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Dynamic synchronous Transfer Mode (DTM); Part 6: Mapping of Synchronous Digital Hierarchy (SDH) over DTM

Reference

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Keywords

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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 6 of a multipart deliverable covering Dynamic synchronous Transfer Mode (DTM), as identified below:

Part 1: "System description";

Part 2: "System characteristics";

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

Dynamic synchronous Transfer Mode (DTM) is a time division multiplex and a circuit-switched network technique that combines switching and transport.

Part 1 describes the general properties of DTM and the DTM service over a unidirectional data channel. The overall system architecture is described and fundamental functions are identified.

Part 2 includes system aspects that are mandatory or optional for nodes from different vendors to interoperate. The interworking granularity should be at node level, such that nodes from different vendors can interoperate with regard to well-defined functions.

Part 3 specifies the physical layer for physical links based on 8B10B encoding.

Part 4 describes how DTM frames are mapped onto SDH containers.

The transport of various tributary signals is specified for PDH (part 5), SDH (part 6), Ethernet (part 7), Frame Relay (part 8), ATM (part 9), IP (part 10), MPLS (part 11), video streaming (part 12).

Subrate DTM is described in part 13.

Finally, management aspects are standardized in part 14.

1 Scope

The present document achieves the following:

- specifies a method for mapping SDH VC-4 and VC-3 containers over DTM channels;
- specifies the characteristics of critical parameters for mapping SDH VC-4 and VC-3 containers over DTM channels;
- gives terms and definitions for mapping encoding.

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.

[EN417-1-1] ETSI EN 300 417-1-1: "Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 1-1: Generic processes and performance".

[EN417-3-1] ETSI EN 300 417-3-1: "Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 3-1: Synchronous Transport Module-N (STM-N) regenerator and multiplex section layer functions".

[EN417-4-1] ETSI EN 300 417-4-1: "Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 4-1: Synchronous Digital Hierarchy (SDH) path layer functions".

[EN164] ETSI EN 301 164: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); SDH leased lines; Connection characteristics".

[EN165] ETSI EN 301 165: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); SDH leased lines; Network and terminal interface presentation".

[ES803-2-3] ETSI ES 201 803-2-3: "Dynamic synchronous Transfer Mode (DTM); Part 2: System characteristics; Sub-part 3: Transport network and channel adaption aspects".

[G.805] ITU-T Recommendation G.805: "Generic functional architecture of transport networks".

[G.806] ITU-T Recommendation G.806: "Characteristics of transport equipment - Description methodology and generic functionality".

3 Definitions and abbreviations

3.1 Definitions

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

Access Point (AP): "reference point" that consists of the pair of co-located "unidirectional access" points, and therefore represents the binding between the trail termination and adaptation functions

NOTE: Adopted from [G.805].

Adapted Information (AI): information passing across an AP

NOTE: See also [G.805] Adopted from [G.806].

Alarm Indication Signal (AIS): special marker sent in a data slot to mark the lack of transported data as a result of a defect in the transmission path

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

Characteristic Information (CI): signal with a specific format, which is transferred on "network connections"

NOTE: The specific formats will be defined in the technology specific Recommendations. The information passing across a CP or TCP. (Adopted from [G.805] and [G.806]).

Connection Point (CP): reference point where the output of a trail termination source or a connection is bound to the input of another connection, or where the output of a connection is bound to the input of a trail termination sink or another connection

NOTE: Adopted from [G.806].

defect: density of anomalies has reached a level where the ability to perform a required function has been interrupted

NOTE Defects are used as input for performance monitoring, the control of consequent actions, and the determination of fault cause. (Adopted from [G.806])

frame: set of slots forming an entity that is transmitted on a physical medium repeatedly every 125 µs (nominally), i.e. 8000 frames/second

idle: special marker sent in a data slot to mark the lack of transported data in the slot

Management Information (MI): signal passing across an access point

NOTE: Adopted from [G.806].

Management Point (MP): reference point where the output of an atomic function is bound to the input of the element management function, or where the output of the element management function is bound to the input of an atomic function

NOTE: The MP is not the TMN Q3 interface. Adopted from [G.806].

Performance Supervision (PS): special marker sent with the data containing per channel Performance Supervision information

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

Server Signal Fail (SSF): signal fail indication output at the CP of an adaptation function

NOTE: Adopted from [G.806].

Signal Fail (SF): signal indicating the associated data has failed in the sense that a near-end defect condition (not being the degraded defect) is active

NOTE: Adopted from [G.806].

slot: time slot within the frame being able to transport 64 bit of data or a number of special codes

Trail Signal Fail (TSF): signal fail indication output at the AP of a termination function

NOTE: Adopted from [G.806].

