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Transmission and Multiplexing (TM); Generic functional requirements for Synchronous Digital Hierarchy (SDH) transmission equipment; Part 2-1: Physical section layer functions

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Foreword

This draft European Telecommunication Standard (ETS) has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

This ETS has been produced in order to provide inter-vendor and inter-operator compatibility for Synchronous Digital Hierarchy (SDH) equipment.

This ETS consists of 8 parts as follows:

Part 1: "Generic processes and performance" (ETS 300 417-1-1 [1]).
Part 2: "Physical section layer functions" (DE/TM-01015-2-1).
Part 3: "STM-N regenerator and multiplex section layer functions" (DE/TM-01015-3-1).
Part 4: "SDH path layer functions" (DE/TM-01015-4-1).
Part 5: "PDH path layer functions" (DE/TM-01015-5-1).
Part 6: "Synchronization distribution layer functions" (DE/TM-01015-6-1).
Part 7: "Auxiliary layer functions" (DE/TM-01015-7-1).
Part 8: "Compound and major compound functions" (DE/TM-01015-8-1).

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This ETS specifies a library of basic building blocks and a set of rules by which they are combined in order to describe a digital transmission equipment. The library comprises the functional building blocks needed to completely specify the generic functional structure of the European digital transmission hierarchy. Equipment which is compliant with this ETS needs to be describable as an interconnection of a subset of these functional blocks contained within this ETS. The interconnections of these blocks need to obey the combination rules given. The generic functionality is described in the ETS 300 417-1-1 [1].

2 Normative references

This ETS incorporates by dated or undated reference, 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 amendments or revisions. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 417-1-1 (1996): "Transmission and Multiplexing (TM); Generic functional requirements for Synchronous Digital Hierarchy (SDH) equipment; Part 1-1: Generic processes and performance".

[2] ETS 300 337 (1995): "Transmission and Multiplexing (TM); Generic frame structures for the transport of various signals (including Asynchronous Transfer Mode (ATM) cells and Synchronous Digital Hierarchy (SDH) elements) at the CCITT Recommendation G.702 hierachical rates of 2 048 kbit/s, 34 368 kbit/s and 139 264 kbit/s".

[3] ETS 300 167 (1993): "Transmission and Multiplexing (TM); Functional characteristics of 2 048 kbit/s interfaces".

[4] ETS 300 147 (1995): "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) Multiplexing structure".

[5] ETS 300 166 (1993): "Transmission and Multiplexing (TM); Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2048 kbit/s - based plesiochronous or synchronous digital hierarchies".

[6] ETS 300 232 (1993): "Transmission and Multiplexing (TM); Optical interfaces for equipments and systems relating to the Synchronous Digital Hierarchy [ITU-T Recommendation G.957 (1993) modified]".

[7] ITU-T Recommendation G.751 (1988): "Digital multiplex equipments operating at the third order bit rate of 34 368 kbit/s and the fourth order bit rate of 139 264 kbit/s and using positive justification".

[8] ITU-T Recommendation G.742 (1988): "Second order digital multiplex equipment operating at 8448 kbit/s and using positive justification".

[9] ITU-T Recommendation G.823 (1993): "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[10] ITU-T Recommendation G.775 (1994): "Loss of signal (LOS) and alarm indication signal (AIS) defect detection and clerance criteria".

[11] ITU-T Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".

[12] ITU-T Recommendation V.11 (1993): "Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s".

[13] ANSI T1.102 (1993): "Telecommunications - Digital Hierarchy - Electrical Interfaces".

[14] ANSI T1.107 (1988): "Telecommunications - Digital Hierarchy - Formats Specifications".

[15] ITU-T Recommendation G.825 (1993): "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".

[16] prETS 300 462-3: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 3: The control of jitter and wander within synchronization networks".

3 Definitions, abbreviations and symbols

3.1 Definitions

The functional definitions are described in ETS 300 417-1-1 [1].

3.2 Abbreviations

ANSI	American National Standards Institute
ETS	European Telecommunications Standard
ETSI	European Telecommunications Standards Institute
ITU-T	International Telecommunications Union- Telecommunications Sector
NNI	Network to Network Interface
PDH	Plesiochronous Digital Hierarchy
SDH	Synchronous Digital Hierarchy
UNI	User to Network Interface

3.3 Symbols and diagrammatic conventions

The symbols and diagrammatic conventions are described in ETS 300 417-1-1 [1].

3.4 Introduction

The atomic functions defining the physical interface section layers are described below. They describe the physical and logical characteristics of the optical and electrical interfaces used in SDH equipments also with their adaptation functionality of PDH multiplex equipments described in the ITU-T Recommendations G.751 [7] and G.742 [8] for signal hierarchies P4, P31 and P22, and adaptation functionality for SDH over PDH specified by ETS 300 337 [2] for signal hierarchies P4s and P31s and ETS 300 167 [3] for P12s layer signals.

The physical interface layers are defined for each of the synchronous and plesiochronous rates as defined in ETS 300 147 [4] and ETS 300 166 [5]. References to the signal structure are mentioned in the appropriate text sections.

4 STM-1 Optical Section Layer Functions

NOTE: Xy.z will be one value out of the set: {I1, S1.1, S1.2, L1.1, L1.2, L1.3}.

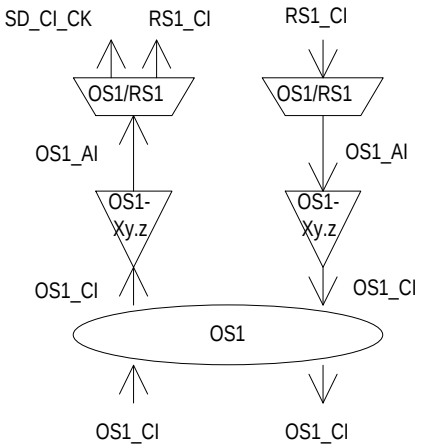


Figure 1: STM-1 Optical Section atomic functions

STM-1 Optical Section Layer CP.

Characteristic Information OS1_CI of the optical layer CP (figure 2) is a digital, optical signal of defined power, bit rate, pulse width and wavelength. A range of such characteristic signals for different optical power budgets is defined in ETS 300 232 [6].

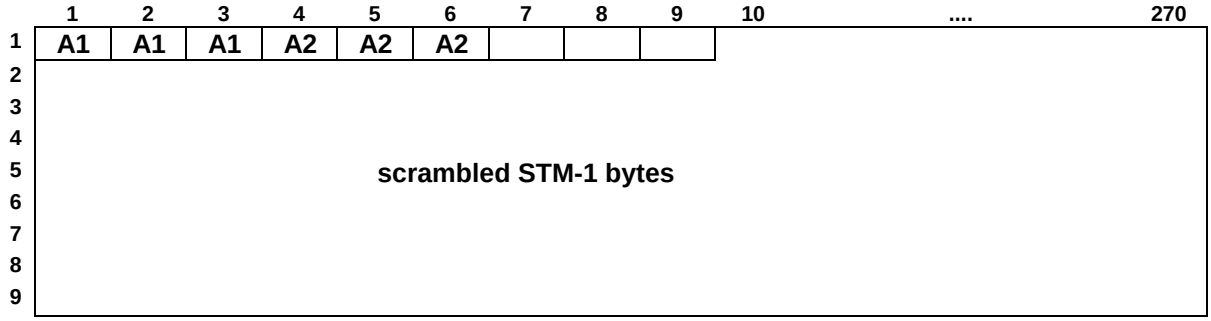


Figure 2: OS1 characteristic information OS1_CI (optical) and adapted information OS1_AI (electrical)

STM-1 Optical Section Layer AP.

The information passing across the OS1 AP takes the form of a scrambled, digital bitstream (including a block frame character at 125 µs intervals) with co-directional bit timing (figure 2). Frame characters and the synchronous, scrambling polynomial are defined in ETS 300 147 [4].

4.1 Optical Section Connection functions

For further study.

4.2 Optical Section Trail Termination functions

4.2.1 Optical Section Trail Termination Source OS1-Xy.z_TT_So

NOTE 1: Xy.z will be one value out of the set: {I1, S1.1, S1.2, L1.1, L1.2, L1.3}.

Symbol:

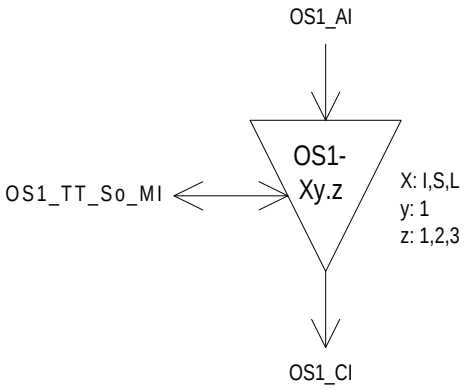


Figure 3: OS1-Xy.z_TT_So symbol

Interfaces:

Table 1: OS1-Xy.z_TT_So input and output signals

Input(s)	Output(s)
OS1_AI_D	OS1_CI_D OS1_TT_So_MI_cTD OS1_TT_So_MI_cTF

Processes:

This function forms the optical STM-1 signal for transmission over the optical cable as defined in ETS 300 232 [6].

Optical characteristics: The function shall generate an optical STM-1 signal that meets the Xy.z characteristics defined in ETS 300 232 [6].

Defects:

dTD, dTF:

NOTE 2: Degraded signal implies that the output although still operational has fallen below some threshold of acceptability which requires maintenance intervention. The definition of the acceptability will in general be specific to a particular design or maintenance philosophy and is not defined in this standard.

Consequent Actions: None.

Defect Correlations:

cTF ← dTF

cTD ← dTD and (not dTF)

Performance Monitoring: None.

4.2.2 Optical Section Trail Termination Sink OS1-Xy.z_TT_Sk

NOTE: Xy.z will be one value out of the set: {I1, S1.1, S1.2, L1.1, L1.2, L1.3}.

Symbol:

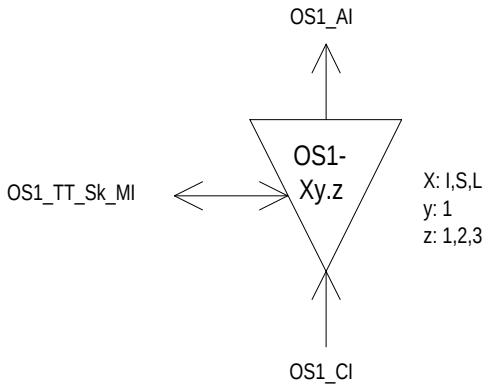


Figure 4: OS1-Xy.z_TT_Sk symbol

Interfaces:

Table 2: OS1-Xy.z_TT_Sk input and output signals

Input(s)	Output(s)
OS1_CI_D	OS1_AI_D
	OS1_AI_TSF
	OS1_TT_Sk_MI_cLOS
OS1_TT_Sk_MI_PortMode	

Processes:

This function recovers the optical STM-1 signal transmitted over the optical cables. The physical characteristics of the interface signal are defined in ETS 300 232 [6].

The function shall convert the received STM-1 signal, normally complying to the Xy.z characteristics defined in ETS 300 232 [6], into the internal OS1_AI signal.

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the optical STM-1 dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

4.3 Optical Section Adaptation functions

4.3.1 Optical Section to Regenerator Section Adaptation Source OS1/RS1_A_So

Symbol:

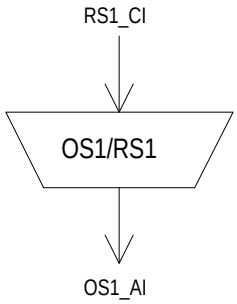


Figure 5: OS1/RS1_A_So symbol

Interfaces:

Table 3: OS1/RS1_A_So input and output signals

Input(s)	Output(s)
RS1_CI_D RS1_CI_CK	OS1_AI_D

Processes:

NOTE: The insertion of the frame alignment signal (A1A2) and the scrambling of the signal would be OS1/RS1_A_So processes according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-N signal causes to violate this process allocation, and locate the scrambling and frame alignment signal insertion processes in the RS1_TT_So.

The function shall process the signal such that in the absence of input jitter at the synchronisation interface, the intrinsic jitter at the STM-1 output interface as measured over a 60 seconds interval shall not exceed:

- 0,5 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 500 Hz and 1,3 MHz;

- 0,1 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 65 kHz and 1,3 MHz.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

4.3.2 Optical Section to Regenerator Section Adaptation Sink OS1/RS1_A_Sk

Symbol:

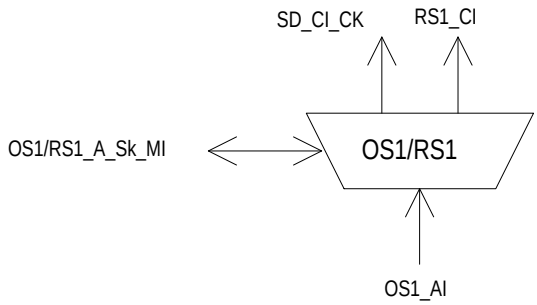


Figure 6: OS1/RS1_A_Sk symbol

Interfaces:

Table 4: OS1/RS1_A_Sk input and output signals

Input(s)	Output(s)
OS1_AI_D	RS1_CI_D
OS1_AI_TSF	RS1_CI_CK
	RS1_CI_FS
	RS1_CI_SSF
	SD_CI_CK
	OS1/RS1_A_Sk_MI_cLOF
	OS1/RS1_A_Sk_MI_pOFS

Processes:

This function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal. It supplies the recovered timing signal to the synchronisation distribution layer.

NOTE 1: The descrambling of the signal would be an OS1/RS1_A_Sk process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-1 signal causes to violate this process allocation, and locate the descrambling process in the RS1_TT_Sk.

Regeneration: The function shall operate with a maximum BER as specified in ETS 300 417-1-1 [1], subclause 11.3.2.1 when any combination of the following signal conditions exist at the input:

- Any input optical power level within the range specified in ETS 300 232 [6].
- Jitter modulation applied to the input signal as specified in ETS 300 417-1-1 [1], subclause 11.3.2.1.
- The input signal bit rate has any value in the range 155 520 kbit/s $\pm$ 20 ppm.

NOTE 2: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Frame alignment: The frame alignment shall be found by searching for the A1, A2 bytes contained in the STM-1 signal. The framing pattern searched for may be a subset of the A1 and A2 bytes contained on the STM-1 signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment. If in the In-Frame state (IF), the maximum Out-Of-Frame (OOF) detection time shall be 625 µs for a random unframed signal. The algorithm used to check the alignment shall be such that, under normal conditions, a 10^{-3} (Poisson type) error ratio will not cause a false OOF more then once per 6 minutes. If in the OOF state, the maximum frame alignment time shall be 250 µs for an error-free signal with no emulated framing patterns. The algorithm used to recover from the OOF state shall be such , that the probability for false frame recovery with a random unframed signal shall be no more than 10^{-5} per 250 µs time interval.

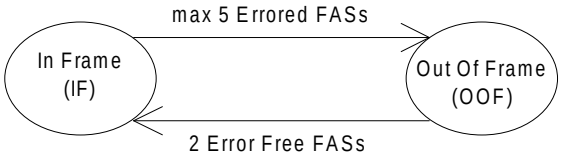
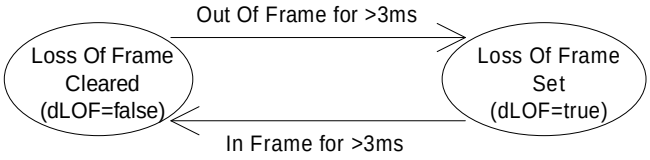


Figure 7: Frame alignment process

The frame start signal (RS1_CI_FS) shall be maintained during the OOF state and only updated upon successful transition form OOF to the IF state.

Defects:

If the OOF anomaly persists for 3 ms, a STM-1 Loss Of Frame defect (dLOF) shall be detected. To provide for the case of intermittent OOFs, the integrating timer shall not be reset to zero until an IF condition persists continuously for 3 ms. The dLOF defect shall be cleared when the IF state persists continuously for 3 ms.



NOTE: Out-Of-Frame integrating timer is not reset to zero until an In-Frame condition persists continuously for 3 ms.

Figure 8: Loss of frame process

Consequent Actions:

aAIS ← dLOF

aSSF ← dLOF

On declaration of an aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cLOF ← dLOF and (not AI_TSF)

Performance Monitoring:

Any second with at least one OOF event shall be reported as an pOFS (Out of Frame Second).

5 STM-4 Optical Section Layer Functions

NOTE: Xy.z will be one value out of the set: {I4, S4.1, S4.2, L4.1, L4.2, L4.3}.

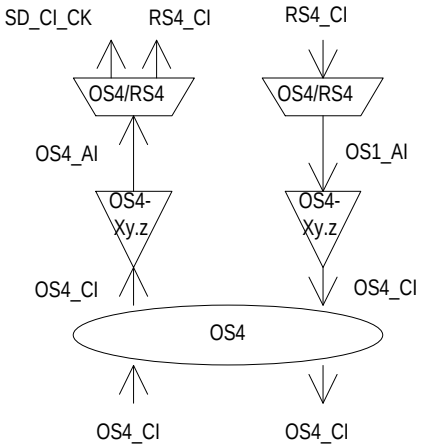


Figure 9: STM-4 Optical Section atomic functions

STM-4 Optical Section Layer CP.

