 63 of the first slot and M(0) is bit 0 of the last slot.
3. Calculate $(M(x) \times x^{32})/G(x)$ and let the reminder become R(x).
4. Complement the bits of R(x) to get the CRC-32 value.

NOTE 1: This definition is meant to be formal and not to describe any particular implementation. Please consult relevant literature on error detection codes and IEEE 802.3 Ethernet and ANSI FDDI CRC-32 in particular.

NOTE 2: The complementation of the first 32 bits is done to ensure that initial runs of only zeros is correctly detected. This property is inherited from Ethernet and FDDI.

NOTE 3: The complementation of the first 32 bits is equivalent to initializing the CRC register with only ones for some implementation. The complementation assumes the initialization of only zeros in the CRC register.

12.2.6 Maintenance signal supervision

The maintenance signal supervision in DCAP-1 is performed through the AIS-marker. See clause 12.1.4 for further details.

12.3 DCAP-2

The DTM Channel Adaptation Protocol 2 (DCAP-2) provides channel adaptation for the transport of data oriented in a bitstream. No structure in the user data is assumed. The frequency justification of isochronous traffic is performed in 1 bit (1 UI) steps. Signal failure may be transmitted end-to-end using the DTM channel AIS marker. Performance supervision of the end-to-end channel is performed. In addition may client framing be coordinated with the DCAP-2 framing.

12.3.1 Data mapping

The DCAP-2 creates a framing format. The DCAP-2 frames follows back-to-back without any intermediary slot words. Each DCAP-2 frame consists of 16 or more data slot words of 64 bit each. Of each data slot word is 3 bits used for overhead data and up to 61 bits for data transport. The overhead bits (bit 63 to bit 61) is used for DCAP-2 frame synchronization, performance supervision and payload size control.

12.3.1.1 Framing

The DCAP-2 frame synchronization is achieved by allocating bit 63 of every slot word for a framing pattern. On the first slot word is this bit set to 1 and for all other slot words is this bit set to 0.

A frame synchronization state machine continuously monitors the synchronization bit. The state machine has two state, In Frame (IF) and Out Of Frame (OOF). If the state machine is in the OOF state and detects the frame pattern in two frames then shall the state machine enter the In Frame state. If the state machine is in the IF state and has failed to detect the frame pattern for a total of 5 frames, the state machine shall enter the Out Of Frame state.

12.3.1.2 Payload data mapping

DCAP-2 payload mapping assumes that $N \pm 1$ bits is transported each frame. For each slot word may at maximum 61 bits be transferred and there is m slot words per frame. Since $q + r/m = n/m$ where $n = N \pm 1$ is the number of bits to be transferred on a particular frame, q is the number of bits transferred on each data slot and r is the number of bits to be dispersed over the m slot words in the frame. At all times is $0 \le r < m$, $0 \le q \le 61$ and $0 \le n \le 61m$.

In DCAP-2 will bit $q-1$ to 0 be used in all slot words of the frame to transport payload bits. The r excess bits is transported in bit q of the r first slot words in the frame (i.e. slot word 0 to $r-1$). The bit stream is mapped onto the used bits of the slot words such that the first transferred bit of the frame is mapped into the highest bit of the first slotword, then the following bits is assigned to falling bit number, then onto the next slot etc.

Unused slot word bits shall have 0 transmitted and no interpretation is performed of those excess bits.

12.3.1.3 Payload size control

The payload size control is transferred in bit 61 of every slot word. In slot word 0, 2 and 4 of a frame is the C1 control bit transmitted. In slot word 1, 3 and 5 of a frame is the C2 control bit transmitted. C1 and C2 flags the frequency justification for this frame. For the nominal justification of $n = N$ is C1 and C2 set to 0. For the positive justification of $n = N + 1$ is C1 set to 1 and C2 set to 0. For the negative justification of $n = N - 1$ is C1 set to 0 and C2 set to 1. Since both C1 and C2 is transmitted three times, a majority decision of the C1 and C2 state can be performed by the receiver.

In slot word 6 to 10 is bit 0 to 4 of the q value sent.

In slot word 11 to 16 is bit 0 to 4 of the r value sent. In the case that $m > 16$ will the transmission length of r be extended on a bit basis in order to hold any legal value of r.

NOTE: The value of m can be observed by the distance between frame synchronization ticks in bit 63. The cycle time is m slots words.