3.2 Abbreviations

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

A	Adapted function
aAIS	Alarm Indication Signal action
AI	Adapted Information
AIS	Alarm Indication Signal
AP	Access Point
AP0	Application layer channel adaptation type 0
AP0e	Application layer channel adaptation type 0 with empty trail termination
aSSF	Server Signal Fail action
BPn	ByPass layer type n
BPnp	ByPass layer type n Protection
C	Connection Function
cAIS	Alarm Indication Signal cause
CH	CHannel layer
CHn	CHannel layer type-n
CHp	CHannel layer Protection
CI	Characteristic Information
CK	ClocK
cLOJ	Loss Of Justification cause
CP	Connection Point
D	Data
dAIS	Alarm Indication Signal defect
DTM	Dynamic synchronous Transfer Mode
fAIS	Alarm Indication Signal fault
FJ-	negative Frequency Justification
FJ+	positive Frequency Justification
fLOJ	Loss Of Justification fault
FS	Frame Start signal
IF	In Frame
II	Idle Insertion
MI	Management Information
Mn	Media layer type-n
MP	Management Point
nAIS	Alarm Indication Signal anomaly
nFJ-	negative Frequency Justification anomaly
nFJ+	positive Frequency Justification anomaly
nLOJ	Loss Of Justification anomaly
OOF	Out-Of-Frame
pFJ-	negative Frequency Justification performance counter
pFJ+	positive Frequency Justification performance counter
POH	Path OverHead
PS	Performance Supervision
SDH	Synchronous Digital Hierarchy
sFS	Frame Start signal
sII	Idle Insertion signal
Sk	Sink
Sn	SDH higher order VC-n layer (n=3,4,4-Xc)
So	Source
SSF	Server Signal Fail
TI	Timing Information
TP	Timing Point
TSF	Trail Signal Fail

TT	Trail Termination
VC	Virtual Container
VC-3	Virtual Container, level 3
VC-4	Virtual Container, level 4

4 Overview

The SDH VC-4 and VC-3 mapping over DTM (see figure 1) describes the mapping and framing of the virtual containers level 4 (VC-4) and level 3 (VC-3) into DTM channels. The functionality is part of the DTM Application layer and provides a transport service to the SDH higher order path layer similar to the service provided by the SDH Multiplexing Section layer [EN417-3-1]. The transport functionality provides a SDH VC DTM Timeslot connection over a DTM network as if this where a physical link between the SDH nodes. The service can be viewed as a leased VC-3, VC-4 or VC-4-Xc over the DTM network, thus similar to [EN164] and [EN165].

SDH Virtual containers contain 261 (VC-4), $261 \times X$ (VC-4-Xc) and 87 (VC-3) octets per row, 9 rows per frame. The VC frame rate may deviate from the SDH transmission rate by up to +/- 4,6 ppm [EN417-3-1] such that frequency justification is required. The SDH frequency justification mechanism of pointer justifications is replaced by DTM idle special marker insertion or exclusion upon justification opportunity.

The SDH supervision functionality is mapped over to the DTM functionality and SDH AIS is being encoded into DTM AIS.