Characteristic Information OS4_CI of the optical layer CP (figure 10) is a digital, optical signal of defined power, bit rate, pulse width and wavelength. A range of such characteristic signals for different optical power budgets is defined in ETS 300 232 [6].

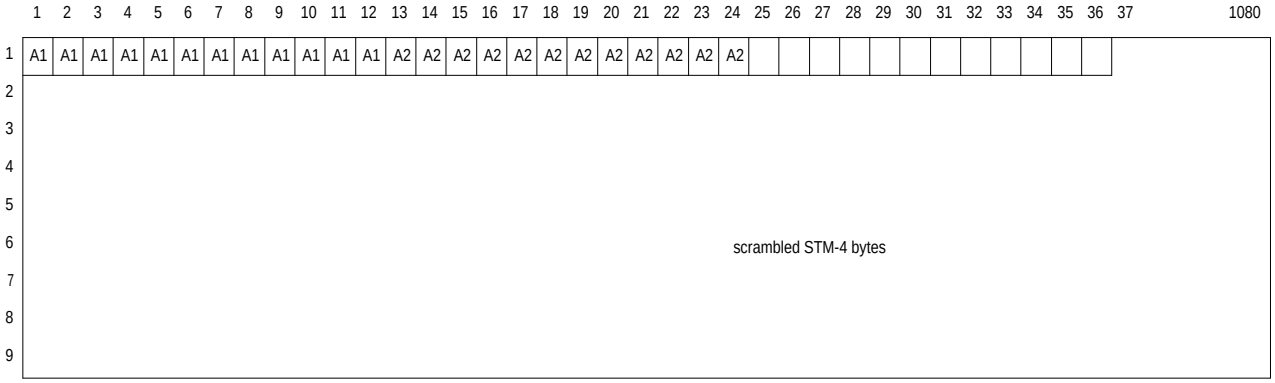


Figure 10: OS4 characteristic information OS4_CI (optical) and adapted information OS4_AI (electrical)

STM-4 Optical Section Layer AP.

The information passing across the OS4 AP takes the form of a scrambled, digital bitstream (including a block frame character at 125 µs intervals) with co-directional bit timing (figure 10). Frame characters and the synchronous, scrambling polynomial are defined in ETS 300 147 [4].

5.1 Optical Section Connection functions

For further study.

5.2 Optical Section Trail Termination functions

5.2.1 Optical Section Trail Termination Source OS4-Xy.z_TT_So

NOTE 1: Xy.z will be one value out of the set: {I4, S4.1, S4.2, L4.1, L4.2, L4.3}.

Symbol:

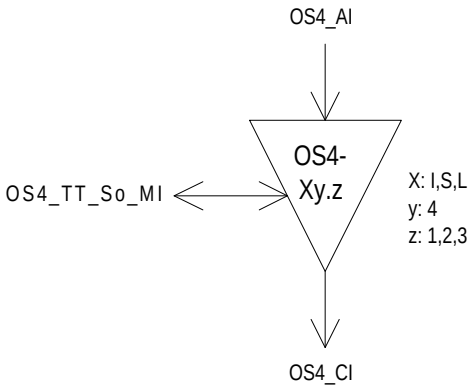


Figure 11: OS4-Xy.z_TT_So symbol

Interfaces:

Table 5: OS4-Xy.z_TT_So input and output signals

Input(s)	Output(s)
OS4_AI_D	OS4_CI_D OS4_TT_So_MI_cTD OS4_TT_So_MI_cTF

Processes:

This function forms the optical STM-4 signal for transmission over the optical cable as defined in ETS 300 232 [6].

Optical characteristics: The function shall generate an optical STM-4 signal that meets the Xy.z characteristics defined in ETS 300 232 [6].

Defects:

dTD, dTF:

NOTE 2: Degraded signal implies that the output although still operational has fallen below some threshold of acceptability which requires maintenance intervention. The definition of the acceptability will in general be specific to a particular design or maintenance philosophy and is not defined in this standard.

Consequent Actions: None.

Defect Correlations:

cTF ← dTF

cTD ← dTD and (not dTF)

Performance Monitoring: None.

5.2.2 Optical Section Trail Termination Sink OS4-Xy.z_TT_Sk

NOTE: Xy.z will be one value out of the set: {I4, S4.1, S4.2, L4.1, L4.2, L4.3}.

Symbol:

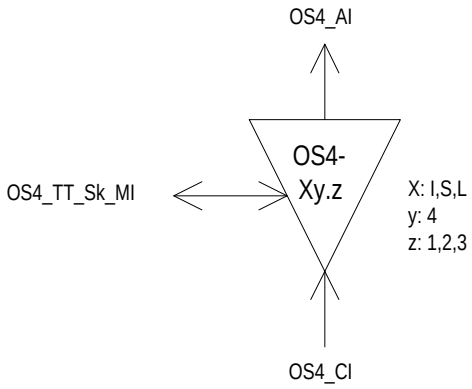


Figure 12: OS4-Xy.z_TT_Sk symbol

Interfaces:

Table 6: OS4-Xy.z_TT_Sk input and output signals

Input(s)	Output(s)
OS4_CI_D	OS4_AI_D
	OS4_AI_TSF
OS4_TT_Sk_MI_PortMode	OS4_TT_Sk_MI_cLOS

Processes:

This function recovers the optical STM-4 signal transmitted over the optical cables. The physical characteristics of the interface signal are defined in ETS 300 232 [6].

The function shall convert the received STM-4 signal, normally complying to the Xy.z characteristics defined in ETS 300 232 [6], into the internal OS4_AI signal.

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the optical STM-4 dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

5.3 Optical Section Adaptation functions

5.3.1 Optical Section to Regenerator Section Adaptation Source OS4/RS4_A_So

Symbol:

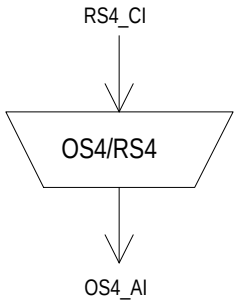


Figure 13: OS4/RS4_A_So symbol

Interfaces:

Table 7: OS4/RS4_A_So input and output signals

Input(s)	Output(s)
RS4_CI_D RS4_CI_CK	OS4_AI_D

Processes:

NOTE: The insertion of the frame alignment signal (A1A2) and the scrambling of the signal would be OS4/RS4_A_So processes according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-N signal causes to violate this process allocation, and locate the scrambling and frame alignment signal insertion processes in the RS4_TT_So.

The function shall process the signal such that in the absence of input jitter at the synchronisation interface, the intrinsic jitter at the STM-4 output interface as measured over a 60 seconds interval shall not exceed:

- 0,5 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 1 000 Hz and 5 MHz;

- 0,1 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 250 kHz and 5 MHz.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

5.3.2 Optical Section to Regenerator Section Adaptation Sink OS4/RS4_A_Sk

Symbol:

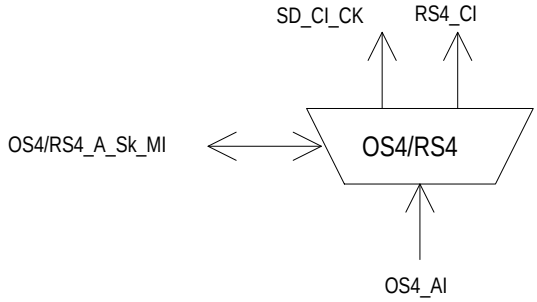


Figure 14: OS4/RS4_A_Sk symbol

Interfaces:

Table 8: OS4/RS4_A_Sk input and output signals

Input(s)	Output(s)
OS4_AI_D	RS4_CI_D
OS4_AI_TSF	RS4_CI_CK
	RS4_CI_FS
	RS4_CI_SSF
	SD_CI_CK
	OS4/RS4_A_Sk_MI_cLOF
	OS4/RS4_A_Sk_MI_pOFS

Processes:

This function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal. It supplies the recovered timing signal to the synchronisation distribution layer.

NOTE 1: The descrambling of the signal would be an OS4/RS4_A_Sk process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-4 signal causes to violate this process allocation, and locate the descrambling process in the RS4_TT_Sk.

Regeneration: The function shall operate with a maximum BER as specified in ETS 300 417-1-1 [1], subclause 11.3.2.1 when any combination of the following signal conditions exist at the input:

- Any input optical power level within the range specified in ETS 300 232 [6].
- Jitter modulation applied to the input signals specified in ETS 300 417-1-1 [1], subclause 11.3.2.1.
- The input signal bit rate has any value in the range 622 080 kbit/s ± 20 ppm.

NOTE 2: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Frame alignment: The frame alignment shall be found by searching for the A1, A2 bytes contained in the STM-4 signal. The framing pattern searched for may be a subset of the A1 and A2 bytes contained on the STM-4 signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment. If in the In-Frame state (IF), the maximum Out-Of-Frame (OOF) detection time shall be 625 µs for a random unframed signal. The algorithm used to check the alignment shall be such that, under normal conditions, a 10^{-3} (Poisson type) error ratio will not cause a false OOF more then once per 6 minutes. If in the OOF state, the maximum frame alignment time shall be 250 µs for an error-free signal with no emulated framing patterns. The algorithm used to recover from the OOF state shall be such , that the probability for false frame recovery with a random unframed signal shall be no more than 10^{-5} per 250 µs time interval.

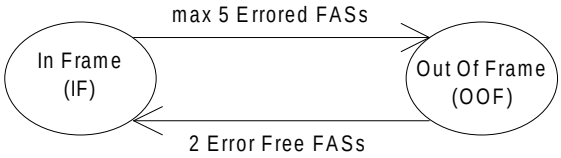
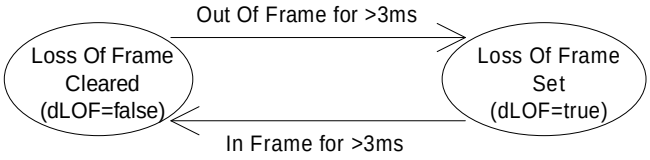


Figure 15: Frame alignment process

The frame start signal (RS4_CI_FS) shall be maintained during the OOF state and only updated upon successful transition form OOF to the IF state.

Defects:

If the OOF anomaly persists for 3 ms, a STM-4 Loss Of Frame defect (dLOF) shall be detected. To provide for the case of intermittent OOFs, the integrating timer shall not be reset to zero until an IF condition persists continuously for 3 ms. The dLOF defect shall be cleared when the IF state persists continuously for 3 ms.



NOTE: Out-Of-Frame integrating timer is not reset to zero until an In-Frame condition persists continuously for 3 ms.

Figure 16: Loss of frame process

Consequent Actions:

aAIS ← dLOF

aSSF ← dLOF

On declaration of an aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cLOF ← dLOF and (not AI_TSF)

Performance Monitoring:

Any second with at least one OOF event shall be reported as an pOFS (Out of Frame Second).

6 STM-16 Optical Section Layer Functions

NOTE: Xy.z will be one value out of the set: {I16, S16.1, S16.2, L16.1, L16.2, L16.3}.

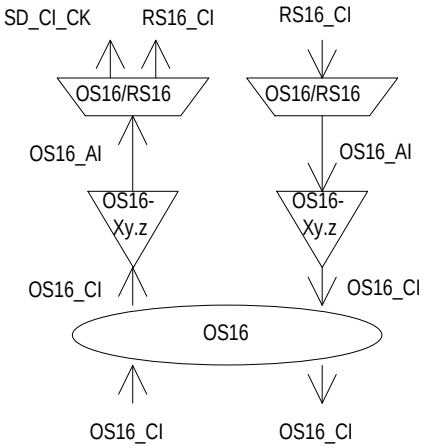


Figure 17: STM-16 Optical Section atomic functions

STM-16 Optical Section Layer CP.

Characteristic Information OS16_CI of the optical layer CP (figure 18) is a digital, optical signal of defined power, bit rate, pulse width and wavelength. A range of such characteristic signals for different optical power budgets is defined in ETS 300 232 [6].

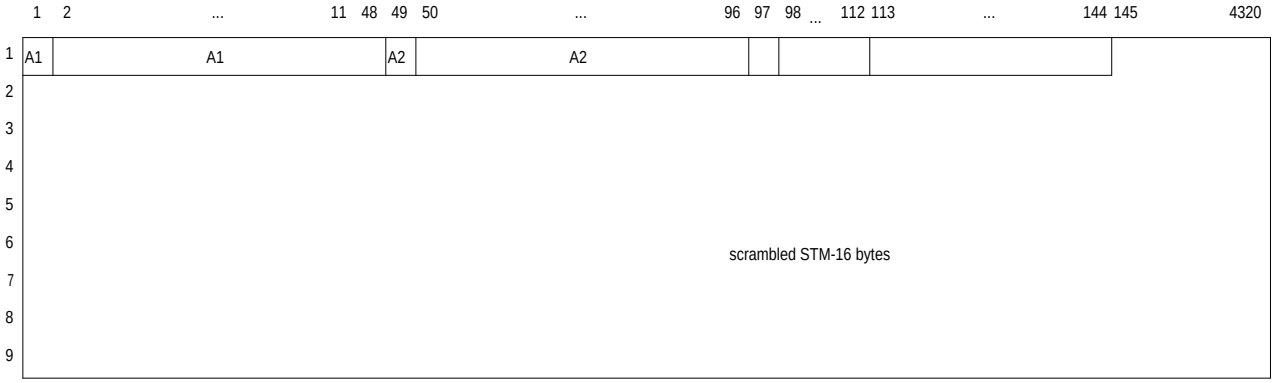


Figure 18: OS16 characteristic information OS16_CI (optical) and adapted information OS16_AI (electrical)

STM-16 Optical Section Layer AP.

The information passing across the OS16 AP takes the form of a scrambled, digital bitstream (including a block frame character at 125 µs intervals) with co-directional bit timing (figure 18). Frame characters and the synchronous, scrambling polynomial are defined in ETS 300 147 [4].

6.1 Optical Section Connection functions

For further study.

6.2 Optical Section Trail Termination functions

6.2.1 Optical Section Trail Termination Source OS16-Xy.z_TT_So

NOTE 1: Xy.z will be one value out of the set: {I16, S16.1, S16.2, L16.1, L16.2, L16.3}.

Symbol:

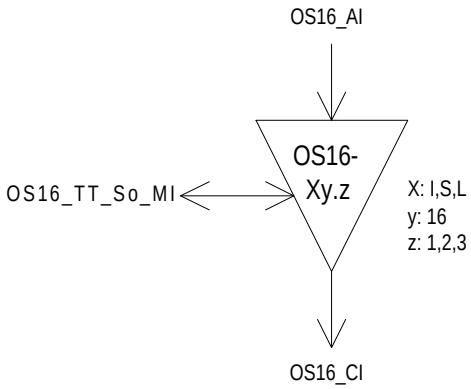


Figure 19: OS16-Xy.z_TT_So symbol

Interfaces:

Table 9: OS16_TT_So input and output signals

Input(s)	Output(s)
OS16_AI_D	OS16_CI_D OS16_TT_So_MI_cTD OS16_TT_So_MI_cTF

Processes:

This function forms the optical STM-16 signal for transmission over the optical cable as defined in ETS 300 232 [6].

Optical characteristics: The function shall generate an optical STM-16 signal that meets the Xy.z characteristics defined in ETS 300 232 [6].

Defects:

dTD, dTF:

NOTE 2: Degraded signal implies that the output although still operational has fallen below some threshold of acceptability which requires maintenance intervention. The definition of the acceptability will in general be specific to a particular design or maintenance philosophy and is not defined in this standard.

Consequent Actions: None.

Defect Correlations:

cTF ← dTF

cTD ← dTD and (not dTF)

Performance Monitoring: None.

6.2.2 Optical Section Trail Termination Sink OS16-Xy.z_TT_Sk

NOTE: Xy.z will be one value out of the set: {I16, S16.1, S16.2, L16.1, L16.2, L16.3}.

Symbol:

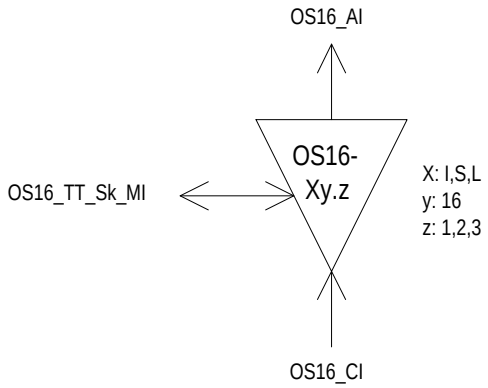


Figure 20: OS16-Xy.z_TT_Sk symbol

Interfaces:

Table 10: OS16_TT_Sk input and output signals

Input(s)	Output(s)
OS16_CI_D	OS16_AI_D
	OS16_AI_TSF
OS16_TT_Sk_MI_PortMode	OS16_TT_Sk_MI_cLOS

Processes:

This function recovers the optical STM-16 signal transmitted over the optical cables. The physical characteristics of the interface signal are defined in ETS 300 232 [6].

The function shall convert the received STM-16 signal, normally complying to the Xy.z characteristics defined in ETS 300 232 [6], into the internal OS16_AI signal.

