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Prenos in multipleksiranje (TM) ï Sinhrona digitalna hierarhija (SDH) ï Sheme zaģļ ite omreģij ï Protokoli in delovanje avtomatiļ nega zaģļ itnega stikala (APS)

Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Network protection schemes; Automatic Protection Switch (APS) protocols and operation

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Foreword

This European Telecommunication Standard (ETS) has been produced by Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS is one of a family of related Technical Specifications (TSs) and ETSs covering the various aspects of SDH protection:

Draft TS 101 009: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) network protection schemes; Types and characteristics";

Draft TS 101 010: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) protection interworking; Rings and other schemes";

ETS 300 746: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Network protection schemes; Automatic Protection Switch (APS) protocols and operation".

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1 Scope

This European Telecommunication Standard (ETS) specifies the Automatic Protection Switching (APS) requirements, switching initiation criteria, and the APS protocols of Synchronous Digital Hierarchy (SDH) multiplex section shared protection ring, multiplex section dedicated protection ring, multiplex section linear protection, and path trail and Sub-Network Connection (SNC) protection schemes. The APS protocols are specified in terms of their multiplex section or path overhead requirement, the signalling messages and their operations under various failure conditions.

NOTE: The network objectives, architectures, functional modelling and operations of the various SDH protection schemes are under study (draft TS 101 009, see annex C). The protection interworking and interconnection scenarios for SDH network protection schemes are also under study (draft TS 101 010, see annex C).

2 Normative references

This ETS incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of, any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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[1] ETS 300 417: "Transmission and Multiplexing (TM); Generic functional requirements for Synchronous Digital Hierarchy (SDH) equipment".

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

[3] ITU-T Recommendation G.708: "Network node interface for the synchronous digital hierarchy".

[4] ITU-T Recommendation G.709: "Synchronous multiplexing structure".

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[5] ITU-T Recommendation G.783: "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".

[6] ITU-T Recommendation G.841: "Types and characteristics of SDH network protection architectures".

3 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

ADM	Add Drop Multiplex
AIS	Alarm Indication Signal
APS	Automatic Protection Switching
AU	Administrative Unit
AU-AIS	Administrative Unit - Alarm Indication Signal
AUG	Administrative Unit Group
AU-n	Administrative Unit (level) n
BER	Bit Error Ratio
BIP-n	Bit Interleaved Parity (of order) n
Br	Bridged
CPE	Customer Premises Equipment
DCC	Data Communication Channel
DXC	Digital Cross-Connect
EXER	EXERcise
EXER-R	EXERcise - Ring
FEBE	Far End Block Error
FERF	Far End Receive Failure

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FS	Forced Switch
FS-P	Forced Switch of the Protection channel to working
FS-R	Forced Switch of working to protection - Ring
FS-W	Forced Switch of a Working channel to protection
HO VC	Higher Order Virtual Container
HO	Higher Order
HOPA	Higher Order Path Adaptation
HOPT	Higher Order Path Termination
HPC	Higher order Path Connection
HP-DEG	Higher order Path-DEGraded
HP-SSF	Higher order Path-Server Signal Fail
HP-TIM	Higher order Path-Trace Identifier Mismatch
HP-UNEQ	Higher order Path-UNEQuipped
ID	IDentification
LO VC	Lower Order Virtual Container
LO	Lower Order
LOF	Loss Of Frame
LOPA	Lower Order Path Adaptation
LOPT	Lower Order Path Termination
LOS	Loss Of Signal
LP	Lockout of Protection
LPC	Lower order Path Connection
LP-DEG	Lower order Path-DEGraded
LP-SSF	Lower order Path-Server Signal Fail
LP-TIM	Lower order Path-Trace Identifier Mismatch
LP-UNEQ	Lower order Path UNEQuipped
MS	Multiplex Section
MS-DPRing	Multiplex Section - Dedicated Protection Ring
MS-P	Manual Switch of the Protection channel to working
MS-R	Manual Switch of working to protection - Ring
MS-SPRing	Multiplex Section - Shared Protection Ring
MS-W	Manual Switch of a Working channel to protection
NE	Network Element
NNI	Network Node Interface
NR	No Request
OAM&P	Operations, Administration Maintenance & Provisioning
OS	Operations System
PC	Private Circuit
POH	Path OverHead
RC	Remote Concentrator
RDI	Remote Defect Indicator
RR	Reverse Request
RR-R	Reverse Request - Ring
RS	Regenerator Section
SA	Section Adaptation
SD	Signal Degrade
SDH	Synchronous Digital Hierarchy
SD-R	Signal Degrade - Ring
SF	Signal Fail
SF-R	Signal Fail - Ring
SNC	Sub-Network Connection
SNC/I	Sub-Network Connection protection with Inherent monitoring
SNC/N	Sub-Network Connection protection with Non-intrusive monitoring
SOH	Section OverHead
SSF	Server Signal Fail
ST	Section Termination
STM	Synchronous Transport Module
STM-N	Synchronous Transport Module (level) N
Sw	Switched
TMN	Telecommunications Management Network
TSI	Time Slot Interchange
TU	Tributary Unit
TUG	Tributary Unit Group

