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Digital terminal equipments – General

Characteristics of plesiochronous digital hierarchy (PDH) equipment functional blocks

ITU-T Recommendation G.705

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.705

Characteristics of plesiochronous digital hierarchy (PDH) equipment fonctional blocks

Summary

This Recommendation specifies both the components and the methodology that should be used in order to specify PDH functionality of network element; it does not specify an individual PDH equipment as such.

Source

ITU-T Recommendation G.705 was prepared by ITU-T Study Group 15 (1997-2000) and approved by the World Telecommunication Standardization Assembly (Montreal, September 27 – October 6, 2000).

Keywords

Equipment functional blocks, PDH.

FOREWORD

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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ITU-T Recommendation G.705

Characteristics of plesiochronous digital hierarchy (PDH) equipment functional blocks

1 Scope

This Recommendation covers the functional requirements of PDH functionality within equipment. Some examples are:

– PDH interfaces on ATM equipment;

– PDH interfaces on SDH equipment;

– PDH interfaces on PDH multiplexer.

G.705 encompasses all the requirements of G.704, G.742, G.743, G.747, G.751 and G.752. As such, all equipment designed to these Recommendations is by definition compliant with G.705. When any discrepancy exists, the requirements of these Recommendations supersede for existing designs.

NOTE – Appendix I provides for information the equivalent representations of PDH multiplexer equipment using atomic functions described in this Recommendation. It underlines the resulting differences compared to the specification given in ITU-T G.742 and G.751.

This Recommendation uses the same specification methodology as the one used in ITU-T G.806. The description is generic and no particular physical partitioning of functions is implied. The input/output information flows associated with the functional blocks serve for defining the functions of the blocks and are considered to be conceptual, not physical.

Not every atomic function defined in this Recommendation is required for every application. Different subsets of atomic functions from this Recommendation and others (e.g. G.783) may be assembled in different ways according to the combination rules given in these Recommendations to provide a variety of different capabilities. Network operators and equipment suppliers may choose which functions must be implemented for each application.

The internal structure of the implementation of this functionality (equipment design) need not be identical to the structure of the functional model, as long as all the details of the externally observable behaviour comply with the EFS.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T E.862 (1992), *Dependability planning of telecommunication networks.*

[2] ITU-T G.703 (1998), *Physical/electrical characteristics of hierarchical digital interfaces.*

[3] ITU-T G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels.*

[4] ITU-T G.706 (1991), *Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in ITU-T G.704.*

[5] ITU-T G.743 (1988), *Second order digital multiplex equipment operating at 6312 kbit/s and using positive justification.*

[6] ITU-T G.752 (1988), *Characteristics of digital multiplex equipments based on a second order bit rate of 6312 kbit/s and using positive justification.*

[7] ITU-T G.775 (1998), *Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) and clearance criteria for PDH signals.*

[8] ITU-T G.781 (1999), *Synchronization layer functions.*

[9] ITU-T G.783 (2000), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks.*

[10] ITU-T G.805 (2000), *Generic functional architecture of transport networks.*

[11] ITU-T G.806 (2000), *Characteristics of transport equipment – Description methodology and generic functionality.*

[12] ITU-T G.810 (1996), *Definitions and terminology for synchronization networks.*

[13] ITU-T G.812 (1998), *Timing requirements of slave clocks suitable for use as node clocks in synchronization networks.*

[14] ITU-T G.823 (2000), *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.*

[15] ITU-T G.824 (2000), *The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy.*

[16] ITU-T G.826 (1999), *Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate.*

[17] ITU-T M.3010 (2000), *Principles for a telecommunications management network.*

[18] ITU-T G.742 (1988), *Second order digital multiplex equipment operating at 8448 kbit/s and using positive justification*

[19] ITU-T 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*

3 Terms and Definitions

This Recommendation uses the following terms:

access point (AP): See ITU-T G.805 [10].

access point identifier (APId): See ITU-T G.831.

adaptation function (A): See ITU-T G.805.

adapted information (AI): See ITU-T G.806 [11].

administrative unit (AU): See ITU-T G.707.

administrative unit group (AUG): See ITU-T G.707.

alarm: See ITU-T G.806.

all-ONEs: See ITU-T G.806.

anomaly: See ITU-T G.806.

atomic function: See ITU-T G.806.