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the optical STM-16 dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

6.3 Optical Section Adaptation functions

6.3.1 Optical Section to Regenerator Section Adaptation Source OS16/RS16_A_So

Symbol:

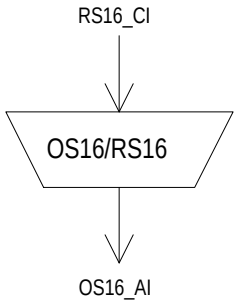


Figure 21: OS16/RS16_A_So symbol

Interfaces:

Table 11: OS16/RS16_A_So input and output signals

Input(s)	Output(s)
RS16_CI_D RS16_CI_CK	OS16_AI_D

Processes:

NOTE: The insertion of the frame alignment signal (A1A2) and the scrambling of the signal would be OS16/RS16_A_So processes according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-N signal causes to violate this process allocation, and locate the scrambling and frame alignment signal insertion processes in the RS16_TT_So.

The function shall process the signal such that in the absence of input jitter at the synchronisation interface, the intrinsic jitter at the STM-16 output interface as measured over a 60 seconds interval shall not exceed:

- 0,5 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 5000 Hz and 20 MHz;

- 0,1 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 1 MHz and 20 MHz.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

6.3.2 Optical Section to Regenerator Section Adaptation Sink OS16/RS16_A_Sk

Symbol:

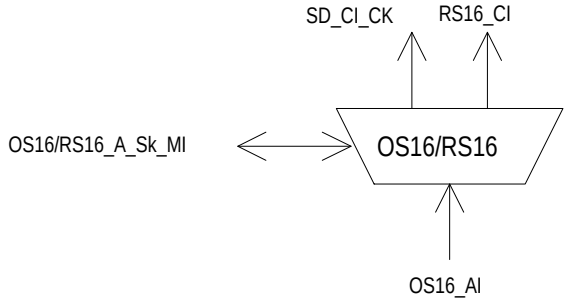


Figure 22: OS16/RS16_A_Sk symbol

Interfaces:

Table 12: OS16/RS16_A_Sk input and output signals

Input(s)	Output(s)
OS16_AI_D	RS16_CI_D
OS16_AI_TSF	RS16_CI_CK
	RS16_CI_FS
	RS16_CI_SSF
	SD_CI_CK
	OS16/RS16_A_Sk_MI_cLOF
	OS16/RS16_A_Sk_MI_pOFS

Processes:

This function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal. It supplies the recovered timing signal to the synchronisation distribution layer.

NOTE 1: The descrambling of the signal would be an OS16/RS16_A_Sk process according clause 5 of ETS 300 417-1-1 [1]. The (historical) definition of the STM-N signal causes to violate this process allocation, and locate the descrambling process in the RS16_TT_Sk.

Regeneration: The function shall operate with a maximum BER as specified in ETS 300 417-1-1 [1], subclause 11.3.2.1 when any combination of the following signal conditions exist at the input:

- Any input optical power level within the range specified in ETS 300 232 [6].
- Jitter modulation applied to the input signal as specified in ETS 300 417-1-1 [1], subclause 11.3.2.1.
- The input signal bit rate has any value in the range 2 488 320 kbit/s ± 20 ppm.

NOTE 2: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Frame alignment: The frame alignment shall be found by searching for the A1, A2 bytes contained in the STM-16 signal. The framing pattern searched for may be a subset of the A1 and A2 bytes contained on the STM-16 signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment. If in the In-Frame state (IF), the maximum Out-Of-Frame (OOF) detection time shall be 625 µs for a random unframed signal. The algorithm used to check the alignment shall be such that, under normal conditions, a 10^{-3} (Poisson type) error ratio will not cause a false OOF more then once per 6 minutes. If in the OOF state, the maximum frame alignment time shall be 250 µs for an error-free signal with no emulated framing patterns. The algorithm used to recover from the OOF state shall be such , that the probability for false frame recovery with a random unframed signal shall be no more than 10^{-5} per 250 µs time interval.

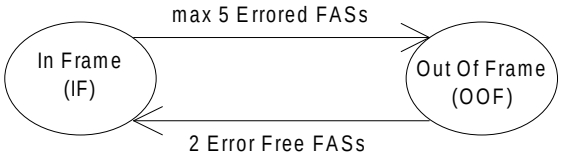
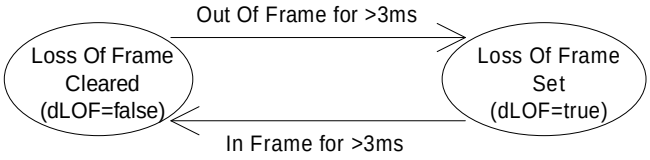


Figure 23: Frame alignment process

The frame start signal (RS16_CI_FS) shall be maintained during the OOF state and only updated upon successful transition form OOF to the IF state.

Defects:

If the OOF anomaly persists for 3 ms, a STM-16 Loss Of Frame defect (dLOF) shall be detected. To provide for the case of intermittent OOFs, the integrating timer shall not be reset to zero until an IF condition persists continuously for 3 ms. The dLOF defect shall be cleared when the IF state persists continuously for 3 ms.



NOTE: Out-Of-Frame integrating timer is not reset to zero until an In-Frame condition persists continuously for 3 ms.

Figure 24: Loss of frame process

Consequent Actions:

aAIS ← dLOF

aSSF ← dLOF

On declaration of an aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cLOF ← dLOF and (not AI_TSF)

Performance Monitoring:

Any second with at least one OOF event shall be reported as an pOFS (Out of Frame Second).

7 STM-64 Optical Section Layer Functions

For further study.

8 STM-1 Electrical Section Layer Functions

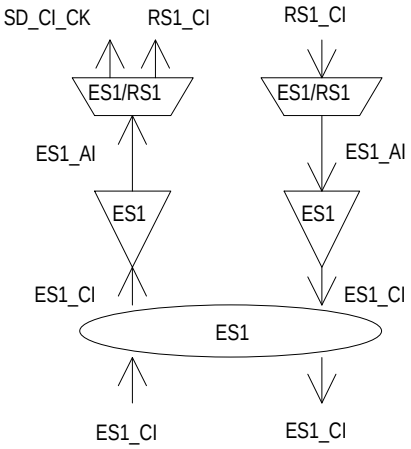


Figure 25: STM-1 Electrical Section atomic functions

STM-1 Electrical Section layer CP.

The Characteristic Information ES1_CI of the intra-station electrical STM-1 layer CP (figure 26) is a digital, CMI encoded, electrical signal of defined amplitude, bit rate and pulse shape as defined in ETS 300 166 [5].

NOTE: Characteristic information for a STM-1 UNI is for further study.

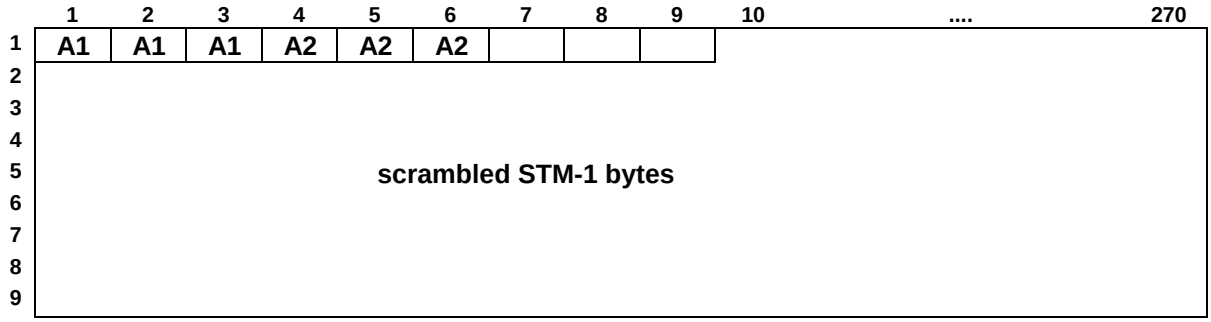


Figure 26: ES1 characteristic and adaptation information ES1_CI and ES1_AI

STM-1 Electrical Section layer AP.

The information passing across the STM-1 ES AP takes the form of a scrambled, digital bitstream (including a block frame character at 125 μs intervals) with co-directional bit timing (figure 26). Frame characters and the synchronous, scrambling polynomial is defined in ETS 300 147 [4].

8.1 STM-1 Electrical Section Connection function ES1_C

For further study.

8.2 STM-1 Electrical Section Trail Termination functions

8.2.1 STM-1 Electrical Section Trail Termination Source ES1_TT_So

Symbol:

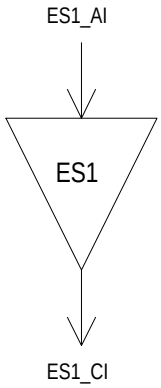


Figure 27: ES1_TT_So symbol

Interfaces:

Table 13: ES1_TT_So input and output signals

Input(s)	Output(s)
ES1_AI_D	ES1_CI_D

Processes:

This function generates the STM-1 electrical Intra-station Section Layer signal as specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Peak to peak voltage: The function shall meet the requirement specified by ETS 300 166 [5].

Rise time: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

8.2.2 STM-1 Electrical Section Trail Termination Sink ES1_TT_Sk

Symbol:

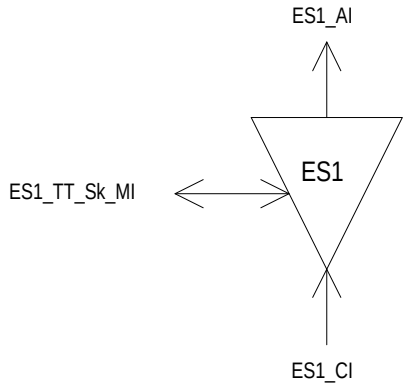


Figure 28: ES1-S1.1_TT_Sk symbol

Interfaces:

Table 14: ES1_TT_Sk input and output signals

Input(s)	Output(s)
ES1_CI_D	ES1_AI_D
	ES1_AI_TSF
	ES1_TT_Sk_MI_cLOS
ES1_TT_Sk_MI_PortMode	

Processes:

This function recovers the electrical STM-1 Intra-station Section Layer signal as defined in ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the electrical STM-1 dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

8.3 STM-1 Electrical Section Adaptation functions

8.3.1 STM-1 Electrical Section to Regenerator Section Adaptation Source ES1/RS1_A_So

Symbol:

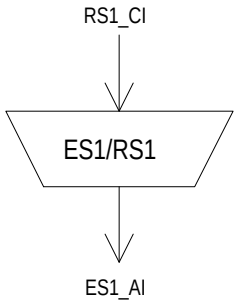


Figure 29: ES1/RS1_A_So symbol

Interfaces:

Table 15: ES1/RS1_A_So input and output signals

Input(s)	Output(s)
RS1_CI_D RS1_CI_CK	ES1_AI_D

Processes:

This function provides CMI encoding of the STM-1 signal.

NOTE: The insertion of the frame alignment signal (A1A2) and the scrambling of the signal would be ES1/RS1_A_So processes according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-1 signal causes to violate this process allocation, and locate the scrambling and frame alignment signal insertion processes in the RS1_TT_So.

CMI encoder: The function shall perform CMI encoding of the data specified by ETS 300 166 [5].

The function shall process the signal such that in the absence of input jitter at the synchronisation interface, the intrinsic jitter at the STM-1 output interface as measured over a 60 seconds interval shall not exceed:

- 0,05 UI peak-peak when measured through a single pole band-pass filter with corner frequencies at 500 kHz and 1,3 MHz.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

8.3.2 STM-1 Electrical Section to Regenerator Section Adaptation Sink ES1/RS1_A_Sk

Symbol:

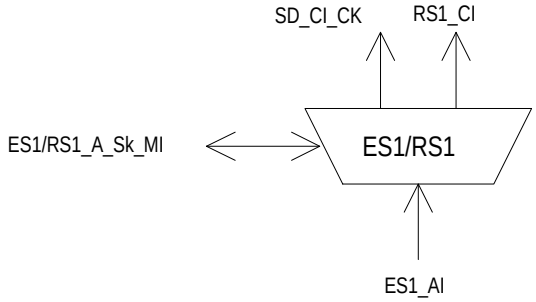


Figure 30: ES1/RS1_A_Sk symbol

Interfaces:

Table 16: ES1/RS1_A_Sk input and output signals

Input(s)	Output(s)
ES1_AI_D	RS1_CI_D
ES1_AI_TSF	RS1_CI_CK
	RS1_CI_FS
	RS1_CI_SSF
	SD_CI_CK
	ES1/RS1_A_Sk_MI_cLOF
	ES1/RS1_A_Sk_MI_pOFS

Processes:

This function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal, and decodes the incoming STM-1 signal. It supplies the recovered timing signal to the synchronisation distribution layer.

NOTE 1: The descrambling of the signal would be an ES1/RS1_A_Sk process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the STM-N signal causes to violate this process allocation, and locate the descrambling process in the RS1_TT_Sk.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.825 [15].
- The input signal bit rate has any value in the range 155 520 kbit/s ± 20 ppm.

NOTE 2: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

CMI decoding: The function shall perform the CMI decoding process specified by ETS 300 166 [5].

Frame alignment: The frame alignment shall be found by searching for the A1, A2 bytes contained in the STM-1 signal. The framing pattern searched for may be a subset of the A1 and A2 bytes contained on the STM-1 signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment. If in the In-Frame state (IF), the maximum Out-Of-Frame (OOF) detection time shall be 625 µs for a random unframed signal. The algorithm used to check the alignment shall be such that, under normal conditions, a 10^{-3} (Poisson type) error ratio will not cause a false OOF more then once per 6 minutes. If in the OOF state, the maximum frame alignment time shall be 250 µs for an error-free signal with no emulated framing patterns. The algorithm used to recover from the OOF state shall be such , that the probability for false frame recovery with a random unframed signal shall be no more than 10^{-5} per 250 µs time interval.

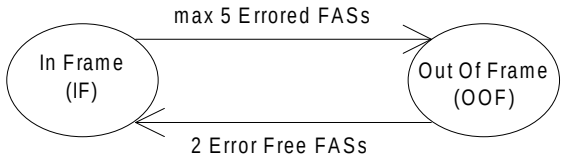


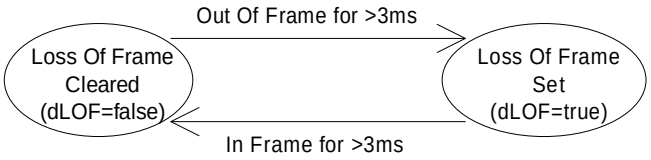
Figure 31: Frame alignment process

The frame start signal (RS1_CI_FS) shall be maintained during the OOF state and only updated upon successful transition form OOF to the IF state.

Descrambling: The operation of the descrambler shall be functionally identical to that of a scrambler in ES1/RS1_A_So.

Defects:

If the OOF anomaly persists for 3 ms, a STM-1 Loss Of Frame defect (dLOF) shall be detected. To provide for the case of intermittent OOFs, the integrating timer shall not be reset to zero until an IF condition persists continuously for 3 ms. The dLOF defect shall be cleared when the IF state persists continuously for 3 ms.



NOTE: Out-Of-Frame integrating timer is not reset to zero until an In-Frame condition persists continuously for 3 ms.

Figure 32: Loss of frame process

Consequent Actions:

aAIS ← dLOF

aSSF ← dLOF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cLOF ← dLOF and (not AI_TSF)

Performance Monitoring:

Any second with at least one OOF event shall be reported as an pOFS (Out of Frame Second).

9 E4 Section Layer Functions

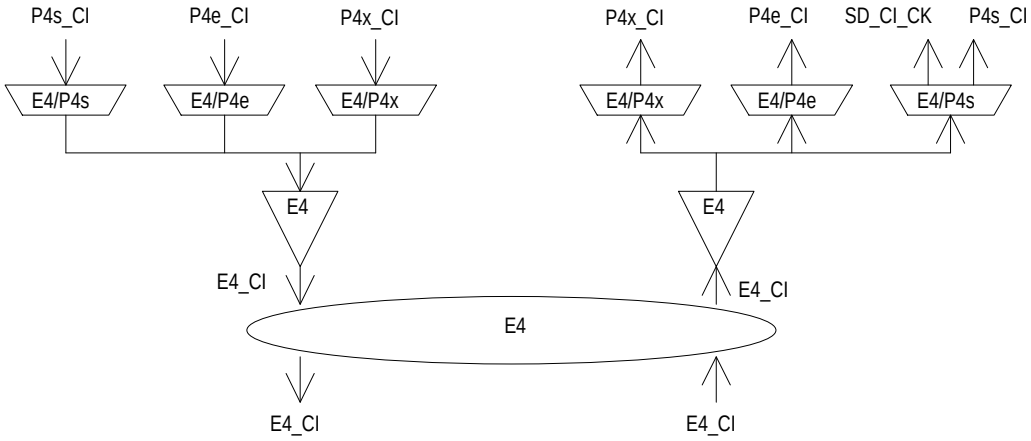


Figure 33: E4 Section atomic functions

E4 layer CP.