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TU-n	Tributary Unit (level) n
VC	Virtual Container
VC-n	Virtual Container (level) n
WTR	Wait To Restore

4 Definitions and classifications

For the purposes of this ETS, the following definitions and classifications apply:

4.1 General definitions

Administrative Unit (AU): See ITU-T Recommendation G.708 [3].

Administrative Unit Group (AUG): See ITU-T Recommendation G.708 [3].

Automatic Protection Switching (APS): See ITU-T Recommendation G.783 [5].

Bit Interleaved Parity (BIP): See ITU-T Recommendation G.708 [3].

bridge: The action of transmitting identical traffic on both the working and protection trails.

dedicated protection: See ITU-T Recommendation G.803 [2].

dual ended operation: See ITU-T Recommendation G.803 [2].

head-end: The node that executes a bridge.

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Loss Of Frame (LOF): See ITU-T Recommendation G.783 [5].

Loss Of Signal (LOS): See ITU-T Recommendation G.783 [5].

Lower Order Virtual Container (LO VC) access: The termination of a higher order VC for the purpose of adding, dropping, or cross-connecting any individual LO VC or VC group.

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misconnection: A condition in which traffic destined for a given node is incorrectly routed to another node and no corrective action has been taken.

Multiplex Section (MS): See ITU-T Recommendation G.803 [2].

Multiplex Section AIS (MS-AIS): See ITU-T Recommendation G.783 [5].

Multiplex Section FERF (MS-FERF): See ITU-T Recommendation G.709 [4].

Network Node Interface (NNI): See ITU-T Recommendation G.708 [3].

pass-through: The action of transmitting the information that is being received from one multiplex section terminating port of a node which is connected to the ring to the other multiplex section terminating port of the same node.

path: See ITU-T Recommendation G.803 [2].

path AIS: See ITU-T Recommendation G.783 [5].

Path Overhead (POH): See ITU-T Recommendation G.708 [3].

protection trail: The trail allocated to transport the working traffic during a switch event. When there is a switch event, traffic on the affected working trail is bridged onto the protection trail.

Regenerator Section (RS): See ITU-T Recommendation G.803 [2].

restoration: See ITU-T Recommendation G.803 [2].

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secondary traffic: Traffic that is carried over the protection trail when it is not used for the protection of working traffic. This is sometimes called extra traffic. Secondary traffic is not protected and is pre-empted when the protection trail is required to protect the working traffic.

Section Overhead (SOH): See ITU-T Recommendation G.708 [3].

shared protection: See ITU-T Recommendation G.803 [2].

single ended operation: See ITU-T Recommendation G.803 [2].

single point failure: Failure located at a single physical point in a sub-network. The failure may affect one or more fibres. A single point failure may be detected by any number of Network Elements (NEs).