AUn-AIS: See ITU-T G.707.

bidirectional trail/connection type: See ITU-T G.806.

bit interleaved parity (BIP): See ITU-T G.707.

broadcast connection type: See ITU-T G.806.

characteristic information (CI): See ITU-T G.806.

client/server layer: See ITU-T G.806.

connection: See ITU-T G.805.

connection function (C): See ITU-T G.806.

connection matrix (CM): See ITU-T G.806.

connection point (CP): See ITU-T G.806.

consolidation: See ITU-T G.806.

common management information service element (CMISE): See ITU-T X.710 and ISO/IEC 9595.

compound function: See ITU-T G.806.

data communications channel (DCC): See ITU-T G.784.

defect: See ITU-T G.806.

failure: See ITU-T G.806.

fault: See ITU-T G.806.

fault cause: See ITU-T G.806.

function: See ITU-T G.806.

grooming: See ITU-T G.806.

layer: See ITU-T G.806.

management information (MI): See ITU-T G.806.

management point (MP): See ITU-T G.806.

network connection (NC): See ITU-T G.805.

network element function (NEF): See ITU-T G.784.

path: See ITU-T G.806.

pointer justification event (PJE): See ITU-T G.783 [9].

process: See ITU-T G.806.

reference point: See ITU-T G.806.

remote defect indication (RDI): See ITU-T G.806.

remote error indication (REI): See ITU-T G.806.

remote information (RI): See ITU-T G.806.

remote point (RP): See ITU-T G.806.

server signal degrade (SSD): See ITU-T G.806.

server signal fail (SSF): See ITU-T G.806.

signal degrade (SD): See ITU-T G.806.

signal fail (SF): See ITU-T G.806.

sub-network connection (SNC): See ITU-T G.805.

telecommunications management network (TMN): See ITU-T M.3010.

termination connection point (TCP): See ITU-T G.806.

timing information (TI): See ITU-T G.806.

timing point (TP): See ITU-T G.806.

trail: See ITU-T G.805.

trail signal degrade (TSD): See ITU-T G.806.

trail signal fail (TSF): See ITU-T G.806.

trail termination function (TT): See ITU-T G.806.

trail trace identifier (TTI): See ITU-T G.707.

NE transit delay: See ITU-T G.806.

tributary unit (TU-m): See ITU-T G.707.

TUm-AIS: See ITU-T G.707.

virtual container (VC-n): See ITU-T G.707.

undefined bit: See ITU-T G.806.

undefined byte: See ITU-T G.806.

4 Abbreviations

This Recommendation uses the following abbreviations:

A	Adaptation function
AcSL	Accepted Signal Label
AcTI	Accepted Trace Identifier
ADM	Add-Drop Multiplexer
AI	Adapted Information
AIS	Alarm Indication Signal
AP	Access Point
APId	Access Point Identifier
ATM	Asynchronous Transfer Mode
AU	Administrative Unit
AU-n	Administrative Unit, level n
AUG	Administrative Unit Group
BER	Bit Error Ratio
BBER	Background Block Error Ratio
BIP	Bit Interleaved Parity
C	Connection function
CI	Characteristic Information
CK	Clock
CM	Connection Matrix
CMISE	Common Management Information Service Element
CP	Connection Point
CRC	Cyclic Redundancy Check