The Characteristic Information E4_CI on the intra-station electrical layer CP is a digital, CMI encoded, electrical signal of defined amplitude, bit rate and pulse shape as defined in ETS 300 166 [5].

NOTE: Characteristic information for an 140 Mbit/s UNI is for further study.

E4 layer AP.

The information passing across the E4/P4x AP is a plesiochronous 139 264 kbit/s signal of non-specified content with co-directional bit timing.

The information passing across the E4/P4e AP is a 139 264 kbit/s signal with co-directional bit timing specified by ITU-T Recommendation G.751 [7]. It contains four 34 368 kbit/s tributary signals (figure 34).

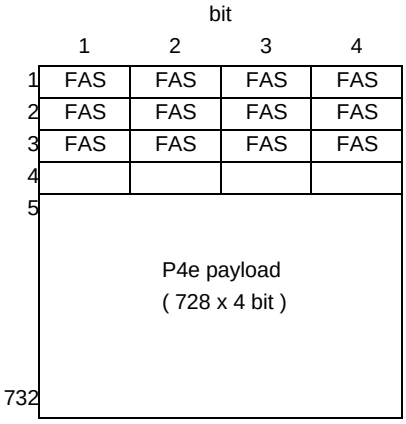


Figure 34: Decoded E4/P4e_AI_D signal

The information passing across the E4/P4s AP is a 139 264 kbit/s signal with co-directional bit timing specified by ETS 300 337 [2] (figure 35).

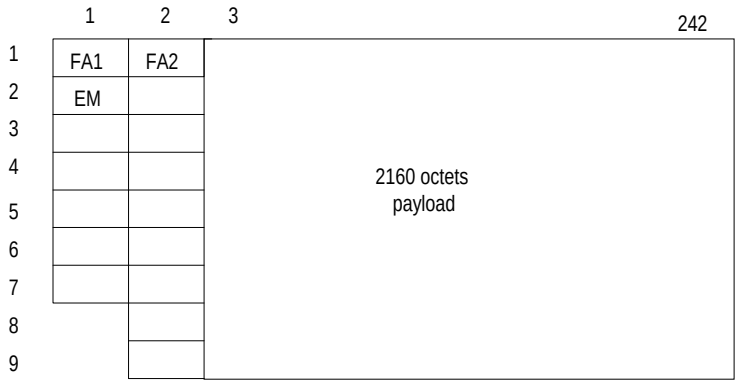


Figure 35: Decoded E4/P4s_AI_D signal

9.1 E4 Connection function E4_C

For further study.

9.2 E4 Trail Termination functions

9.2.1 E4 Trail Termination Source E4_TT_So

Symbol:

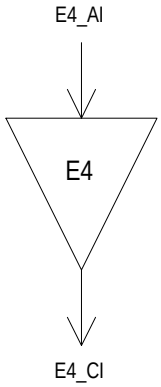


Figure 36: E4_TT_So symbol

Interfaces:

Table 17: E4_TT_So input and output signals

Input(s)	Output(s)
E4_AI_D	E4_CI_D

Processes:

This function generates the electrical Intra-station Section Layer signal E4 specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Peak to Peak Voltage: The function shall meet the requirement specified by ETS 300 166 [5].

Rise time: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

9.2.2 E4 Trail Termination Sink E4_TT_Sk

Symbol:

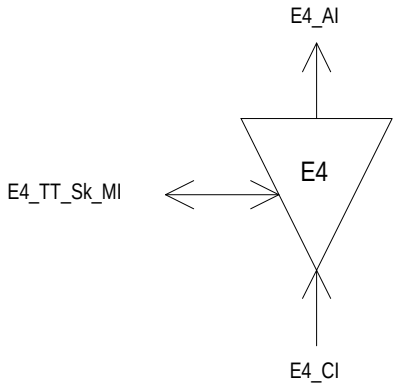


Figure 37: E4_TT_Sk symbol

Interfaces:

Table 18: E4_TT_Sk input and output signals

Input(s)	Output(s)
E4_CI_D	E4_AI_D
	E4_AI_TSF
E4_TT_Sk_MI_PortMode	E4_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E4 specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417 1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 139 264 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

9.3 E4 Adaptation functions

9.3.1 E4 to P4x Adaptation Source E4/P4x_A_So

Symbol:

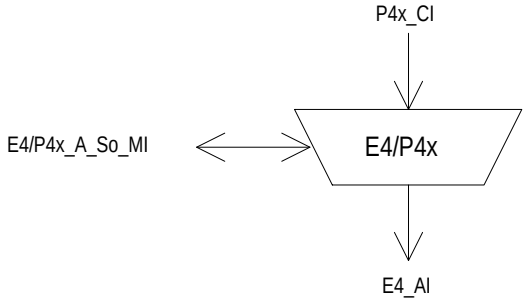


Figure 38: E4/P4x_A_So symbol

Interfaces:

Table 19: E4/P4x_A_So input and output signals

Input(s)	Output(s)
P4x_CI_D P4x_CI_CK E4/P4x_A_So_MI_Active	E4_AI_D

Processes:

This function provides the CMI encoding of the 139 264 kbit/s information stream as defined in ETS 300 166 [5].

CMI encoder: The function shall perform CMI encoding of the data specified by ETS 300 166 [5].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 33 shows that more than one adaptation source function exists in this E4 layer that can be connected to one E4 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

9.3.2 E4 to P4x Adaptation Sink E4/P4x_A_Sk

Symbol:

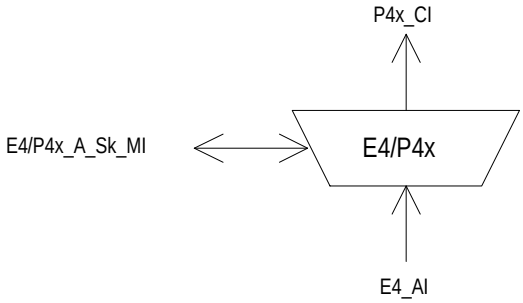


Figure 39: E4/P4x_A_Sk symbol

Interfaces:

Table 20: E4/P4x_A_Sk input and output signals

Input(s)	Output(s)
E4_AI_D E4_AI_TSF E4/P4x_A_Sk_MI_Active	P4x_CI_D P4x_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 139 264 kbit/s E4 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm.

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

CMI decoding: The function shall perform the CMI decoding process specified by ETS 300 166 [5].

Figure 33 shows that more than one adaptation sink function exists in this E4 layer that can be connected to one E4 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

9.3.3 E4 to P4e Adaptation Source E4/P4e_A_So

Symbol:

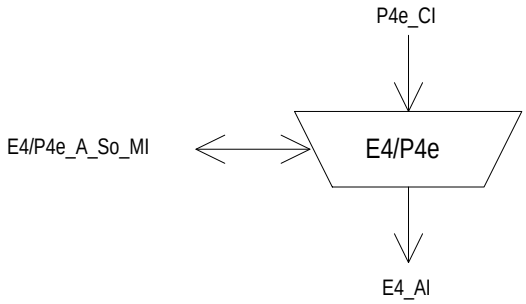


Figure 40: E4/P4e_A_So symbol

Interfaces:

Table 21: E4/P4e_So input and output signals

Input(s)	Output(s)
P4e_CI_D P4e_CI_CK E4/P4e_A_So_MI_Active	E4_AI_D

Processes:

This function performs CMI encoding of the 139 264 kbit/s signal.

NOTE 1: The insertion of the frame alignment signal would be a E4/P4e_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 139 264 kbit/s signal in ITU-T Recommendation G.751 [7] causes to violate this process allocation, and locate the FAS insertion process in the P4e_TT_So.

CMI encoder: The function shall perform CMI encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 33 shows that more than one adaptation source function exists in this E4 layer that can be connected to one E4 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

9.3.4 E4 to P4e Adaptation Sink E4/P4e_A_Sk

Symbol:

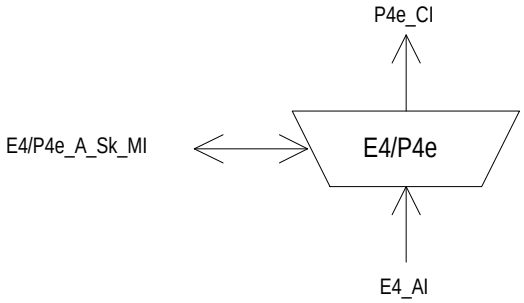


Figure 41: E4/P4e_A_Sk symbol

Interfaces:

Table 22: E4/P4e_Sk input and output signals

Input(s)	Output(s)
E4_AI_D	P4e_CI_D
	P4e_CI_CK
	P4e_CI_FS
E4_AI_TSF	P4e_CI_SSF
E4/P4e_A_Sk_MI_AIS_Reported	E4/P4e_A_Sk_MI_cLOF
E4/P4e_A_Sk_MI_Active	E4/P4e_A_Sk_MI_cAIS

Processes:

The function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal, and decodes the incoming electrical 139 264 kbit/s E4 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm.

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

CMI decoding: The function shall perform the CMI decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the frame alignment of the 139 264 kbit/s signal to recover the frame start signal FS. The procedures to assume the loss and recovery of frame alignment shall be according the ITU-T Recommendation G.751 [7], §1.5.3.

Figure 33 shows that more than one adaptation sink function exists in this E4 layer that can be connected to one E4 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

The function shall detect a loss of frame defect (dLOF) when four consecutive frame alignment signals have been incorrectly received in their predicted positions. When frame alignment is lost, the dLOF defect shall be cleared when three consecutive frame alignment signals are detected.

The function shall detect an AIS defect (dAIS) according the specification in subclause 8.2.1.7 of ETS 300 417-1-1 [1], with X = 5, Y = 2928, Z = 6.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

9.3.5 E4 to P4s Adaptation Source E4/P4s_A_So

Symbol:

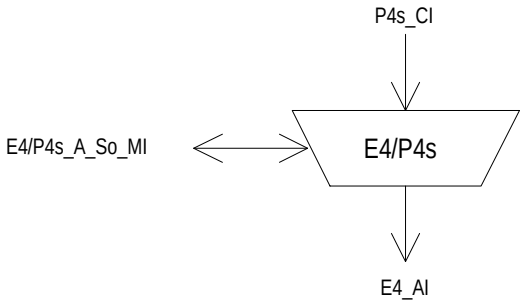


Figure 42: E4/P4s_A_So symbol

Interfaces:

Table 23: E4/P4s_So input and output signals

Input(s)	Output(s)
P4s_CI_D P4s_CI_CK E4/P4s_A_So_MI_Active	E4_AI_D

Processes:

This function provides CMI encoding of the 139 264 kbit/s P4s signal.

NOTE 1: The insertion of the frame alignment signal (A1A2) would be a E4/P4s_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 139 264 kbit/s signal in ETS 300 337 [2] causes to violate this process allocation, and locate the FAS insertion process in the P4s_TT_So.

CMI encoder: The function shall perform CMI encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 33 shows that more than one adaptation source function exists in this E4 layer that can be connected to one E4 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

9.3.6 E4 to P4s Adaptation Sink E4/P4s_A_Sk

Symbol:

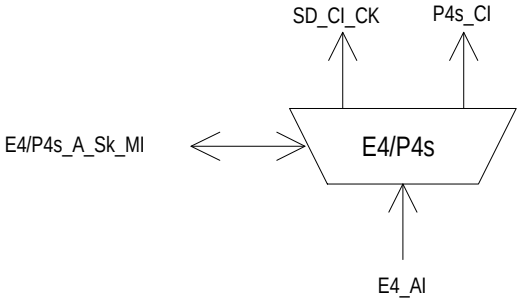


Figure 43: E4/P4s_A_Sk symbol

Interfaces:

Table 24: E4/P4s_Sk input and output signals

Input(s)	Output(s)
E4_AI_D	P4s_CI_D
	P4s_CI_CK
	P4s_CI_FS
E4_AI_TSF	P4s_CI_SSF
E4/P4s_A_Sk_MI_AIS_Reported	SD_CI_CK
E4/P4s_A_Sk_MI_Active	E4/P4s_A_Sk_MI_cLOF
	E4/P4s_A_Sk_MI_cAIS
	E4/P4s_A_Sk_MI_pOFS

Processes:

The function regenerates the received signal, recovers bit timing (CK), decodes the incoming electrical 139 264 kbit/s E4 signal, and recovers frame start reference (FS). It supplies the recovered timing signal to the synchronisation distribution layer.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm.

NOTE 1: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

CMI decoding: The function shall perform the CMI decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the frame alignment of the 139 264 kbit/s signal to recover the frame start signal FS. The frame alignment shall be found by searching for the A1, A2 bytes contained in the 140 Mbit/s signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment.

Frame alignment is deemed to have been lost (entering Out Of Frame (OOF) state) when either:

- four consecutive FAS are detected in error (i.e. ≥ 1 error in each FAS);

- X or more frames with one or more BIP8 violations are detected in a block of 1 000 frames.

Frame alignment is deemed to have been recovered (entering In Frame (IF) state) when three consecutive non-errored FAS are found.

NOTE 2: The value of X is for further study.

In the IF state even bit parity (BIP-8) is computed for each bit n of every byte of the preceding frame and compared with bit n of the EM byte recovered from the current frame. A difference between the computed BIP-8 and the EM value is taken as evidence of one or more errors in the previous frame.

NOTE 3: This process is identical with the BIP-8 violation process of the P4s_TT_Sk function. The process may be used in common for both functions.

Should a research for frame alignment be initiated either due to:

- a fortuitous FAS position being found once and not being found a second time in its expected position;

- exceeding the threshold which indicates false alignment;

then the new search for frame alignment should start 1 bit displaced forward from the position of the last indication of frame alignment.

NOTE 4: The above is required in order to avoid repeated alignment on to a simulation of the framing location.

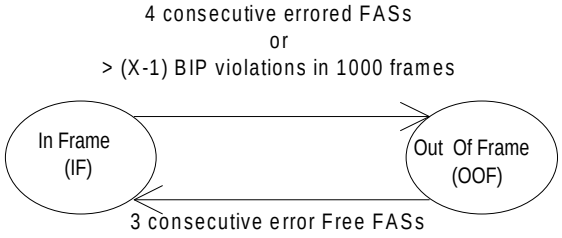


Figure 44: Frame alignment state diagram

Figure 33 shows that more than one adaptation sink function exists in this E4 layer that can be connected to one E4 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

If the frame alignment is deemed to be lost (OOF state), a 140 Mbit/s Loss Of Frame defect (dLOF) shall be detected. The dLOF defect shall be cleared when the frame alignment is deemed to have been recovered (IF state).

The dAIS defect shall be detected specified by ETS 300 417-1-1 [1], subclause 8.2.1.7 for 140 Mbit/s, with X = 7, Y = 18408, Z = 8.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

10 E32 Section Layer Functions

NOTE: The application of this layer is under discussion in ETSI STC TM3. Dependent on the outcome, this clause might be deleted.

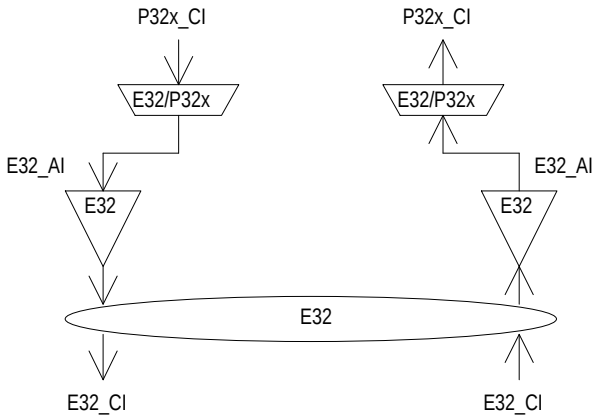


Figure 45: E32 Section atomic functions

E32 layer CP.

The Characteristic Information E32_CI of the intra-station electrical layer CP is a digital, electrical signal of defined amplitude, bit rate and pulse shape specified by ANSI T1.102 [13].

E32 layer AP.

The information passing across the E32/P32x AP is a 44 736 kbit/s signal with co-directional bit timing.

10.1 E32 Connection function E32_C

For further study.

10.2 E32 Trail Termination functions

10.2.1 E32 Trail Termination Source E32_TT_So

Symbol:

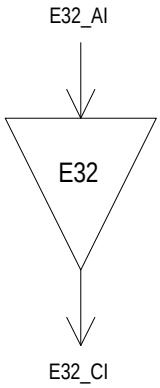


Figure 46: E32_TT_So symbol

Interfaces:

Table 25: E32_TT_So input and output signals

Input(s)	Output(s)
E32_AI_D	E32_CI_D

Processes:

This function generates the electrical Intra-station Section Layer signal E32 specified by ANSI T1.102 [13].