Sub-Network Connection (SNC): See ITU-T Recommendation G.803 [2].

sub-network connection protection: See ITU-T Recommendation G.803 [2].

switch: The action of selecting traffic from the protection trail rather than the working trail.

tail-end: The node that requests the bridge.

Time Slot Interchange (TSI): The capability of changing the timeslot position of through-connected traffic (i.e. traffic that is not added or dropped from the node).

trail: See ITU-T Recommendation G.803 [2].

trail protection: See ITU-T Recommendation G.803 [2].

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Tributary Unit (TU): See ITU-T Recommendation G.708 [3].

Tributary Unit Group (TUG): See ITU-T Recommendation G.708 [3].

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Virtual Container (VC): See ITU-T Recommendation G.708 [3].

Wait To Restore (WTR): The condition in which a working trail meets the restoral threshold after an SD or SF condition. The transport of working traffic is ready to be reverted to the working trail from the protection trail.

working traffic: Traffic that is normally carried in a working trail, except in the event of a protection switch.

working trail: The trail over which working traffic is transported when there is no switch events.

4.2 Ring definitions

add traffic: Traffic that is inserted into a working trail at a ring node.

drop traffic: Traffic that is extracted from a working trail at a ring node.

long path: The path segment away from the span for which a ring request is initiated. Typically, there are other intermediate nodes along this path segment.

ring: A ring is constructed within a layer consisting of a set of nodes, each of which is connected to its immediate neighbour (adjacent) nodes by a trail/link connection, forming a closed loop. The capacity offered by the ring between any pair of adjacent nodes is the same.

ring request: The request sent over the long path away from the span for which the request is initiated, i.e. a long path request.

ring switching: Protection mechanism in a ring, which in the event of a switch the working traffic is carried over the protection trail away from the failure.

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short path: The path segment over the span for which a span request is initiated. This span is always the one to which both the head-end and tail end are connected.

span: The set of multiplex sections between two adjacent nodes on a ring.

squelching: The process of inserting path AIS in order to prevent misconnection.

4.3 Protection classifications

Classification of SDH protection schemes is based on the ITU-T Recommendation G.803 [2] layering concept of a transport network model.

NOTE: See also draft TS 101 009 (annex C).

5 Multiplex section trail protection protocols

5.1 Multiplex section trail linear protection

5.1.1 APS requirements

An APS protocol is required to co-ordinate the bridge and switch operations between the nodes. The requirements for the protocol are listed below:

Switch time. For MS trail linear protection the switching time shall be less than 50 ms.

Secondary traffic. For 1:n MS trail linear protection, access to the protection trails may be provided as an option to accommodate secondary, low priority traffic.

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Switching types. MS trail linear protection shall support both single ended and dual ended switching.

Operation Modes. The mode of operation shall be both revertive and non-revertive.

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Manual control. External commands shall be provided for manual control of protection switching by the operations systems or the craftpersons.

5.1.2 Switch initiation criteria

The requests to perform protection switching can be initiated either externally or automatically.

Externally initiated commands are entered by way of the Operations System (OS) or the craftperson interface. Subclause 5.1.2.1 describes these externally initiated commands available at the OS, craftsperson, or both interfaces.

APS requests can also be initiated based on multiplex section and equipment performance criteria. Subclause 5.1.2.2 provides the automatically initiated command criteria.

5.1.2.1 Externally initiated commands

External requests are initiated at an NE by either the OS or the craftsperson. The external request may be transmitted to the appropriate NE via the APS bytes, the TMN, or over the local craft interface. The requests are evaluated by the priority algorithm in the protection switching controller.

5.1.2.1.1 Commands not signalled on the APS channel

The descriptions of the externally initiated commands are provided below:

clear: This command clears the externally initiated command at the node to which the command was addressed. For 1:n and 1+1 revertive architecture, the NE-to-NE signalling following removal of the externally initiated commands is performed using the NR code.