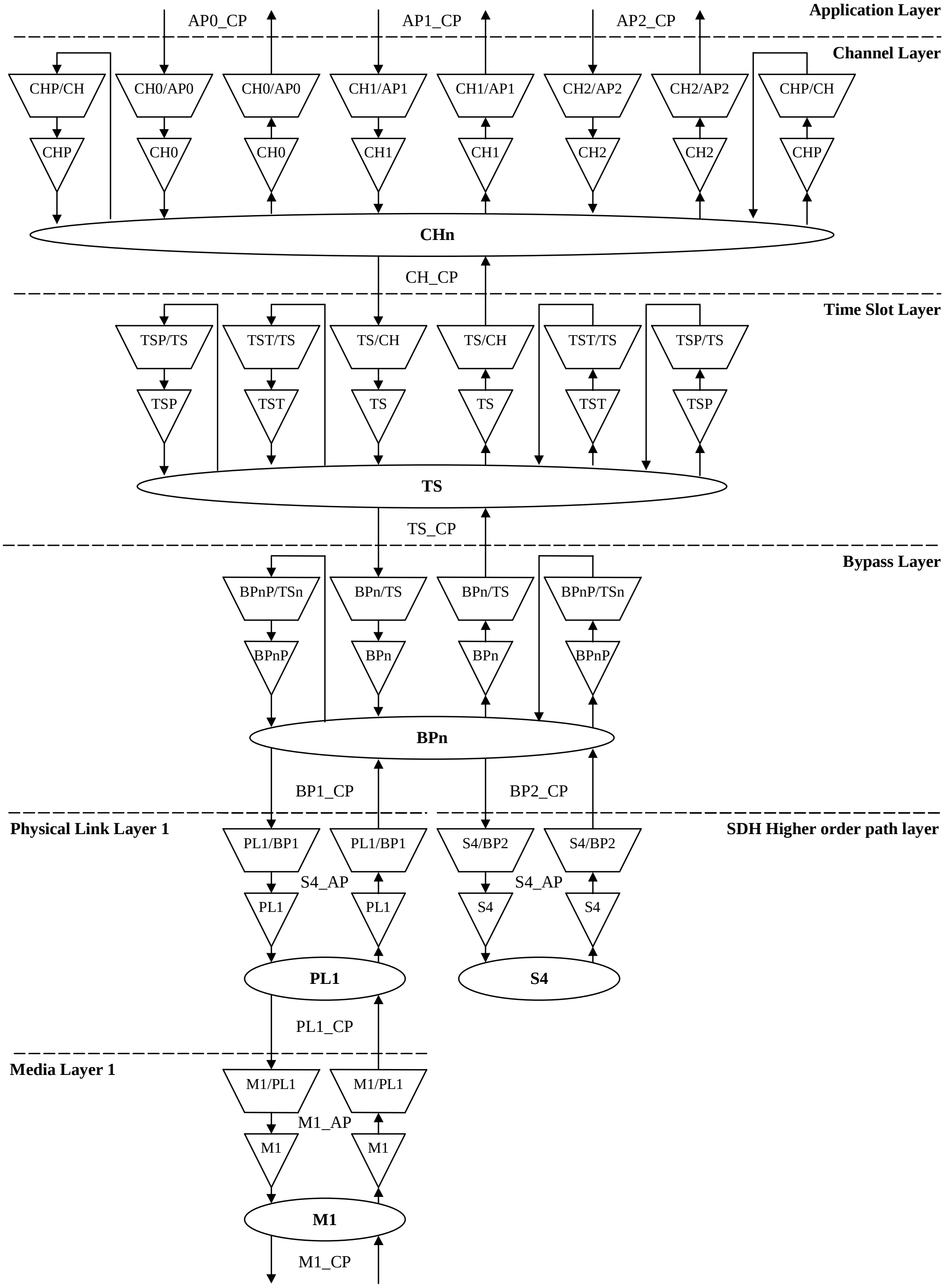

Figure 1: Transport Network Reference Model for DTM

5 DTM SDH Transport Application Layer

The SDH VC-4/VC-3 over DTM transport is specified as the adaptation functions on top of the DCAP-0 [ES803-2-3] trail terminator functions, providing the S4/S3 Higher order trail over DTM.

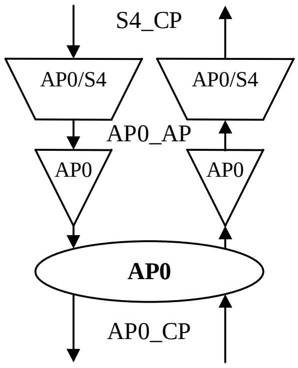

Figure 2: DTM Application layer 0 for SDH VC-4 mapping atomic functions

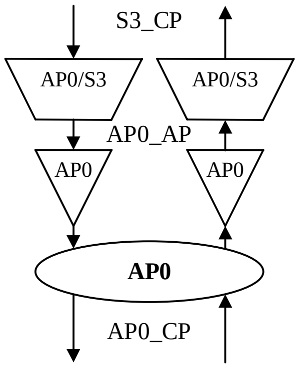

Figure 3: DTM Application layer 0 for SDH VC-3 mapping atomic functions

5.1 Access point information

5.1.1 Characteristic Information

The Characteristic Information (CI) of the Connection Point (CP) is described in [EN417-4-1].

5.1.2 Adapted Information

The Adapted Information (AI) of the Adaptation Point (AP) is described in [ES803-2-3] as the Application 0 Characteristic Information.

5.1.3 Management Information

The Management Information (MI) of the Management Point (MP) is (for VC-4 and VC-3 respectively):

- the 1 second timer signal AP0/S4_A_So_MI_1second and AP0/S3_A_So_MI_1second;
- the positive frequency justification 1 second performance counter AP0/S4_A_So_MI_pFJ+ and AP0/S3_A_So_MI_pFJ+;
- the negative frequency justification 1 second performance counter AP0/S4_A_So_MI_pFJ- and AP0/S3_A_So_MI_pFJ-;
- the loss of justification cause signal AP0/S4_A_Sk_MI_cLOJ and AP0/S3_A_Sk_MI_cLOJ;

- and the alarm indication signal cause signal AP0/S4_A_Sk_MI_cAIS and AP0/S3_A_Sk_MI_cAIS.

5.1.4 Timing Information

The Timing Information (TI) of the Timing Point (TP) is:

- the Application 0 data clock timing indication AP0_TI_CK;
- and the Application 0 frame start timing indication AP0_TI_FS.

5.2 Connection function (AP0_C)

Not applicable. There are no connection functions defined for this layer.

5.3 Trail Termination functions (AP0e_TT)

The trail termination functions are empty mappings between AI and CI.

5.3.1 Void

5.3.1.1 Application 0 empty Termination Source function (AP0e_TT_So)

Symbol:

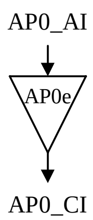

Figure 4: Application 0 empty Trail Termination Source (AP0e_TT_So)

Interfaces:

Table 1: AP0e_TT_So Input and output signals

Input(s)	Output(s)
AP0_AI_D	AP0_CI_D
AP0_AI_CK	AP0_CI_CK
AP0_AI_FS	AP0_CI_FS
AP0_AI_II	AP0_CI_II
AP0_AI_PSI	AP0_CI_PSI
AP0_AI_TSF	AP0_CI_SSF

Processes and anomalies:

None.

Defects:

None.

Consequent actions:

None.

Defect correlation:

None.

Performance monitoring:

None.

Output mapping:

AP0_CI_D ← AP0_AI_D.

AP0_CI_CK ← AP0_AI_CK.

AP0_CI_FS ← AP0_AI_FS.

AP0_CI_II ← AP0_AI_II.

AP0_CI_PSI ← AP0_AI_PSI.

AP0_CI_SSF ← AP0_AI_TSF.

Fault management:

None.

Long term performance monitoring:

None.