The function shall meet the *medium, pulse amplitude, pulse shape, power level, pulse imbalance and DC power* requirements specified by ANSI T1.102 [13].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

10.2.2 E32 Trail Termination Sink E32_TT_Sk

Symbol:

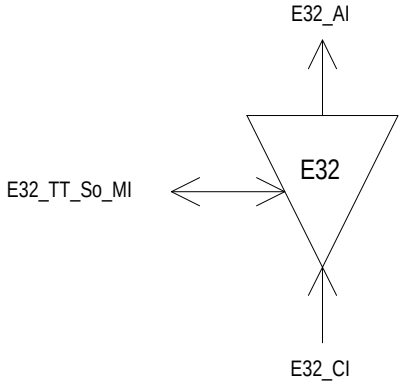


Figure 47: E32_TT_Sk symbol

Interfaces:

Table 26: E32_TT_Sk input and output signals

Input(s)	Output(s)
E32_CI_D	E32_AI_D
	E32_AI_TSF
E32_TT_Sk_MI_PortMode	E32_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E32 specified by ANSI T1.102 [13].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 44 736 kbit/s dLOS specification in ITU-T Rec. G.775 [10].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

10.3 E32 Adaptation functions

10.3.1 E32 to P32x Adaptation Source E32/P32x_A_So

Symbol:

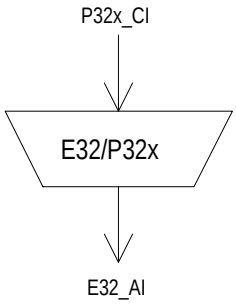


Figure 48: E32/P32x_A_So symbol

Interfaces:

Table 27: E32/P32x_A_So input and output signals

Input(s)	Output(s)
P32x_CI_D P32x_CI_CK	E32_AI_D

Processes:

This function provides the B3ZS encoding of the 44 736 kbit/s information stream specified by ITU-T Recommendation G.703 [11].

B3ZS encoder: The function shall perform B3ZS encoding of the data specified by ANSI T1.102 [13].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

10.3.2 E32 to P32x Adaptation Sink E32/P32x_A_Sk

Symbol:

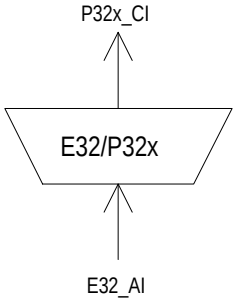


Figure 49: E32/P32x_A_Sk symbol

Interfaces:

Table 28: E32/P32x_A_Sk input and output signals

Input(s)	Output(s)
E32_AI_D E32_AI_TSF	P32x_CI_D P32x_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 44 736 kbit/s E32 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ANSI T1.102 [13].
- Jitter modulation applied to the input signal with any value specified by ANSI T1.102 [13].
- The input signal bit rate has any value in the range 44 736 kbit/s ± 20 ppm.

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

B3ZS decoding: The function shall perform the B3ZS decoding process specified by ANSI T1.102 [13].

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an AIS signal (see below for definition) - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

The AIS signal for this interface (as specified by ANSI T1.107 [14]) is a signal with valid M-frame alignment channel, M-subframe alignment channel and valid P bits. The information bits are set to a “10” sequence starting with a “1” after each M-frame alignment bit, X-bit, P-bit, and C-bit channel. The C-bits are set to “0”. The X-bits are set to “1”.

Defect Correlations: None.

Performance Monitoring: None.

11 E31 Section Layer Functions

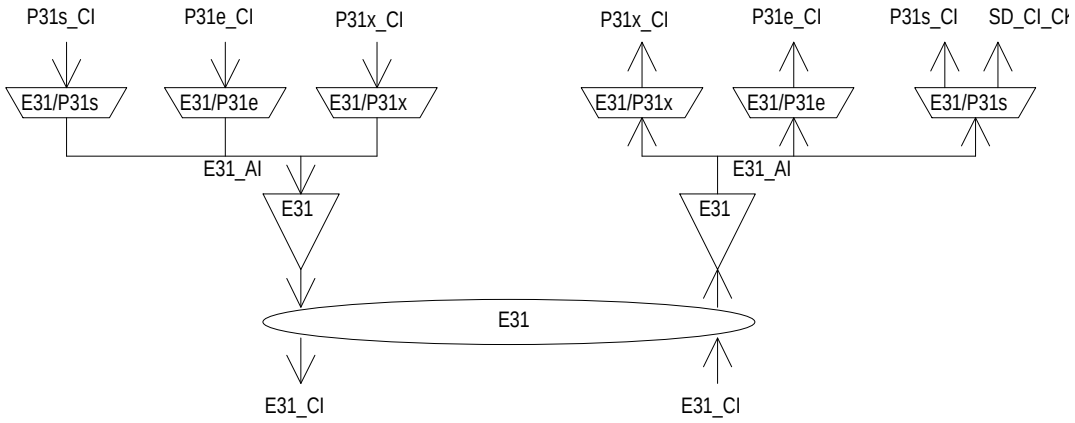


Figure 50: E31 Section atomic functions

E31 layer CP.

The Characteristic Information E31_CI of the intra-station electrical layer CP is a digital, electrical signal of defined amplitude, bit rate and pulse shape specified by ETS 300 166 [5].

NOTE: Characteristic information for an 34 Mbit/s UNI is for further study.

E31 layer AP.

The information passing across the E31/P31x AP is a 34 368 kbit/s signal of non-specified content with co-directional bit timing.

The information passing across the E31/P31e AP is a 34 368 kbit/s signal with co-directional bit timing specified by ITU-T Recommendation G.751 [7]. It contains four 8 448 kbit/s tributary signals (figure 51).

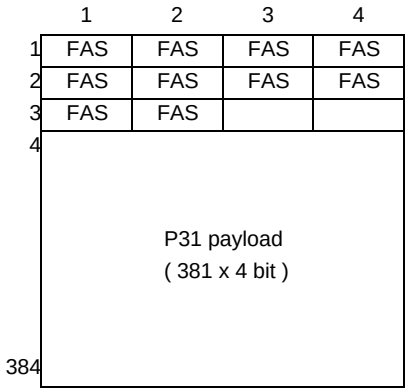


Figure 51: Decoded E31/P31e_AI_D signal

The information passing across the E31/P31s AP is a 34 368 kbit/s signal with co-directional bit timing specified by ETS 300 337 [2] (figure 52).

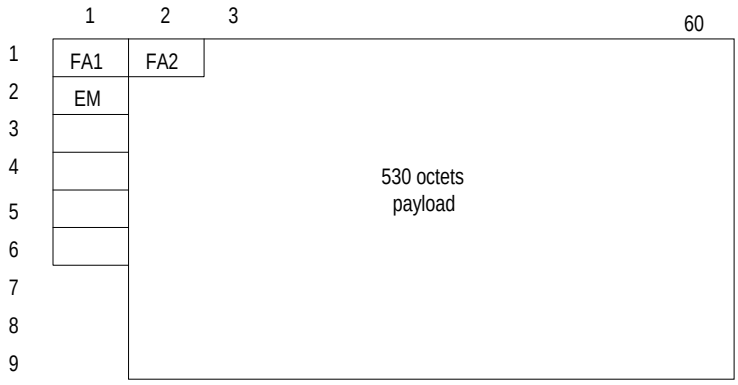


Figure 52: Decoded E31/P31s_AI_D signal

11.1 E31 Connection function E31_C

For further study.

11.2 E31 Trail Termination functions

11.2.1 E31 Trail Termination Source E31_TT_So

Symbol:

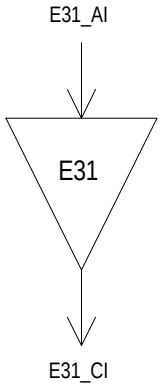


Figure 53: E31_TT_So symbol

Interfaces:

Table 29: E31_TT_So input and output signals

Input(s)	Output(s)
E31_AI_D	E31_CI_D

Processes:

This function generates the electrical Intra-station Section Layer signal E31 specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Nominal Peak to Peak Voltage of a mark (pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Peak voltage of a space (no pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Nominal pulse width: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval: The function shall meet the requirement specified by ETS 300 166 [ ].

Ratio of widths of positive and negative pulses at the nominal half amplitude: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.2.2 E31 Trail Termination Sink E31_TT_Sk

Symbol:

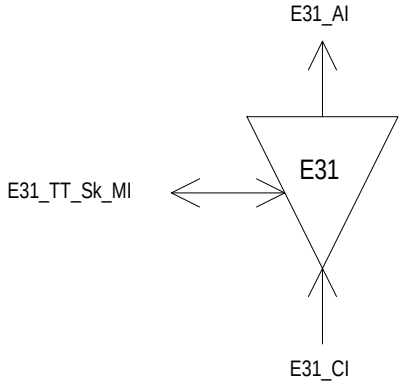


Figure 54: E31_TT_Sk symbol

Interfaces:

Table 30: E31_TT_Sk input and output signals

Input(s)	Output(s)
E31_CI_D	E31_AI_D
	E31_AI_TSF
E31_TT_Sk_MI_PortMode	E31_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E31 specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 34 368 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

11.3 E31 Adaptation functions

11.3.1 E31 to P31x Adaptation Source E31/P31x_A_So

Symbol:

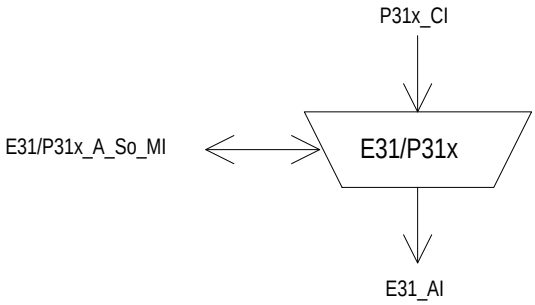


Figure 55: E31/P31x_A_So symbol

Interfaces:

Table 31: E31/P31x_A_So input and output signals

Input(s)	Output(s)
P31x_CI_D P31x_CI_CK E31/P31x_A_So_MI_Active	E31_AI_D

Processes:

This function provides the HDB3 encoding of the 34 368 kbit/s information stream specified by ETS 300 166 [5].

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 50 shows that more than one adaptation source function exists in this E31 layer that can be connected to one E31 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.3.2 E31 to P31x Adaptation Sink E31/P31x_A_Sk

Symbol:

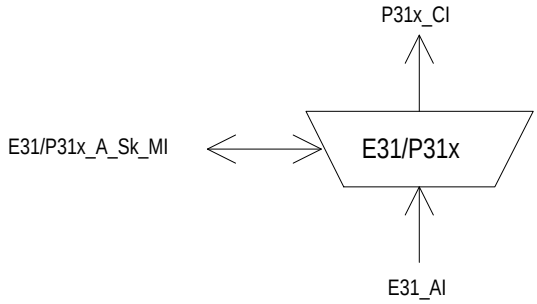


Figure 56: E31/P31x_A_Sk symbol

Interfaces:

Table 32: E31/P31x_A_Sk input and output signals

Input(s)	Output(s)
E31_AI_D E31_AI_TSF E31/P31x_A_Sk_MI_Active	P31x_CI_D P31x_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 34 368 kbit/s E31 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 34 368 kbit/s ± 20 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Figure 50 shows that more than one adaptation sink function exists in this E31 layer that can be connected to one E31 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

11.3.3 E31 to P31e Adaptation Source E31/P31e_A_So

Symbol:

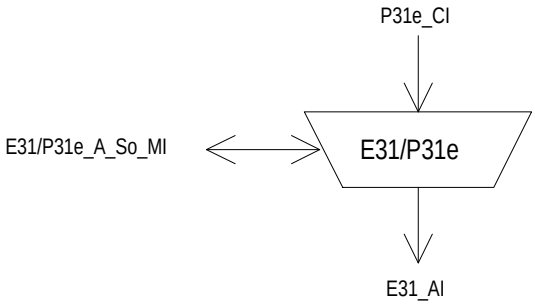


Figure 57: E31/P31e_A_So symbol

Interfaces:

Table 33: E31/P31e_So input and output signals

Input(s)	Output(s)
P31e_CI_D P31e_CI_CK E31/P31e_A_So_MI_Active	E31_AI_D

Processes:

This function performs HDB3 encoding of the 34 368 kbit/s signal.

NOTE 1: The insertion of the frame alignment signal would be a E31/P31e_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 34 368 kbit/s signal in ITU-T Recommendation G.751 [7] causes to violate this process allocation, and locate the FAS insertion process in the P31e_TT_So.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 50 shows that more than one adaptation source function exists in this E31 layer that can be connected to one E31 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.3.4 E31 to P31e Adaptation Sink E31/P31e_A_Sk

Symbol:

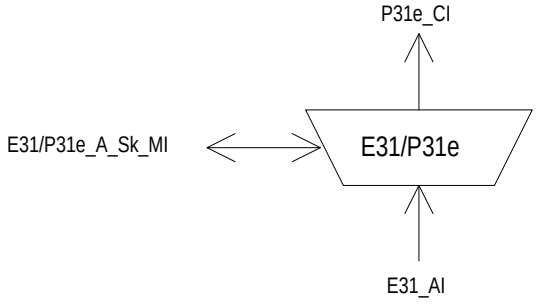


Figure 58: E31/P31e_A_Sk symbol

Interfaces:

Table 34: E31/P31e_Sk input and output signals

Input(s)	Output(s)
E31_AI_D	P31e_CI_D
	P31e_CI_CK
	P31e_CI_FS
E31_AI_TSF	P31e_CI_SSF
E31/P31e_A_Sk_MI_AIS_Reported	E31/P31e_A_Sk_MI_cLOF
E31/P31e_A_Sk_MI_Active	E31/P31e_A_Sk_MI_cAIS

Processes:

The function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal, and decodes the incoming electrical 34 368 kbit/s E31 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 34 368 kbit/s $\pm$ 20 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the frame alignment of the 34 368 kbit/s signal to recover the frame start signal FS. The procedures to assume the loss and recovery of frame alignment shall be according the ITU-T Recommendation G.751 [7], §1.4.3.

Figure 50 shows that more than one adaptation sink function exists in this E31 layer that can be connected to one E31 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

The function shall detect a loss of frame defect (dLOF) when four consecutive frame alignment signals have been incorrectly received in their predicted positions. When frame alignment is lost, the dLOF defect shall be cleared when three consecutive frame alignment signals are detected.

The function shall detect an AIS defect (dAIS) according the specification in subclause 8.2.1.7 of ETS 300 417-1-1 [1], with X = 4, Y = 1536, Z = 5.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

11.3.5 E31 to P31s Adaptation Source E31/P31s_A_So

Symbol:

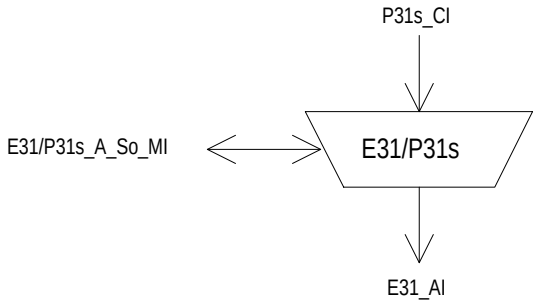


Figure 59: E31/P31s_A_So symbol

Interfaces:

Table 35: E31/P31s_So input and output signals

Input(s)	Output(s)
P31s_CI_D P31s_CI_CK E31/P31s_A_So_MI_Active	E31_AI_D

Processes:

This function provides HDB3 encoding of the 34 368 kbit/s P31s signal.

NOTE 1: The insertion of the frame alignment signal (A1A2) would be a E31/P31s_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 34 368 kbit/s signal in ETS 300 337 [2] causes to violate this process allocation, and locate the FAS insertion process in the P31s_TT_So.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 50 shows that more than one adaptation source function exists in this E31 layer that can be connected to one E31 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.3.6 E31 to P31s Adaptation Sink E31/P31s_A_Sk

Symbol:

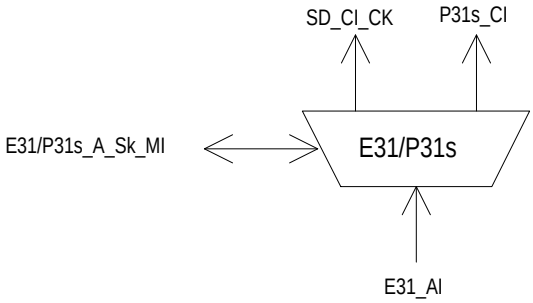


Figure 60: E31/P31s_A_Sk symbol

Interfaces:

Table 36: E31/P31s_Sk input and output signals

Input(s)	Output(s)
E31_AI_D	P31s_CI_D
	P31s_CI_CK
	P31s_CI_FS
E31_AI_TSF	P31s_CI_SSF
E31/P31s_A_Sk_MI_AIS_Reported	SD_CI_CK
E31/P31s_A_Sk_MI_Active	E31/P31s_A_Sk_MI_cLOF
	E31/P31s_A_Sk_MI_cAIS
	E31/P31s_A_Sk_MI_pOFS

Processes:

The function regenerates the received signal, recovers bit timing (CK), decodes the incoming electrical 34 368 kbit/s E31 signal, and recovers frame start reference (FS). It supplies the recovered timing signal to the synchronisation distribution layer. It can be activated/deactivated when multiple adaptation function types are connected to the access point.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 34 368 kbit/s $\pm$ 20 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].

NOTE 1: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the frame alignment of the 34 368 kbit/s signal to recover the frame start signal FS. The frame alignment shall be found by searching for the A1, A2 bytes contained in the 34 Mbit/s signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment.

Frame alignment is deemed to have been lost (entering Out Of Frame (OOF) state) when either:

- four consecutive FAS are detected in error (i.e. $\geq$ 1 error in each FAS);
- 986 or more frames with one or more BIP8 violations are detected in a block of 1 000 frames.