Unused slot words shall have 0 transmitted and no interpretation is performed of those excess bits.

12.3.1.4 Performance supervision

The performance supervision in DCAP-2 is achieved by performing a BIP-16 checksum over an entire frame. On bit 62 is the BIP-16 sequenced out on the first 16 slot words of a frame. Bit 15 (BIP over bit 63, 47, 31 and 15) of the BIP-16 shall be sent in the first slot word, and bit 14 to 0 in sequence of the following slot words.

Unused slot words shall have 0 transmitted and no interpretation is performed of those excess bits.

12.3.2 Maintenance signal supervision

The maintenance signal supervision in DCAP-2 is performed through the AIS-marker. See clause 12.1.4 for further details.

Annex A (informative): Generic template Layer model (<L>)

This is a layer modelling template. See clause 5 for overview of functionality and clause 6 for detailed descriptions and model parts to include. Please consult clause 5.9 and 5.10 for detailed description on how to proceed.

L is used to indicate the short name for the layer being modelled, replace with proper short name.

Layer is used to indicate the long name for the layer being modelled, replace with proper long name.

CL is used to indicate the short name for the client layer being the client of the modelled layer, replace with proper short name for client layer.

Client Layer is used to indicate the long name for the client layer being the client of the modelled layer, replace with proper long name for client layer.

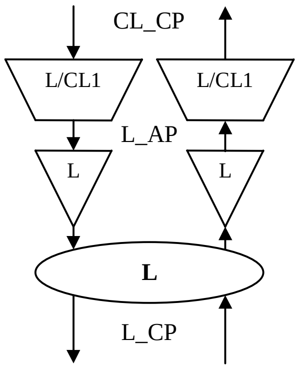


Figure 96: Layer atomic functions

A.1 Access point information

A.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is for further study.

A.1.2 Adapted Information

The Adapted Information (AI) of the Adaption Point (AP) is for further study.

A.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is for further study.

A.1.4 Timing Information

The Timing Information (TI) of the Timing Point (TP) is for further study.

A.2 Connection function (L_C)

Overview of connection functionalities if any.

A.2.1 Some connection function (L_C_FOO)

Description of the FOO connection functionality is for further study.

A.3 Trail Termination functions

A.3.1 Layer Trail Termination function (L_TT)

Layer Trail Termination description is for further study.

A.3.1.1 Layer Trail Termination Source function (L_TT_So)

Symbol

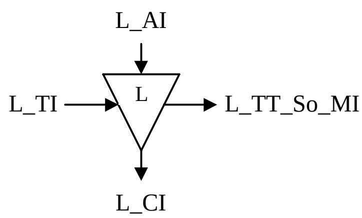


Figure 97: Layer Trail Termination Source (L_TT_So)

Interfaces

Table 100: L_TT_So Input and output signals

Input(s)	Output(s)
L_AI_D	L_CI_D

Processes and anomalies

<Insert all used processes and anomaly detections from clause 6.1>

Defects

<Insert all used defect filters from clause 6.2>

Consequent actions

<Insert all used consequence action filters from clause 6.3>

Defect correlation

<Insert all used defect correlation filters from clause 6.4>

Performance monitoring

<Insert all used performance monitoring filters from clause 6.5>

Output mapping

<Insert all output mappings, i.e. tying all output signals to their sources>

Fault management

<Insert all fault management sources from clause 6.6.1, for deeper fault management parts see clause 6.6>

Long term performance monitoring

<Insert all long term performance monitoring sources from clause 6.8, for deeper performance monitoring parts see clause 6.8>

A.3.1.2 Layer Trail Termination Sink function (L_TT_Sk)

Symbol

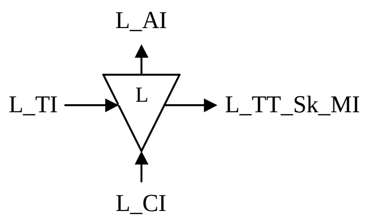


Figure 98: Layer Trail Termination Sink (L_TT_Sk)

<Remove unnecessary interfaces (usually TI and MI). Rename the trail terminator, interfaces and figure title>