5.3.1.2 Application 0 empty Trail Termination Sink function (AP0e_TT_Sk)

Symbol:

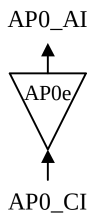

Figure 5: Application 0 empty Trail Termination Sink (AP0e_TT_Sk)

Interfaces:

Table 2: AP0e_TT_Sk Input and output signals

Input(s)	Output(s)
AP0_CI_D	AP0_AI_D
AP0_CI_CK	AP0_AI_CK
AP0_CI_FS	AP0_AI_FS
AP0_CI_II	AP0_AI_II
AP0_CI_PSI	AP0_AI_PSI
AP0_CI_SSF	AP0_AI_TSF

Processes and anomalies:

None.

Defects:

None.

Consequent actions:

None.

Defect correlation:

None.

Performance monitoring:

None.

Output mapping:

AP0_AI_D ← AP0_CI_D.

AP0_AI_CK ← AP0_CI_CK.

AP0_AI_FS ← AP0_CI_FS.

AP0_AI_II ← AP0_CI_II.

AP0_AI_PSI ← AP0_CI_PSI.

AP0_AI_TSF ← AP0_CI_SSF.

Fault management:

None.

Long term performance monitoring:

None.

5.4 Adaptation functions (AP0/Sn_A)

5.4.1 DTM Application 0/SDH Higher order path Adaptation function (AP0/S4_A)

This clause describes the SDH VC-4 adaptation using DCAP-0 trail terminators.

5.4.1.1 Media Adaptation Source function (AP0/S4_A_So)

Symbol:

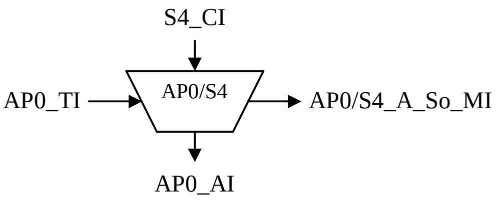

Figure 6: DTM Application 0/SDH Higher order path Adaptation Source (AP0/S4_A_So)

Interfaces:

Table 3: AP0/S4_A_So Input and output signals

Input(s)	Output(s)
S4_CI_D	AP0_AI_D
S4_CI_CK	AP0_AI_CK
S4_CI_FS	AP0_AI_II
S4_CI_SSF	AP0_AI_PSI
AP0_TI_CK	AP0_AI_FS
AP0_TI_FS	AP0_AI_TSF
AP0/S4_A_So_MI_1second	AP0/S4_A_So_MI_pFJ-
	AP0/S4_A_So_MI_pFJ+

Processes and anomalies:

The generation of frame alignment pattern in order to indicate the initial segment of a multi-segment VC-4 transport stream according to clause 6.2.1. See [ES803-2-3] clause 6.1.9.4.

The division of the VC-4 octet stream into segments as specified in clause 6. See [ES803-2-3] clause 6.1.13.5.

The multiplexing of the section alignment signal and the 5 first octets of the segment into an initial slot. See [ES803-2-3] clause 6.1.13.6.

The multiplexing of 8 contiguous octets in the segment into a data slot. See [ES803-2-3] clause 6.1.13.6.

The multiplexing of an initial slot and 293 contiguous data slots into a slot stream on AI_D. See [ES803-2-3] clause 6.1.13.6.

sII: 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: 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: 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.

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 [ES803-2-3] clause 6.1.8.1.

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 [ES803-2-3] clause 6.1.8.1. For justification opportunity, see clause 6.1.

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 [ES803-2-3] clause 6.1.8.1. For justification opportunity, see clause 6.1.

nFJ+: The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See [ES803-2-3] clause 6.1.8.1.

nFJ-: The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See [ES803-2-3] clause 6.1.8.1.

AIS: The Alarm Indication Signal (AIS) insertion into AI_D instead of received signal when the CI_SSF signal is asserted. See [ES803-2-3] clause 6.1.5.1.

Defects:

None.

Consequent actions:

aAIS: The Alarm Indication Signal action (aAIS) is asserted when the Server Signal Fail (SSF) is asserted.
See [ES803-2-3] clause 6.3.1.1.

aAIS ← CI_SSF.

Defect correlation:

None.

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 [ES803-2-3] clause 6.5.3.1.

pFJ+ ← Σ nFJ+.

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 [ES803-2-3] clause 6.5.3.2.

pFJ- ← Σ nFJ-.

Output mapping:

AP0_AI_D ← AI_D.

AP0_AI_CK ← AP0_TI_CK.

AP0_AI_II ← sII.

AP0_AI_PSI ← sPSI.

AP0_AI_FS ← sFS.

AP0_AI_TSF ← S4_CI_SSF.

AP0/S4_A_So_MI_pFJ+ ← pFJ+.

AP0/S4_A_So_MI_pFJ- ← pFJ-.

Fault management:

None.

Long term performance monitoring:

FJ+(t-10) (A_Sk): 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_Sk): 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.