Frame alignment is deemed to have been recovered (entering In Frame (IF) state) when three consecutive non-errored FAS are found.

In the IF state even bit parity (BIP-8) is computed for each bit n of every byte of the preceding frame and compared with bit n of the EM byte recovered from the current frame. A difference between the computed BIP-8 and the EM value is taken as evidence of one or more errors in the previous frame.

NOTE 2: This process is identical with the BIP-8 violation process of the P31s_TT_Sk function. The process may be used in common for both functions.

Should a research for frame alignment be initiated either due to:

- a fortuitous FAS position being found once and not being found a second time in its expected position;
- exceeding the threshold which indicates false alignment;

then the new search for frame alignment should start 1 bit displaced forward from the position of the last indication of frame alignment.

NOTE 3: The above is required in order to avoid repeated alignment on to a simulation of the framing location.

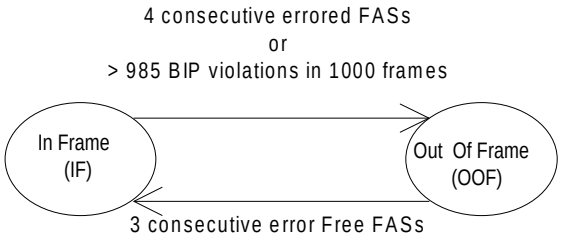


Figure 61: Frame alignment state diagram

Figure 50 shows that more than one adaptation sink function exists in this E31 layer that can be connected to one E31 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

If the frame alignment is deemed to be lost (OOF state), a 34 Mbit/s Loss Of Frame defect (dLOF) shall be detected. The dLOF defect shall be cleared when the frame alignment is deemed to have been recovered (IF state).

The dAIS defect shall be detected specified by ETS 300 417-1-1 [1], subclause 8.2.1.7 for 34 Mbit/s, with X = 7, Y = 4296, Z = 8.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

12 E22 Section Layer Functions

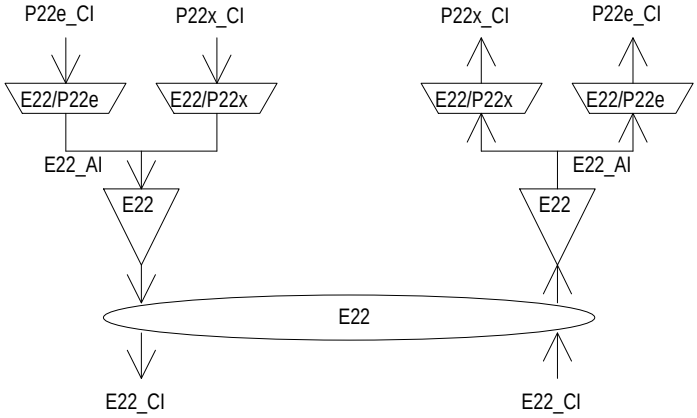


Figure 62: E22 Section atomic functions

E22 layer CP.

The Characteristic Information E22_CI of the intra-station electrical CP is a digital, electrical signal of defined amplitude, bit rate and pulse shape specified by ETS 300 166 [5].

E22 layer AP.

The information passing across the E22/P22x AP is a 8 448 kbit/s signal with co-directional bit timing.

The information passing across the E22/P22e AP is a 8 448 kbit/s signal with co-directional bit timing. It contains four 2 048 kbit/s tributary signals (figure 63).

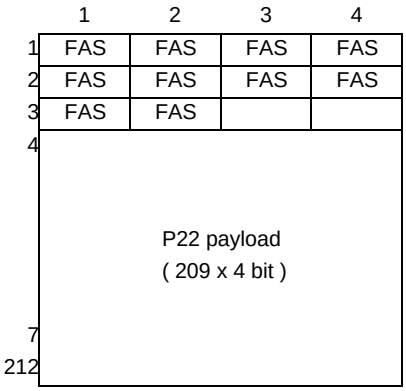


Figure 63: Decoded E22/P22e_AI_D signal

12.1 E22 Connection function E22_C

For further study.

12.2 E22 Trail Termination functions

12.2.1 E22 Trail Termination Source E22_TT_So

Symbol:

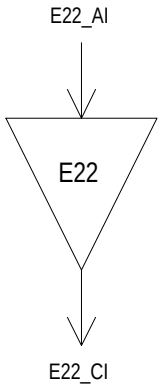


Figure 64: E22_TT_So symbol

Interfaces:

Table 37: E22_TT_So input and output signals

Input(s)	Output(s)
E22_AI_D	E22_CI_D

Processes:

This function generates the electrical Intra-station Section Layer signal E22 specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Nominal Peak Voltage of a mark (pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Peak voltage of a space (no pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Nominal pulse width: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of widths of positive and negative pulses at the nominal half amplitude: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

12.2.2 E22 Trail Termination Sink E22_TT_Sk

Symbol:

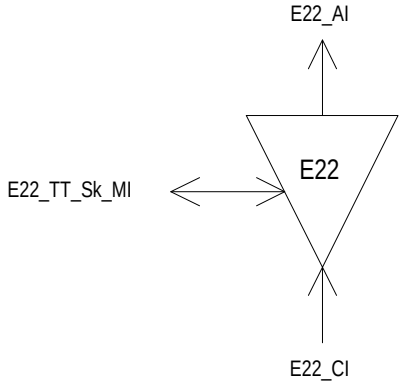


Figure 65: E22_TT_Sk symbol

Interfaces:

Table 38: E22_TT_Sk input and output signals

Input(s)	Output(s)
E22_CI_D	E22_AI_D
	E22_AI_TSF
E22_TT_Sk_MI_PortMode	E22_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E22 specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 8 448 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

12.3 E22 Adaptation functions

12.3.1 E22 to P22x Adaptation Source E22/P22x_A_So

Symbol:

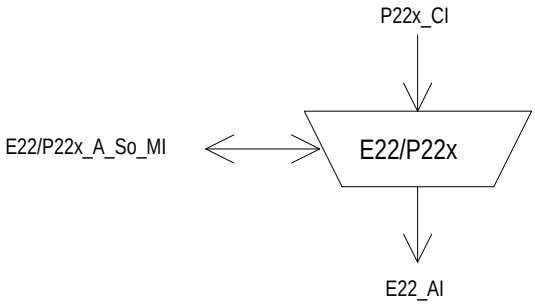


Figure 66: E22/P22x_A_So symbol

Interfaces:

Table 39: E22/P22x_A_So input and output signals

Input(s)	Output(s)
P22x_CI_D P22x_CI_CK E22/P22x_A_So_MI_Active	E22_AI_D

Processes:

This function provides the HDB3 encoding of the 8 448 kbit/s information stream specified by ETS 300 166 [5].

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 62 shows that more than one adaptation source function exists in this E22 layer that can be connected to one E22 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

12.3.2 E22 to P22x Adaptation Sink E22/P22x_A_Sk

Symbol:

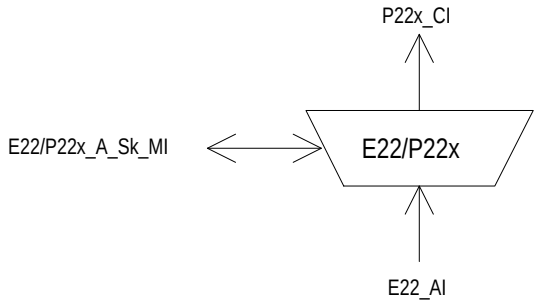


Figure 67: E22/P22x_A_Sk symbol

Interfaces:

Table 40: E22/P22x_A_Sk input and output signals

Input(s)	Output(s)
E22_AI_D E22_AI_TSF E22/P22x_A_Sk_MI_Active	P22x_CI_D P22x_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 8 448 kbit/s E22 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 8 448 kbit/s ± 30 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Figure 62 shows that more than one adaptation sink function exists in this E22 layer that can be connected to one E22 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

12.3.3 E22 to P22e Adaptation Source E22/P22e_A_So

Symbol:

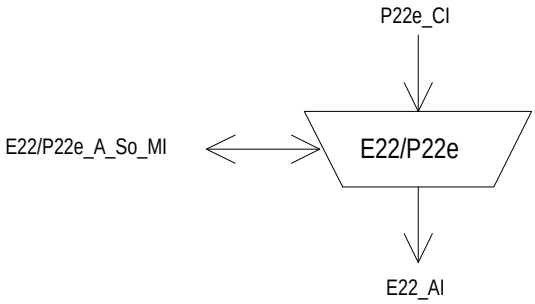


Figure 68: E22/P22e_A_So symbol

Interfaces:

Table 41: E22/P22e_So input and output signals

Input(s)	Output(s)
P22e_CI_D P22e_CI_CK E22/P22e_A_So_MI_Active	E22_AI_D

Processes:

This function performs HDB3 encoding of the 8 448 kbit/s signal.

NOTE 1: The insertion of the frame alignment signal would be a E22/P22e_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 8 448 kbit/s signal in ITU-T Recommendation G.742 [8] causes to violate this process allocation, and locate the FAS insertion process in the P22e_TT_So.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 62 shows that more than one adaptation source function exists in this E22 layer that can be connected to one E22 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

12.3.4 E22 to P22e Adaptation Sink E22/P22e_A_Sk

Symbol:

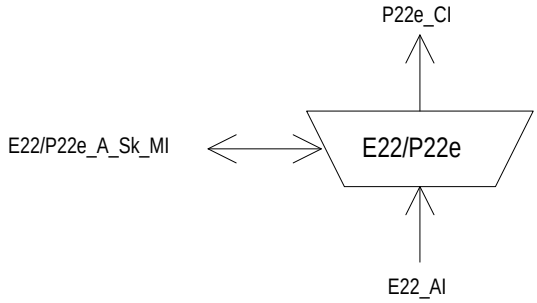


Figure 69: E22/P22e_A_Sk symbol

Interfaces:

Table 42: E22/P22e_Sk input and output signals

Input(s)	Output(s)
E22_AI_D	P22e_CI_D
	P22e_CI_CK
	P22e_CI_FS
E22_AI_TSF	P22e_CI_SSF
E22/P22e_A_Sk_MI_AIS_Reported	E22/P22e_A_Sk_MI_cLOF
E22/P22e_A_Sk_MI_Active	E22/P22e_A_Sk_MI_cAIS

Processes:

The function regenerates the received signal, recovers bit timing (CK) and frame start reference (FS) from the received signal, and decodes the incoming electrical 8 448 kbit/s E22 signal. It can be activated/deactivated when multiple adaptation function types are connected to the access point.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 8 448 kbit/s ± 30 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the frame alignment of the 8 448 kbit/s signal to recover the frame start signal FS. The procedures to assume the loss and recovery of frame alignment shall be according the ITU-T Recommendation G.751 [7], §1.4.3.

Figure 62 shows that more than one adaptation sink function exists in this E22 layer that can be connected to one E22 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

The function shall detect a loss of frame defect (dLOF) when four consecutive frame alignment signals have been incorrectly received in their predicted positions. When frame alignment is lost, the dLOF defect shall be cleared when three consecutive frame alignment signals are detected.

The function shall detect an AIS defect (dAIS) according the specification in subclause 8.2.1.7 of ETS 300 417-1-1 [1], with X = 4, Y = 1536, Z = 5.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

13 E12 Section Layer Functions

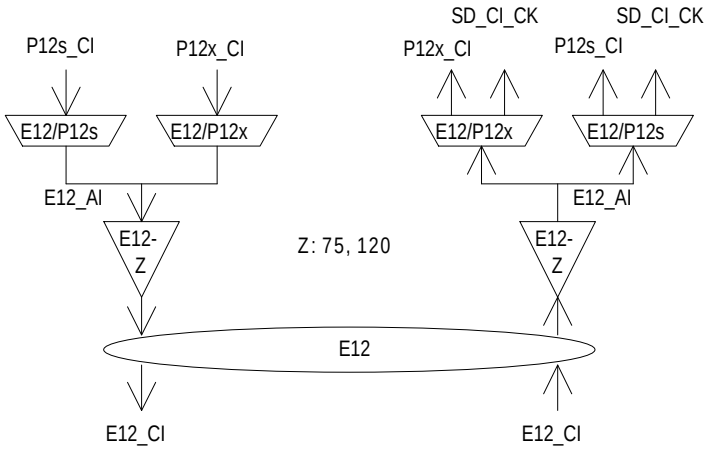


Figure 70: E12 Section atomic functions

E12 layer CP.

The Characteristic Information E12_CI of the intra-station electrical CP is a digital, electrical signal of defined amplitude, bit rate, impedance and pulse shape specified by ETS 300 166 [5].

NOTE: The specification within this document is limited to the Network Node Interface (NNI).

E12 layer AP.

The information passing across the E12/P12x AP is a 2 048 kbit/s signal with co-directional bit timing.

The information passing across the E12/P12s AP is a 2 048 kbit/s signal with co-directional bit timing with a frame structure specified by ETS 300 167 [3] (figures 71, 72).

A third type of information passing across the E12/ISDN is a signal containing an ISDN payload. The functional model of these I-layers is for further study.

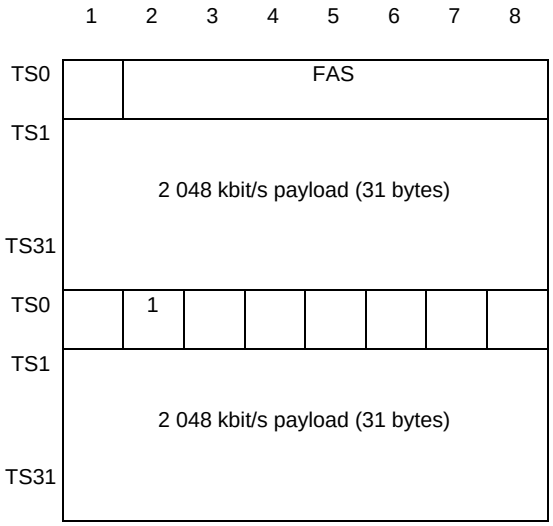


Figure 71: Decoded P12s_CI_D (without CRC-4 multiframe)

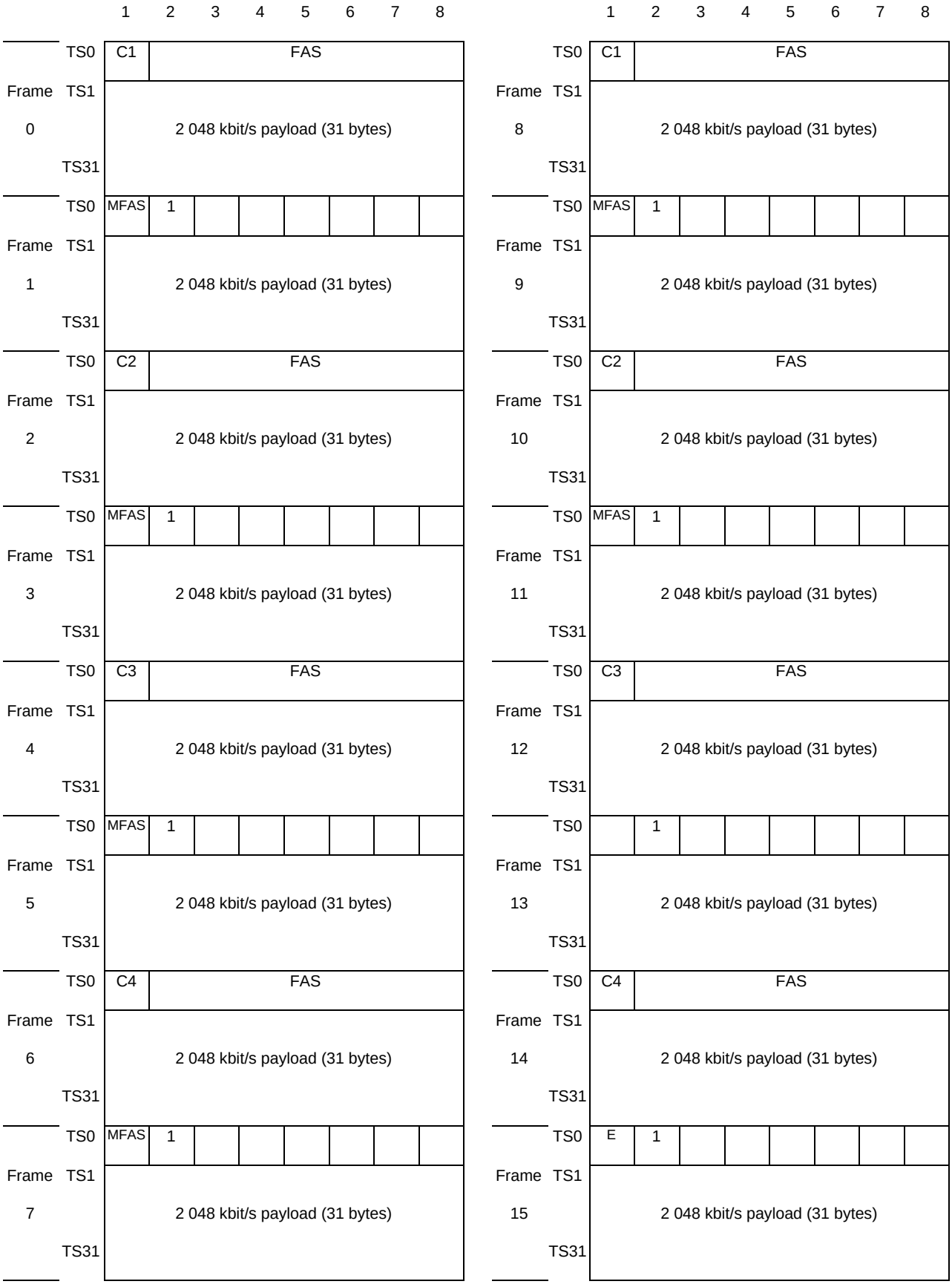


Figure 72: Decoded P12s_CI_D (with CRC-4 multiframe)

13.1 E12 Connection function E12_C

For further study.