Interfaces

Table 101: L_TT_Sk Input and output signals

Input(s)	Output(s)
L_AI_D	L_CI_D

Processes and anomalies

<Insert all used processes and anomaly detections from clause 6.1>

Defects

<Insert all used defect filters from clause 6.2>

Consequent actions

<Insert all used consequence action filters from clause 6.3>

Defect correlation

<Insert all used defect correlation filters from clause 6.4>

Performance monitoring

<Insert all used performance monitoring filters from clause 6.5>

Output mapping

<Insert all output mappings, i.e. tying all output signals to their sources>

Fault management

<Insert all fault management sources from clause 6.6.1, for deeper fault management parts see clause 6.6>

Long term performance monitoring

<Insert all long term performance monitoring sources from clause 6.8, for deeper performance monitoring parts see clause 6.8>

A.4 Adaptation functions

A.4.1 Layer Adaptation function (L/CL_A)

<Layer Adaptation function descriptions>

A.4.1.1 Layer to Client Layer Adaptation Source function (L/CL_A_So)

Symbol

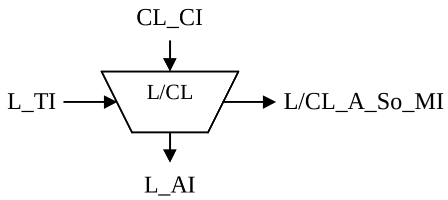


Figure 99: Layer to Client Layer Adaptation Source (L/CL_A_So)

<Remove unnecessary interfaces (usually TI and MI). Rename the trail terminator, interfaces and figure title>

Interfaces

Table 102: L/CL_A_So Input and output signals

Input(s)	Output(s)
CL_CI_D	L_AI_D

Processes and anomalies

<Insert all used processes and anomaly detections from clause 6.1>

Defects

<Insert all used defect filters from clause 6.2>

Consequent actions

<Insert all used consequence action filters from clause 6.3>

Defect correlation

<Insert all used defect correlation filters from clause 6.4>

Performance monitoring

<Insert all used performance monitoring filters from clause 6.5>

Output mapping

<Insert all output mappings, i.e. tying all output signals to their sources>

Fault management

<Insert all fault management sources from clause 6.6.1, for deeper fault management parts see clause 6.6>

Long term performance monitoring

<Insert all long term performance monitoring sources from clause 6.8, for deeper performance monitoring parts see clause 6.8>

A.4.1.2 Layer to Client Layer Adaptation Sink function (L/CL_A_Sk)

Symbol

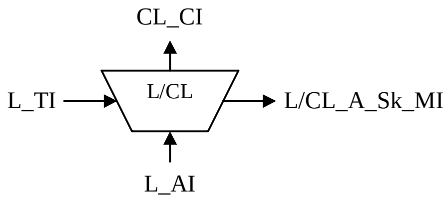


Figure 100: Layer to Client Layer Adaptation Sink (L/CL_A_Sk)

<Remove unnecessary interfaces (usually TI and MI). Rename the trail terminator, interfaces and figure title>

Interfaces

Table 103: L/CL_A_Sk Input and output signals

Input(s)	Output(s)
L_AI_D	CL_CI_D

Processes and anomalies

<Insert all used processes and anomaly detections from clause 6.1>

Defects

<Insert all used defect filters from clause 6.2>

Consequent actions

<Insert all used consequence action filters from clause 6.3>

Defect correlation

<Insert all used defect correlation filters from clause 6.4>

Performance monitoring

<Insert all used performance monitoring filters from clause 6.5>

Output mapping

<Insert all output mappings, i.e. tying all output signals to their sources>

Fault management

<Insert all fault management sources from clause 6.6.1, for deeper fault management parts see clause 6.6>

Long term performance monitoring

<Insert all long term performance monitoring sources from clause 6.8, for deeper performance monitoring parts see clause 6.8>

Annex B (informative): Bibliography

[ES803-2-2] ETSI ES 201 803-2-2: "Dynamic synchronous Transfer Mode (DTM); Part 2: System characteristics; Sub-part 2: Network aspects".

[ES803-5] ETSI ES 201 803-5: "Dynamic synchronous Transfer Mode (DTM); Part 5: Mapping of PDH over DTM".

[IEEE802.3] IEEE 802.3: "IEEE Standard for Information technology; Telecommunications and information exchange between systems; Specific requirements; Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications".

History

Document history		
V1.1.1	September 2003	Membership Approval Procedure MV 20031121: 2003-09-23 to 2003-11-21
V1.1.1	November 2003	Publication