5.4.1.2 Media Adaptation Sink function (AP0/S4_A_Sk)

Symbol:

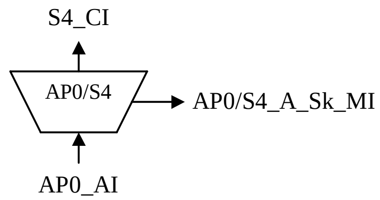

Figure 7: Media Adaptation Sink (AP0/S4_A_Sk)

Interfaces:

Table 4: AP0/S4_A_Sk Input and output signals

Input(s)	Output(s)
AP0_AI_D	S4_CI_D
AP0_AI_CK	S4_CI_CK
AP0_AI_II	S4_CI_FS
AP0_AI_PSI	S4_CI_SSF
AP0_AI_FS	AP0/S4_A_Sk_MI_cAIS
AP0_AI_TSF	AP0/S4_A_Sk_MI_cLOJ

Processes and anomalies:

The monitoring of frame alignment pattern in order to identify the initial segment of a multi-segment VC-4 transport stream according to clause 6.2.1. See [ES803-2-3] clause 6.1.9.4.

sFS: 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 [ES803-2-3] clause 6.1.9.4.

nLOJ: If the initial segment does not occur after the specified justification, then the Loss Of Justification anomaly (nLOJ) is asserted, else nLOJ is not asserted. See clause 6.2.1 and [ES803-2-3] clause 6.1.9.4.

The demultiplexing of the initial slot and 293 contiguous data slots from the slot stream on AI_D.
See [ES803-2-3] clause 6.1.13.6.

The demultiplexing of the initial slot to the section alignment signal and the 5 first octets of the segment.
See [ES803-2-3] clause 6.1.13.6.

The demultiplexing of the data slots into 8 contiguous octets in the VC-4 octet stream.
See [ES803-2-3] clause 6.1.13.6.

The reconstruction of the VC-4 octet stream from the received segments as specified in clause 6.
See [ES803-2-3] clause 6.1.13.5.

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 [ES803-2-3] clause 6.1.11.3.

The elastic buffering of the transported signal such that the buffer output is being clocked by the smoothed clock. See [ES803-2-3] clause 6.1.11.3.

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: The Alarm Indication Signal anomaly (nAIS) is asserted when a AIS-marker is being detected in the AI_D stream. See [ES803-2-3] clause 6.1.5.1.

Defects:

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 not asserted 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 [ES803-2-3] clause 6.2.4.2.

dLOJ: The Loss Of Justification defect (dLOJ) shall be asserted when the justification persistence state machine is in the OOF state. See [ES803-2-3] clause 6.2.4.2.

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 not asserted. See clause 6.2.6.1.

Consequent actions:

aAIS: The Alarm Indication Signal action (aAIS) is asserted when the Loss Of Justification defect (dLOJ), the Alarm Indication Signal defect (dAIS) is asserted or the Trail Signal Fail (AI_TSF) is. See clause 6.3.1.1.

aAIS ← dLOJ or dAIS or AI_TSF.

aSSF: The Server Signal Fail action (aSSF) is asserted when the Alarm Indication Signal defect (dAIS) is asserted, the Trail Signal Fail (AI_TSF) is asserted or the Loss Of Justification defect (dLOJ) is asserted. See clause 6.3.1.2.

aSSF ← dAIS or AI_TSF or dLOJ.

Defect correlation:

cLOJ: The Loss Of Justification cause (cLOJ) is asserted when the Loss Of Justification defect (dLOJ) is asserted, the Alarm Indication Signal defect (dAIS) not asserted and Trail Signal Fail (AI_TSF) is not asserted. See clause 6.4.4.2.

cLOJ ← dLOJ and (not dAIS) and (not AI_TSF)

cAIS: The Alarm Indication Signal cause (cAIS) is asserted when the Alarm Indication Signal defect (dAIS) is asserted and the Trail Signal Failure (AI_TSF) is not asserted. See clause 6.4.6.1.

cAIS ← dAIS and (not AI_TSF)

Performance monitoring:

None.

Output mapping:

S4_CI_D ← CI_D.

S4_CI_CK ← CI_CK.

S4_CI_FS ← sFS.

S4_CI_SSF ← aSSF.

AP0/S4_A_Sk_MI_cLOJ ← cLOJ.

AP0/S4_A_Sk_MI_cAIS ← cAIS.

Fault management:

fAIS (A_Sk): The Alarm Indication Signal fault (fAIS) is asserted when the Alarm Indication Signal cause (cAIS) is asserted consistently for $2,5 \pm 0,5$ seconds and not asserted when the cAIS have been not asserted for $10 \pm 0,5$ seconds. See clause 6.6.1.3.

fLOJ (A_Sk): The Loss Of Justification fault (fLOF) is asserted when the Loss Of Justification cause (cLOJ) is asserted consistently for $2,5 \pm 0,5$ seconds and not asserted when the cLOJ have been not asserted for $10 \pm 0,5$ seconds. See clause 6.6.1.6.

Long term performance monitoring:

None.

5.4.2 DTM Application 0/SDH Higher order path Adaptation function (AP0/S3_A)

This clause describes the SDH VC-3 adaptation using DCAP-0 trail terminators.

5.4.2.1 Media Adaptation Source function (AP0/S3_A_So)

Symbol:

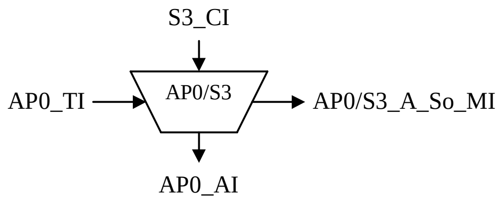

Figure 8: DTM Application 0/SDH Higher order path Adaptation Source (AP0/S3_A_So)

Interfaces:

Table 5: AP0/S3_A_So Input and output signals

Input(s)	Output(s)
S3_CI_D	AP0_AI_D
S3_CI_CK	AP0_AI_CK
S3_CI_FS	AP0_AI_II
S3_CI_SSF	AP0_AI_PSI
AP0_TI_CK	AP0_AI_FS
AP0_TI_FS	AP0_AI_TSF
AP0/S3_A_So_MI_1second	AP0/S3_A_So_MI_pFJ-
	AP0/S3_A_So_MI_pFJ+

Processes and anomalies:

The generation of frame alignment pattern in order to indicate the initial segment of a multi-segment VC-3 transport stream according to clause 7.2.1. See [ES803-2-3] clause 6.1.9.4.