13.2 E12 Trail Termination functions

13.2.1 E12 Trail Termination Source E12-Z_TT_So

NOTE: Z will be one value out of the set: {75, 120}.

Symbol:

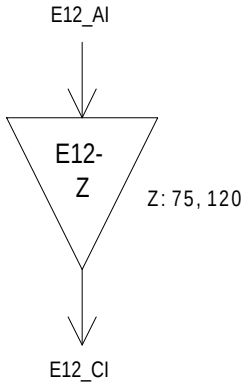


Figure 73: E12-Z_TT_So symbol

Interfaces:

Table 43: E12_TT_So input and output signals

Input(s)	Output(s)
E12_AI_D	E12_CI_D

Processes:

This function generates the electrical Intra-station Section Layer signal E12 specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Nominal Peak Voltage of a mark (pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Peak voltage of a space (no pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Nominal pulse width: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of widths of positive and negative pulses at the nominal half amplitude: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Output signal balance: For the case of a 120 Ω interface, the function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

13.2.2 E12 Trail Termination Sink E12-Z_TT_Sk

NOTE: Z will be one value out of the set: {75, 120}.

Symbol:

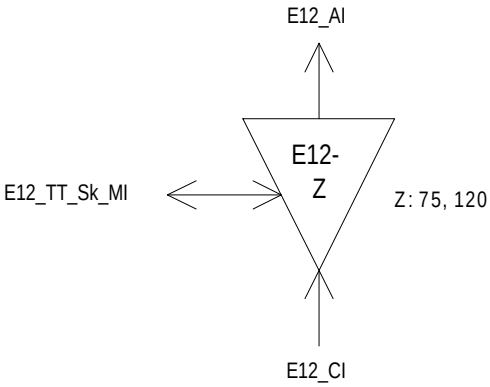


Figure 74: E12-Z_TT_Sk symbol

Interfaces:

Table 44: E12_TT_Sk input and output signals

Input(s)	Output(s)
E12_CI_D	E12_AI_D
	E12_AI_TSF
E12_TT_Sk_MI_PortMode	E12_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E12 specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 2 048 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

13.3 E12 Adaptation functions

13.3.1 E12 to P12x Adaptation Source E12/P12x_A_So

Symbol:

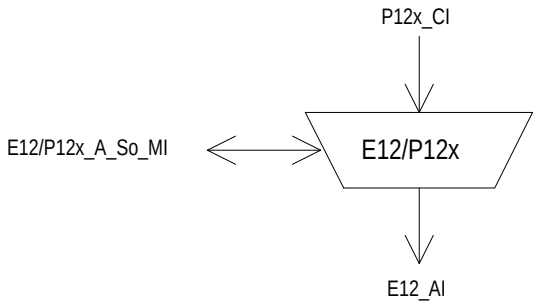


Figure 75: E12/P12x_A_So symbol

Interfaces:

Table 45: E12/P12x_A_So input and output signals

Input(s)	Output(s)
P12x_CI_D P12x_CI_CK E12/P12x_A_So_MI_Active	E12_AI_D

Processes:

This function provides the HDB3 encoding of the 2 048 kbit/s information stream specified by ETS 300 166 [5].

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 70 shows that more than one adaptation source function exists in this E12 layer that can be connected to one E12 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

13.3.2 E12 to P12x Adaptation Sink E12/P12x_A_Sk

Symbol:

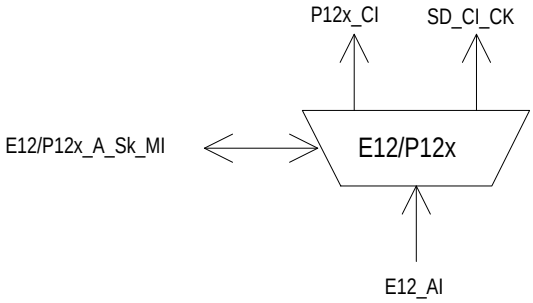


Figure 76: E12/P12x_A_Sk symbol

Interfaces:

Table 46: E12/P12x_A_Sk input and output signals

Input(s)	Output(s)
E12_AI_D	P12x_CI_D
E12_AI_TSF	P12x_CI_CK
E12/P12x_A_Sk_MI_Active	SD_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 2 048 kbit/s E12 signal. It supplies the recovered timing signal to the synchronisation distribution layer.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 2 048 kbit/s ± 50 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].
- For the case of a 120 Ω interface, the input signal has an longitudinal voltage specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Figure 70 shows that more than one adaptation sink function exists in this E12 layer that can be connected to one E12 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface *(e.g.* 2 048 kHz ± 50 ppm, or nominal frequency) - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

13.3.3 E12 to P12s Adaptation Source E12/P12s_A_So

Symbol:

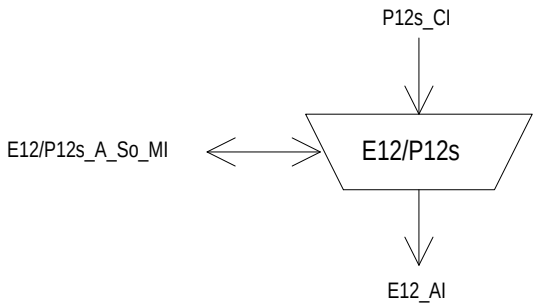


Figure 77: E12/P12s_A_So symbol

Interfaces:

Table 47: E12/P12s_So input and output signals

Input(s)	Output(s)
P12s_CI_D P12s_CI_CK E12/P12s_A_So_MI_Active	E12_AI_D

Processes:

This function provides HDB3 encoding of the 2 048 kbit/s P12s signal specified by ETS 300 166 [5].

NOTE 1: The insertion of the 2 048 kbit/s frame alignment signal would be a E12/P12s_A_So process according clause 5 ETS 300 417-1-1 [1]. The (historical) definition of the 2 048 kbit/s signal in ETS 300 167 [3] causes to violate this process allocation, and locate the FAS insertion process in the P12s_TT_So.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Figure 70 shows that more than one adaptation source function exists in this E12 layer that can be connected to one E12 access point. For such case, a subset of these adaptation source functions is allowed to be activated together. For this subset, access to the access point by other adaptation source functions must be denied.

Activation: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

13.3.4 E12 to P12s Adaptation Sink E12/P12s_A_Sk

Symbol:

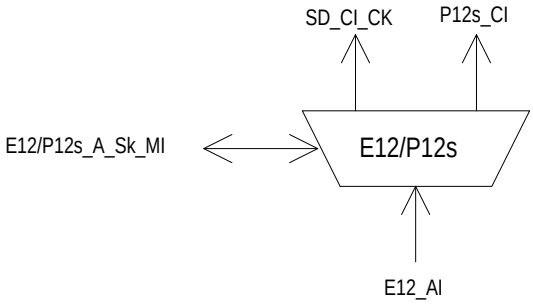


Figure 78: E12/P12s_A_Sk symbol

Interfaces:

Table 48: E12/P12s_Sk input and output signals

Input(s)	Output(s)
E12_AI_D	P12s_CI_D
	P12s_CI_CK
	P12s_CI_FS
E12_AI_TSF	P12s_CI_MFS
	P12s_CI_SSF
E12/P12s_A_Sk_MI_AIS_Reported	SD_CI_CK
E12/P12s_A_Sk_MI_Active	E12/P12s_A_Sk_MI_cLOF
	E12/P12s_A_Sk_MI_cAIS
	E12/P12s_A_Sk_MI_cNCI

Processes:

The function regenerates the received signal, recovers bit timing (CK), decodes the incoming electrical 2 048 kbit/s E12 signal, and recovers frame start reference (FS). It supplies the recovered timing signal to the synchronisation distribution layer.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 2 048 kbit/s $\pm$ 50 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].
- For the case of a 120 Ω interface, the input signal has an longitudinal voltage applied as specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ETS 300 166 [5].

Frame alignment: The function shall perform the (multi)frame alignment of the 2 048 kbit/s signal to recover the (multi)frame start signal (M)FS according Annex B of ETS 300 167 [3].

The frame start reference (FS) shall be maintained during the OOF state and only updated upon successful transition form OOF to the IF state.

Figure 70 shows that more than one adaptation sink function exists in this E12 layer that can be connected to one E12 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults (e.g. cLOF) to be detected and reported. To prevent this an adaptation sink function can be deactivated.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the all-ONEs signal at its output (CI_D) and not report its status via the management point.

Defects:

The dLOF defect shall be detected when the framing algorithm is in the state "out of primary BFA". Once in the dLOF state this state shall be exited when the framing algorithm is in one of the three following states: "in primary BFA", "assume CRC4 to CRC4 interworking", "assume CRC4 to non-CRC4 interworking".

The dNCI (No CRC4 Interworking) defect shall be detected when the framing algorithm is in the state "assume CRC4 to non-CRC4 interworking". Once in the dNCI state this state shall be exited when the framing algorithm is in one of the three following states: "out of primary BFA", "in primary BFA", "assume CRC4 to CRC4 interworking".

The dAIS defect shall be detected specified by ETS 300 417-1-1 [1], subclause 8.2.1.7 for 2 Mbit/s, with X = 2, Y = 512, Z = 3.

Consequent Actions:

aAIS ← dAIS or dLOF or AI_TSF

aSSF ← dAIS or dLOF or AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations:

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS) and (not AI_TSF)

cNCI ← dNCI

Performance Monitoring: None.

14 T12 Section Layer Functions

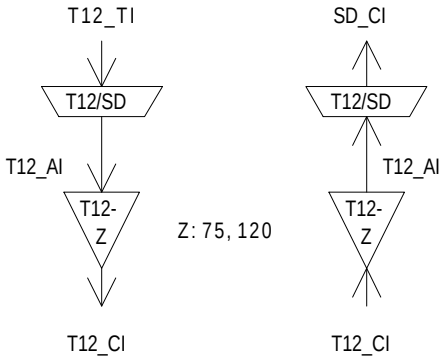


Figure 79: T12 Section atomic functions

T12 layer CP.

The Characteristic Information T12_CI of the intra-station electrical layer CP is an electrical 2 048 kHz signal of defined amplitude, frequency and pulse shape specified by ETS 300 166 [5].

T12 layer AP.

The information passing across the T12/SD AP is a 2048 kHz synchronisation signal.

14.1 T12 Connection function T12_C

Not applicable.

14.2 T12 Trail Termination functions

14.2.1 T12 Trail Termination Source T12-Z_TT_So

NOTE: Z will be one value out of the set: {75, 120}.

Symbol:

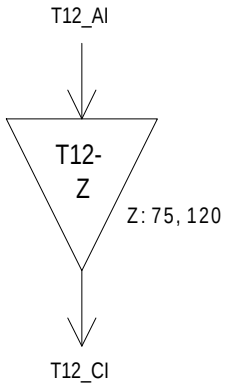


Figure 80: T12-Z_TT_So symbol

Interfaces:

Table 49: T12_TT_So input and output signals

Input(s)	Output(s)
T12_AI_CK T12_AI_SQLCH	T12_CI_CK

Processes:

This function generates the electrical 2 048 kHz signal used for transmission of synchronisation signals to an external equipment on a plesiochronous intra-station section specified by ETS 300 166 [5].

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Maximum Peak Voltage: The function shall meet the requirement specified by ETS 300 166 [5].

Minimum peak voltage: The function shall meet the requirement specified by ETS 300 166 [5].

Pair in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions:

On activation of T12_AI_SQLCH the function shall shutdown the output within 250 µs; on clearing of T12_AI_SQLCH the function shall output normal signal within 250 µs.

NOTE: A 2 MHz T12 interface is used to pass timing synchronisation information. As the signal does not support the Synchronisation Status Message (SSM) it should be shutdown when the synchronisation timing source has a quality level less or equal than a minimum provisioned level.

Defect Correlations: None.

Performance Monitoring: None.

14.2.2 T12 Trail Termination Sink T12-Z_TT_Sk

NOTE: Z will be one value out of the set: {75, 120}.

Symbol:

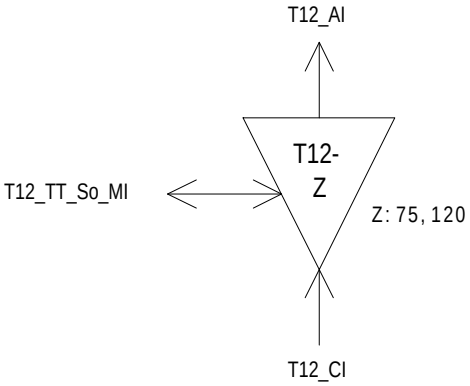


Figure 81: T12-Z_TT_Sk symbol

Interfaces:

Table 50: T12_TT_Sk input and output signals

Input(s)	Output(s)
T12_CI_CK	T12_AI_CK
	T12_AI_TSF
T12_TT_Sk_MI_PortMode	T12_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical 2 048 kHz signal used for transmission of synchronisation signals from an external equipment on a plesiochronous intra-station section specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect 2 048 kHz Loss Of Signal defect (dLOS) similar with the 2 048 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

14.3 T12 Adaptation functions

14.3.1 T12 to SD Adaptation Source T12/SD_A_So

Symbol:

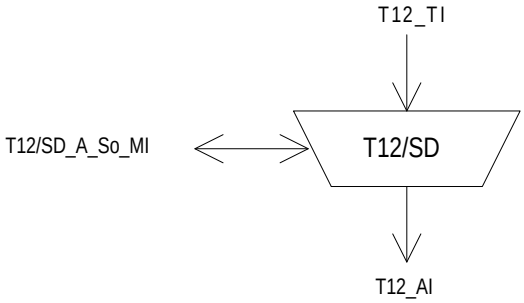


Figure 82: T12/SD_A_So symbol

Interfaces:

Table 51: T12/SD_A_So input and output signals

Input(s)	Output(s)
T12_TI_CK T12_TI_QL T12/SD_A_So_MI_QLmin	T12_AI_CK T12_AI_SQLCH

Processes:

This function adapts the equipment internal and specific Timing Characteristic information from the SD Layer into a 2 048 kHz timing information to be transmitted to an external equipment. It controls the squelching of the 2 048 kHz output signal as a result of quality level comparison.

The function shall not add any jitter.

NOTE 1: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Defects: None.

Consequent Actions:

aSQLCH ← (TI_QL < MI_QLmin)

NOTE 2: The comparison of the quality level (TI_QL) with the minimum quality level (QLmin) is performed on the QL priority, not on the SSM coding of the QL level.

Defect Correlations: None.

Performance Monitoring: None.

14.3.2 T12 to SD Adaptation Sink T12/SD_A_Sk

Symbol:

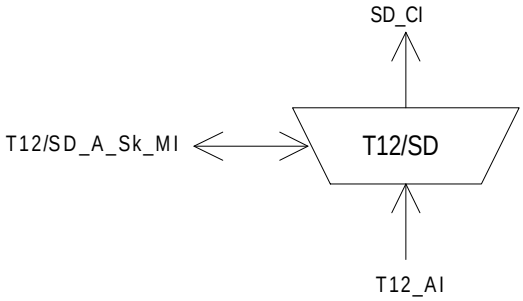


Figure 83: T12/SD_A_Sk symbol

Interfaces:

Table 52: T12/SD_A_Sk input and output signals

Input(s)	Output(s)
T12_AI_CK	SD_CI_CK
T12_AI_TSF	SD_CI_QL
T12/SD_A_Sk_MI_QLvalue	SD_CI_SSF

Processes:

This function adapts the 2 048 kHz timing information from an external reference to an equipment specific timing characteristic information. It assigns a fixed quality level to the output signal.

This function regenerates the received clock signal. It supplies the recovered timing signal to the synchronisation distribution layer.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in prETS 300 462-3 [16].
- The input signal frequency has any value in the range 2 048 kHz ± 4,6 ppm.

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Defects: None.

Consequent Actions:

aSSF ← AI_TSF

SD_CI_QL ← T12/SD_A_Sk_MI_QLvalue

Defect Correlations: None.

Performance Monitoring: None.

15 E11 Section Layer Functions

NOTE: The application of this layer is under discussion in ETSI STC TM3. Dependent on the outcome, this clause might be deleted.