The division of the VC-3 octet stream into segments as specified in clause 7. See [ES803-2-3] clause 6.1.13.5.

The multiplexing of the section alignment signal and the 7 first octets of the segment into an initial slot. See [ES803-2-3] clause 6.1.13.6.

The multiplexing of 8 contiguous octets in the segment into a data slot. See [ES803-2-3] clause 6.1.13.6.

The multiplexing of an initial slot and 97 contiguous data slots into a slot stream on AI_D. See [ES803-2-3] 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.

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 [ES803-2-3] clause 6.1.8.1.

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 [ES803-2-3] clause 6.1.8.1. For justification opportunity, see clause 7.1.

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 [ES803-2-3] clause 6.1.8.1. For justification opportunity, see clause 7.1.

nFJ+: The positive frequency justification anomaly (nFJ+) is asserted when a positive frequency justification has occurred, else it is de-asserted. See [ES803-2-3] clause 6.1.8.1.

nFJ-: The negative frequency justification anomaly (nFJ-) is asserted when a negative frequency justification has occurred, else it is de-asserted. See [ES803-2-3] clause 6.1.8.1.

AIS: The Alarm Indication Signal (AIS) insertion into AI_D instead of received signal when the CI_SSF signal is asserted. See [ES803-2-3] clause 6.1.5.1.

Defects:

None.

Consequent actions:

aAIS: The Alarm Indication Signal action (aAIS) is asserted when the Server Signal Fail (SSF) is asserted. See [ES803-2-3] clause 6.3.1.1.

aAIS ← CI_SSF.

Defect correlation:

None.

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 [ES803-2-3] clause 6.5.3.1.

pFJ+ ← Σ nFJ+.

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 [ES803-2-3] clause 6.5.3.2.

pFJ- ← Σ nFJ-.

Output mapping:

AP0_AI_D ← AI_D.

AP0_AI_CK ← AP0_TI_CK.

AP0_AI_II ← sII.

AP0_AI_PSI ← sPSI.

AP0_AI_FS ← sFS.

AP0_AI_TSF ← AP0_CI_SSF.

AP0/S4_A_So_MI_pFJ+ ← pFJ+.

AP0/S4_A_So_MI_pFJ- ← pFJ-.

Fault management:

None.

Long term performance monitoring:

FJ+(t-10) (A_Sk): 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_Sk): 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.

5.4.2.2 Media Adaptation Sink function (AP0/S3_A_Sk)

Symbol:

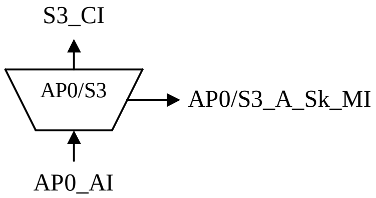

Figure 9: Media Adaptation Sink (AP0/S3_A_Sk)

Interfaces:

Table 6: AP0/S4_A_Sk Input and output signals

Input(s)	Output(s)
AP0_AI_D	S3_CI_D
AP0_AI_CK	S3_CI_CK
AP0_AI_II	S3_CI_FS
AP0_AI_PSI	S3_CI_SSF
AP0_AI_FS	AP0/S3_A_Sk_MI_cAIS
AP0_AI_TSF	AP0/S3_A_Sk_MI_cLOJ

Processes and anomalies:

The monitoring of frame alignment pattern in order to identify the initial segment of a multi-segment VC-3 transport stream according to clause 7.2.1. See [ES803-2-3] clause 6.1.9.4.

sFS: 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 [ES803-2-3] clause 6.1.9.4.

nLOJ: If the initial segment does not occur after the specified justification, then the Loss Of Justification anomaly (nLOJ) is asserted, else nLOJ is not asserted. See clause 6.2.1 and [ES803-2-3] clause 6.1.9.4.

The demultiplexing of the initial slot and 97 contiguous data slots from the slot stream on AI_D.
See [ES803-2-3] clause 6.1.13.6.

The demultiplexing of the initial slot to the section alignment signal and the 7 first octets of the segment.
See [ES803-2-3] clause 6.1.13.6.

The demultiplexing of the data slots into 8 contiguous octets in the VC-3 octet stream.
See [ES803-2-3] clause 6.1.13.6.

The reconstruction of the VC3 octet stream from the received segments as specified in clause 7.
See [ES803-2-3] clause 6.1.13.5.

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 [ES803-2-3] clause 6.1.11.3.

The elastic buffering of the transported signal such that the buffer output is being clocked by the smoothed clock. See [ES803-2-3] clause 6.1.11.3.

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: The Alarm Indication Signal anomaly (nAIS) is asserted when a AIS-marker is being detected in the AI_D stream. See [ES803-2-3] clause 6.1.5.1.

Defects:

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 not asserted 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 [ES803-2-3] clause 6.2.4.2.

dLOJ: The Loss Of Justification defect (dLOJ) shall be asserted when the justification persistence state machine is in the OOF state. See [ES803-2-3] clause 6.2.4.2.

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 not asserted. See clause 6.2.6.1.

Consequent actions:

aAIS: The Alarm Indication Signal action (aAIS) is asserted when the Loss Of Justification defect (dLOJ), the Alarm Indication Signal defect (dAIS) is asserted or the Trail Signal Fail (AI_TSF) is. See clause 6.3.1.1.

aAIS ← dLOJ or dAIS or AI_TSF.

aSSF: The Server Signal Fail action (aSSF) is asserted when the Alarm Indication Signal defect (dAIS) is asserted, the Trail Signal Fail (AI_TSF) is asserted or the Loss Of Justification defect (dLOJ) is asserted. See clause 6.3.1.2.

aSSF ← dAIS or AI_TSF or dLOJ.

Defect correlation:

cLOJ: The Loss Of Justification cause (cLOJ) is asserted when the Loss Of Justification defect (dLOJ) is asserted, the Alarm Indication Signal defect (dAIS) not asserted and Trail Signal Fail (AI_TSF) is not asserted. See clause 6.4.4.2.

cLOJ ← dLOJ and (not dAIS) and (not AI_TSF).

cAIS: The Alarm Indication Signal cause (cAIS) is asserted when the Alarm Indication Signal defect (dAIS) is asserted and the Trail Signal Failure (AI_TSF) is not asserted. See clause 6.4.6.1.

cAIS ← dAIS and (not AI_TSF)

Performance monitoring:

None.

Output mapping:

S3_CI_D ← CI_D.

S3_CI_CK ← CI_CK.

S3_CI_FS ← sFS.

S3_CI_SSF ← aSSF.

AP0/S3_A_Sk_MI_cLOJ ← cLOJ.

AP0/S3_A_Sk_MI_cAIS ← cAIS.

Fault management:

fAIS (A_Sk): The Alarm Indication Signal fault (fAIS) is asserted when the Alarm Indication Signal cause (cAIS) is asserted consistently for $2,5 \pm 0,5$ seconds and not asserted when the cAIS have been not asserted for $10 \pm 0,5$ seconds. See clause 6.6.1.3.

fLOJ (A_Sk): The Loss Of Justification fault (fLOF) is asserted when the Loss Of Justification cause (cLOJ) is asserted consistently for $2,5 \pm 0,5$ seconds and not asserted when the cLOJ have been not asserted for $10 \pm 0,5$ seconds. See clause 6.6.1.6.

Long term performance monitoring:

None.

6 Mapping of SDH VC-4 over DTM

The SDH VC-4 [EN417-3-1] is mapped onto the DTM DCAP-0 [ES803-2-3] format, providing means to transport the VC-4 data, VC-4 frame alignment, SSF and providing performance supervision. The VC-4 can be of either VC-4 or VC-4-Xc forms, so mapping must be able to handle X of 1, 4, 16, 64 or 256. Each of the 9 rows of the VC-4 contains $261 \times X$ octets of data, including the POH header. See table 7 for VC-4 and VC-4-Xc mapping characteristics.

Table 7: SDH VC-3, VC-4 and VC-4-Xc mapping characteristics

Path layer	VC-3	VC-4	VC-4-4c	VC-4-16c	VC-4-64c	VC-4-256c
Octets per line	87	261	1 044	4 176	16 704	66 816
Lines	9	9	9	9	9	9
Octets per frame	783	2 349	9 396	37 584	150 336	601 344
Bitrate (Mb/s or Gb/s)	50,112	150,336	601,344	2,405376	9,621504	38,486016
Sections	1	1	4	16	64	256
Octets per section	783	2 349	2 349	2 349	2 349	2 349
Data Slots per section	98	294	294	294	294	294
PS slots per section	1	1	1	1	1	1
Total slots per section	99	295	295	295	295	295
Total section slots per frame	99	295	1 180	4 720	18 880	75 520
Frequency Justification slots	1	1	1	1	1	1
Total slot count	100	296	1 181	4 721	18 881	75 521

6.1 DCAP-0 slot elements

The DCAP-0 elements of 64 bit data slot, Idle-marker, Performance Supervision-marker (PS-marker), AIS-marker are described in [ES803-2-3]. The lines with POH-header and payload are transported in one or more sections holding a complete VC-4 frame.

Each section is prefixed by a PS-marker, holding the channel end-to-end performance supervision, and also acting as a section delimiter. The justification is performed by prefixing 2, 1 or 0 Idle markers before the first section and its PS-marker, thus giving one justification point on each VC-4 frame.

NOTE: The PS-marker of the first section shall include the correct idle marker count of the frequency justification opportunity that just occurred. This is a direct consequence of the DCAP-0 definitions. Similarly, PS-markers for other sections should have zero as their idle marker count values.

6.2 Data slot mapping

The 2349 octets of each section are divided into one section beginning slot and 293 section data slots. The section data slot holds 8 octets of data while the section beginning slot holds 5 data octets and 3 non-data octets. The non-data octets of the section-beginning slot is used to identify which of the section beginning slots that holds the J1 octet of the transported VC-4. The sections are thus synchronous to the transported VC-4.