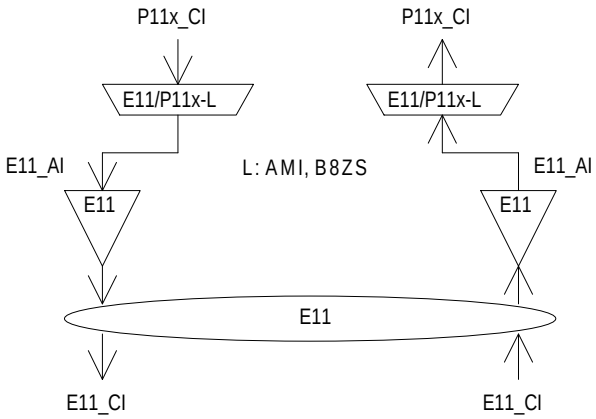


Figure 84: E11 Section atomic functions

E11 layer CP.

The Characteristic Information E11_CI of the intra-station electrical layer CP is a digital, electrical 1 544 kbit/s signal of defined amplitude, bit rate and pulse shape specified by ANSI T1.102 [13].

E11 layer AP.

The information passing across the E11/P11x AP is a 1 544 kbit/s signal with co-directional bit timing.

15.1 E11 Connection function E11_C

For further study.

15.2 E11 Trail Termination functions

15.2.1 E11 Trail Termination Source E11_TT_So

Symbol:

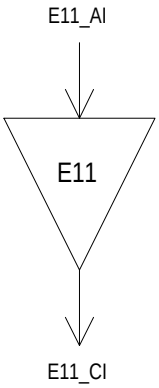


Figure 85: E11_TT_So symbol

Interfaces:

Table 53: E11_TT_So input and output signals

Input(s)	Output(s)
E11_AI_D	E11_CI_D

Processes:

This function generates the electrical 1544 kbit/s Intra-station Section Layer signal E11 specified by ANSI T1.102 [13].

The function shall meet the *medium, pulse amplitude, pulse shape, power level, pulse imbalance and DC power* requirements specified by ANSI T1.102 [13].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

15.2.2 E11 Trail Termination Sink E11_TT_Sk

Symbol:

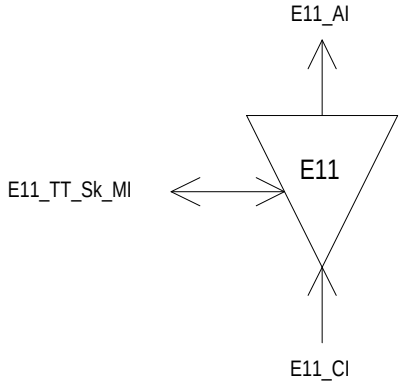


Figure 86: E11_TT_Sk symbol

Interfaces:

Table 54: E11_TT_Sk input and output signals

Input(s)	Output(s)
E11_CI_D	E11_AI_D
	E11_AI_TSF
E11_TT_Sk_MI_PortMode	E11_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical 1 544 kbit/s Intra-station Section Layer signal E11 specified by ANSI T1.102 [13].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417 -1-1 [1].

Defects:

The function shall detect Loss Of Signal defect (dLOS) according the 1 544 kbit/s dLOS specification in ITU-T Rec. G.775 [10].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

15.3 E11 Adaptation functions

15.3.1 E11 to P11x Adaptation Source E11/P11x-L_A_So

NOTE 1: L will be one value out of the set: {AMI, B8ZS}.

Symbol:

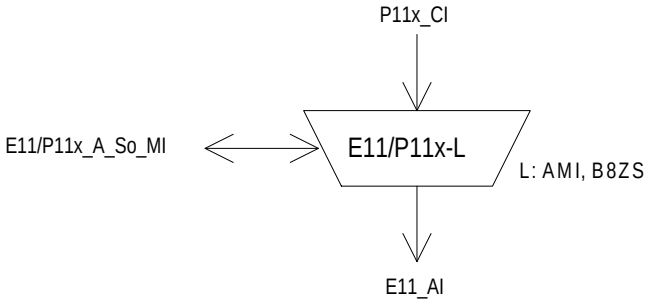


Figure 87: E11/P11x-L_A_So symbol

Interfaces:

Table 55: E11/P11x-L_A_So input and output signals

Input(s)	Output(s)
P11x_CI_D P11x_CI_CK E11/P11x_A_So_MI_Active	E11_AI_D

Processes:

This function provides the line encoding of the 1 544 kbit/s information stream specified by ANSI T1.102 [13].

Line encoder: The function shall perform line encoding of the data as specified ANSI T1.102 [13].

The function shall not add any jitter.

NOTE 2: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

15.3.2 E11 to P11x Adaptation Sink E11/P11x-L_A_Sk

NOTE 1: L will be one value out of the set: {AMI, B8ZS}.

Symbol:

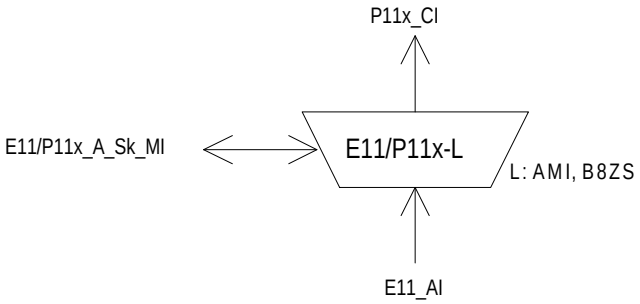


Figure 88: E11/P11x_A_Sk symbol

Interfaces:

Table 56: E11/P11x_A_Sk input and output signals

Input(s)	Output(s)
E11_AI_D E11_AI_TSF E11/P11x_A_Sk_MI_Active	P11x_CI_D P11x_CI_CK

Processes:

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and decodes the incoming electrical 1 544 kbit/s E11 signal. It supplies the recovered timing signal to the synchronisation distribution layer.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ANSI T1.102 [13].
- Jitter modulation applied to the input signal with any value specified by ANSI T1.102 [13].
- The input signal bit rate has any value in the range 1 544 kbit/s ± 50 ppm.

NOTE 2: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Line decoding: The function shall perform the line decoding process specified by ANSI T1.102 [13].

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface (e.g. 1 544 kHz ± 50 ppm) - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

16 E0 Section Layer Functions

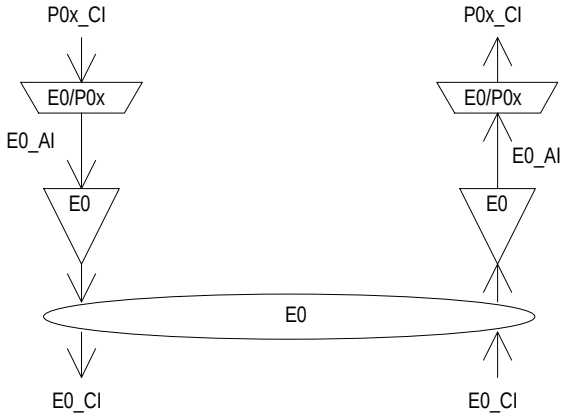


Figure 89: E0 Section atomic functions

E0 layer CP.

The Characteristic Information E0_CI of the intra-station electrical layer CP is a digital, electrical 64 kbit/s co-directional signal set of defined amplitude, bit rate and pulse shape specified by ETS 300 166 [5].

E0 layer AP.

The information passing across the E0/P0x AP is a 64 kbit/s signal with co-directional bit timing and octet identification.

16.1 E0 Connection function E0_C

For further study.

16.2 E0 Trail Termination functions

16.2.1 E0 Trail Termination Source E0_TT_So

Symbol:

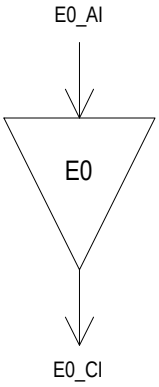


Figure 90: E0_TT_So symbol

Interfaces:

Table 57: E0_TT_So input and output signals

Input(s)	Output(s)
E0_AI_D	E0_CI_D

Processes:

This function generates the electrical 64 kbit/s co-directional Intra-station Section Layer signal E0 specified by ETS 300 166 [5]

Pulse shape: The function shall meet the requirement specified by ETS 300 166 [5].

Peak to Peak Voltage: The function shall meet the requirement specified by ETS 300 166 [5].

Peak voltage of a space (no pulse): The function shall meet the requirement specified by ETS 300 166 [5].

Nominal pulse width: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval: The function shall meet the requirement specified by ETS 300 166 [5].

Ratio of widths of positive and negative pulses at the nominal half amplitude: The function shall meet the requirement specified by ETS 300 166 [5].

Pair(s) in each direction: The function shall meet the requirement specified by ETS 300 166 [5].

Output signal balance: The function shall meet the requirement specified by ETS 300 166 [5].

Output return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

16.2.2 E0 Trail Termination Sink E0_TT_Sk

Symbol:

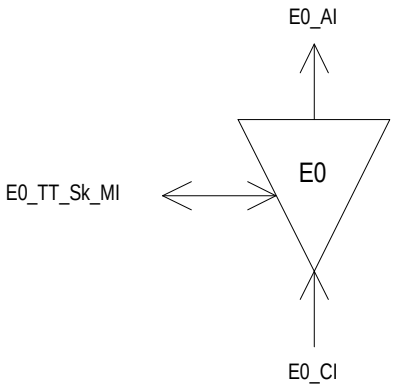


Figure 91: E0_TT_Sk symbol

Interfaces:

Table 58: E0_TT_Sk input and output signals

Input(s)	Output(s)
E0_CI_D	E0_AI_D
	E0_AI_TSF
E0_TT_Sk_MI_PortMode	E0_TT_Sk_MI_cLOS

Processes:

This function recovers the electrical Intra-station Section Layer signal E0 specified by ETS 300 166 [5].

Input return loss: The function shall meet the requirement specified by ETS 300 166 [5].

Impedance towards ground: The function shall meet the requirement specified by ETS 300 166 [5].

Port Mode: The function shall have a port mode as specified by subclause 8.5 of ETS 300 417-1-1 [1].

Defects:

The function shall detect a Loss Of Signal defect[1] (dLOS) according the 64 kbit/s dLOS specification in subclause 8.2.1.6 of ETS 300 417-1-1 [1].

Consequent Actions:

aTSF ← dLOS

Defect Correlations:

cLOS ← MON and dLOS

Performance Monitoring: None.

16.3 E0 Adaptation functions

16.3.1 E0 to P0x Adaptation Source E0/P0x_A_So

Symbol:

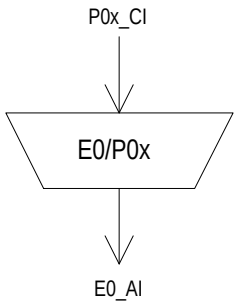


Figure 92: E0/P0x_A_So symbol

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1 An E0 interface used for OW or User Channel doesn't need to be monitored for loss of signal.

Interfaces:

Table 59: E0/P0x_A_So input and output signals

Input(s)	Output(s)
P0x_CI_D P0x_CI_CK P0x_CI_FS	E0_AI_D

Processes:

This function provides the encoding of the co-directional 64 kbit/s information stream specified by ETS 300 166 [5].

Encoder: The function shall perform encoding of the data as specified in ETS 300 166 [5].

The function shall not add any jitter.

NOTE: Jitter at the NNI is the combination of the jitter generated and transferred via the client layers.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

16.3.2 E0 to P0x Adaptation Sink E0/P0x_A_Sk

Symbol:

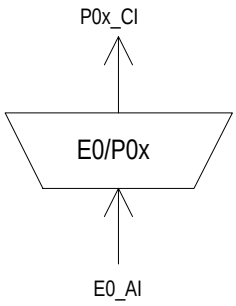

Figure 93: E0/P0x_A_Sk symbol

Interfaces:

Table 60: E0/P0x_A_Sk input and output signals

Input(s)	Output(s)
E0_AI_D E0_AI_TSF	P0x_CI_D P0x_CI_CK P0x_CI_FS

Processes:

This function regenerates the received signal, recovers bit timing (CK) and octet timing from the received signal, and decodes the incoming electrical co-directional 64 kbit/s E0 signal.

Regeneration: The function shall operate without any errors when any combination of the following signal conditions exist at the input:

- An input electrical amplitude level with any value in the range specified by ETS 300 166 [5].
- Jitter modulation applied to the input signal with any value defined in ITU-T Recommendation G.823 [9].
- The input signal bit rate has any value in the range 64 kbit/s ± 100 ppm.
- The input signal has an interfering signal specified by ETS 300 166 [5].
- The input signal has an longitudinal voltage applied as specified by ETS 300 166 [5].

NOTE: The frequency and jitter/wander tolerance might be further constrained by the requirements of the client layers.

Decoding: The function shall perform the decoding process specified by ETS 300 166 [5] for 64 kbit/s co-directional interfaces.

Defects: None.

Consequent Actions:

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal - complying to the frequency limits for this interface (e.g. 64 kHz ± 100 ppm, or nominal frequency) - within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations: None.

Performance Monitoring: None.

17 V11 Section Layer Functions

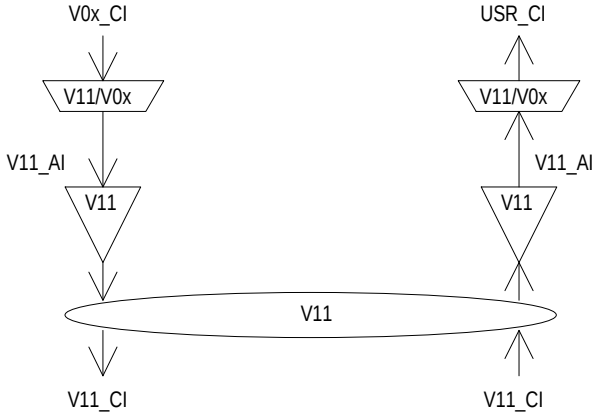

Figure 94: V11 Section atomic functions

V11 layer CP.

The Characteristic Information V11_CI of the intra-station electrical layer CP is a digital, electrical signal of defined amplitude, bit rate and pulse shape specified by ITU-T recommendation V.11 [12].

V11 layer AP.

The information passing across the V11/V0X AP is a X kbit/s signal with contra-directional bit and byte timing signal. X can be a value in the range up to 10 Mbit/s. In SDH equipment, the V11 payload is typically any of the (64 kbit/s) user channel signals or national use signals.

17.1 V11 Connection function V11_C

Not applicable.

17.2 V11 Trail Termination functions

17.2.1 V11 Trail Termination Source V11_TT_So

Symbol:

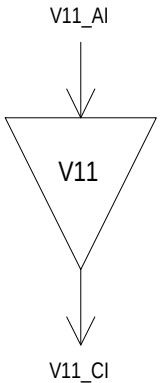

Figure 95: V11_TT_So symbol

Interfaces:

Table 61: V11_TT_So input and output signals

Input(s)	Output(s)
V11_AI_D V11_AI_CK	V11_CI_D V11_CI_CK

Processes:

This function generates the electrical signal used for transmission of information stream across an User interface specified by ITU-T Recommendation V.11 [12] accompanied by associated timing element signals.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

17.2.2 V11 Trail Termination Sink V11_TT_Sk

Symbol:

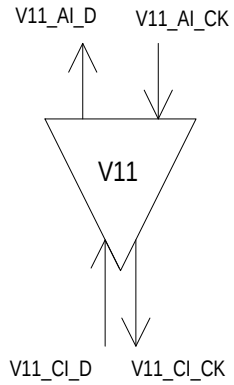

Figure 96: V11_TT_Sk symbol

Interfaces:

Table 62: V11_TT_Sk input and output signals

Input(s)	Output(s)
V11_CI_D V11_AI_CK	V11_AI_D V11_CI_CK

Processes: None.

This function accepts the electrical signal used for transmission of information stream across an user interface specified by ITU-T Recommendation V.11 [12].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

17.3 V11 Adaptation functions

17.3.1 V11 to V0X Adaptation Source V11/V0X_A_So

Symbol:

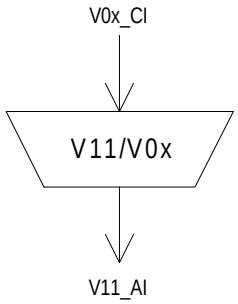

Figure 97: V11/V0X_A_So symbol

Interfaces:

Table 63: V11/V0X_A_So input and output signals

Input(s)	Output(s)
V0X_CI_D V0X_CI_CK	V11_AI_D V11_AI_CK

Processes: None.

This function passes through the data and clock signals for transmission on an electrical media from the 64 kbit/s user data from one of the user channel bytes specified by ITU-T Recommendation V.11 [12].

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

17.3.2 V11 to V0X Adaptation Sink V11/V0X_A_Sk

Symbol:

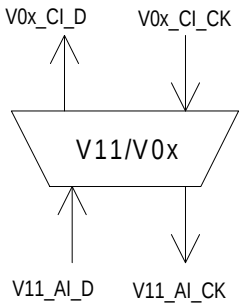

Figure 98: V11/V0X_A_Sk symbol

Interfaces:

Table 64: V11/V0X_A_Sk input and output signals

Input(s)	Output(s)
V11_AI_D V0X_CI_CK	V0X_CI_D V11_AI_CK

Processes:

This function passes through the data and clock signals.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

History

Document history			
April 1996	Public Enquiry	PE 105:	1996-04-08 to 1996-08-30