6.2.1 Section beginning

The section beginning slots have 3 non-data octets (bit 63 down to 40). One octet is used for identifying the initial segment. The initial segment is encoded as the bit-string 01010101 (bit 63 down to bit 56) and the other segments (if transmitted, i.e. if X > 1) is encoded as the bitstring 00101010 (bit 63 down to bit 56). The lower 7 bits (bit 62 down to bit 56) of the octet is those used to transport an alternating bit pattern such that majority decisions can be performed. Thus, if 4 or more bits indicate initial segment, then is the initial segment pattern detected, else it is not detected. The highest bit (bit 63) of the initial segment identifier octet is reserved, it shall be set to 0 by the transmitter and shall not be interpreted by the receiver.

The 2 unused non-data octets (bit 55 down to 40) are reserved. All bits shall be set to 0 by the transmitting end, and the receiver shall not interpret these octets.

In total is 17 bits reserved and should not be interpreted. The checksum shall however be calculated regardless of the use, i.e. no special measures are required to hide the reserved bits from the checksum calculation.

The 5 data octets (bit 39 down to 0) hold data octets from the VC-4-Xc datastream. If the section beginning is the initial section beginning, the J1 octet of the POH header shall be found in bit 39 down to bit 32 and bit 31 down to bit 0 shall hold the 4 octets immediately after J1 according to normal SDH multiplexing rules [EN417-3-1].

A frame synchronization state machine continuously monitors the initial segment frame pattern. 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 sections, being one frame apart (i.e. X sections) 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 in the expected segment for a total of 5 frames, the state machine shall enter the Out Of Frame state.

6.2.2 Section data

In a section data slot shall bit 63 down to bit 0 hold the next 8 octets of the VC-4 octet stream, beginning with the first octet mapped into bit 63 down to bit 56, and then octet per octet until bit 7 down to 0 have been mapped.

6.3 VC-4 mapping

The VC-4 and VC-4-Xc (including the "fixed stuff" of the POH of column 2 to X) will be converted into X sections, each holding 2349 octets. The first section for each VC-4 frame will start on the J1 octet (column 1), followed by the octets in normal SDH multiplex order. The section containing the J1 will be marked with a frame marker.

7 Mapping of SDH VC-3 over DTM

The SDH VC-3 [EN417-3-1] is mapped onto the DTM DCAP-0 [ES803-2-3] format, providing means to transport the VC-3 data, VC-3 frame alignment, SSF and providing performance supervision. Each of the 9 rows of the VC3 contains 87 octets of data, including the POH header. See table 7 for VC-3 mapping characteristics.

7.1 DCAP-0 slot elements

The DCAP-0 elements of 64 bit data slot, Idle-marker, Performance Supervision-marker, AIS-marker are described in [ES803-2-3]. The lines with POH-header and payload are transported in one section holding a complete VC-3 frame.

Each section is prefixed by a PS-marker, holding the channel end-to-end performance supervision, and also acting as a section delimiter. The justification is performed by prefixing 2, 1 or 0 Idle markers before the section and its PS-marker, thus giving one justification point on each VC-3 frame.

NOTE: The PS-marker of the first section shall include the correct idle marker count of the frequency justification opportunity that just occurred. This is a direct consequence of the DCAP-0 definitions. Similarly, PS-markers for other sections should have zero as their idle marker count values.

7.2 Data slot mapping

The 783 octets of each section are divided into one section beginning slot and 97 section data slots. The section data slot holds 8 octets of data while the section beginning slot holds 7 data octets and 1 non-data octet. The non-data octet of the section-beginning slot is used to identify which of the section beginning slots that holds the J1 octet of the transported VC-3. The section is thus synchronous to the transported VC-3.

7.2.1 Section beginning

The section beginning slots have 1 non-data octet (bit 63 down to 56). One octet is used for identifying the initial segment. The initial segment is encoded as the bit-string 01010101 (bit 63 down to bit 56). The lower 7 bits (bit 62 down to bit 56) of the octet is those used to transport an alternating bit pattern such that majority decisions can be performed. Thus, if 4 or more bits indicate initial segment, then is the initial segment pattern detected, else it is not detected. The highest bit (bit 63) of the initial segment identifier octet is reserved, it shall be set to 0 by the transmitter and shall not be interpreted by the receiver.

In total is 1 bits reserved and should not be interpreted. The checksum shall however be calculated regardless of the use, i.e. no special measures are required to hide the reserved bits from the checksum calculation.

The 7 data octets (bit 55 down to 0) hold data octets from the VC-3 datastream. If the section beginning is the initial section beginning, the J1 octet of the POH header shall be found in bit 55 down to bit 48 and bit 47 down to bit 0 shall hold the 6 octets immediately after J1 according to normal SDH multiplexing rules [EN417-3-1].

A frame synchronization state machine continuously monitors the initial segment frame pattern. 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 sections, being one frame apart (i.e. X sections) 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 in the expected segment for a total of 5 frames, the state machine shall enter the Out Of Frame state.

7.2.2 Section data

In a section data slot shall bit 63 down to bit 0 hold the next 8 octets of the VC-3 octet stream, beginning with the first octet mapped into bit 63 down to bit 56, and then octet per octet until bit 7 down to 0 have been mapped.

7.3 VC-3 mapping

The VC-3 will be converted into 1 section, each holding 783 octets. The first section for each VC-3 frame will start on the J1 octet (column 1), followed by the octets in normal SDH multiplex order. The section containing the J1 will be marked with a frame marker.

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