CRC-N	Cyclic Redundancy Check, width N
CSES	Consecutive Severely Errored Second
D	Data
DCC	Data Communications Channel
DS	Defect Second
DEC	Decrement
DEG	Degraded
DEGTHR	Degraded Threshold
DXC	Digital Cross Connect
E0	Electrical interface signal 64 kbit/s
E11	Electrical interface signal 1544 kbit/s
E12	Electrical interface signal 2048 kbit/s
E22	Electrical interface signal 8448 kbit/s
E31	Electrical interface signal 34 368 kbit/s
E32	Electrical interface signal 44 736 kbit/s
E4	Electrical interface signal 139 264 kbit/s
EBC	Errored Block Count
EDC	Error Detection Code
EDCV	Error Detection Code Violation
EMF	Equipment Management Function
EQ	Equipment
ES	Electrical Section
ES1	Electrical Section, level 1
ES	Errored Second
Eq	ITU-T G.703 [2] type electrical signal, bit rate order q (q=11, 12, 21, 22, 31, 32, 4)
ExSL	Expected Signal Label
ExTI	Expected Trace Identifier
F_B	Far-end Block
F_DS	Far-end Defect Second
F_EBC	Far-end Errored Block Count
FAS	Frame Alignment Signal
FIFO	First In First Out
FM	Fault Management
FOP	Failure Of Protocol
FS	Forced Switch
FS	Frame Start signal
HO	Higher Order
HOA	Higher Order Assembler
HOI	Higher Order Interface
HOVC	Higher Order Virtual Container
HP	Higher order Path

HPA	Higher order Path Adaptation
HPC	Higher order Path Connection
HPOM	Higher order Path Overhead Monitor
HPP	Higher order Path Protection
HPT	Higher order Path Termination
HSUT	Higher order path Supervisory Unequipped Termination
HTCA	Higher order path Tandem Connection Adaptation
HTCT	Higher order path Tandem Connection Termination
HTCM	Higher order path Tandem Connection Monitor
HUG	Higher order path Unequipped Generator
ID	Identifier
IEC	Incoming Error Count
IF	In Frame state
INC	Increment
IncAIS	Incoming AIS
LC	Link Connection
LO	Lockout
LO	Lower Order
LOA	Loss Of Alignment; generic for LOF, LOM, LOP
LOF	Loss Of Frame
LOI	Lower Order Interface
LOM	Loss Of Multiframe
LOP	Loss Of Pointer
LOS	Loss of Signal
LOVC	Lower Order Virtual Container
LP	Lower order Path
LPA	Lower order Path Adaptation
LPC	Lower order Path Connection
LPOM	Lower order Path Overhead Monitor
LPP	Lower order Path Protection
LPT	Lower order Path Termination
LTC	Loss of Tandem Connection
LTCA	Lower order path Tandem Connection Adaptation
LTCT	Lower order path Tandem Connection Termination
LTCM	Lower order path Tandem Connection Monitor
LTI	Loss of all Incoming Timing references
LUG	Lower order path Unequipped Generator
MC	Matrix Connection
MCF	Message Communication Function
MI	Management Information
MON	Monitored

MP	Management Point
MRTIE	Maximum Relative Time Interval Error
MS	Manual Switch
MSB	Most Significant Bit
MTIE	Maximum Time Interval Error
N_B	Near-end Block
N_BBE	Near-end Background Block Error
N_DS	Near-end Defect Second
N_EBC	Near-end Errored Block Count
NC	Network Connection
N.C.	Not Connected
NDF	New Data Flag
NE	Network Element
NEF	Network Element Function
NNI	Network Node Interface
NMON	Not Monitored
NU	National Use
OAM	Operation, Administration and Maintenance
ODI	Outgoing Defect Indication
OEI	Outgoing Error Indication
OF_B	Outgoing Far-end Block
OF_BBE	Outgoing Far-end Background Block Error
OF_DS	Outgoing Far-end Defect Second
OF_EBC	Outgoing Far-end Errored Block Count
OFS	Out-of-Frame Second
OHA	OverHead Access
ON_B	Outgoing Near-end Block
ON_BBE	Outgoing Near-end Background Block Error
ON_DS	Outgoing Near-end Defect Second
ON_EBC	Outgoing Near-end Errored Block Count
OOF	Out Of Frame
OSF	Outgoing Signal Fail
OW	Order Wire
P0x	64 kbit/s layer (transparent)
P11x	1544 kbit/s layer (transparent)
P12s	2048 kbit/s PDH path layer with synchronous 125 μs frame structure according to ITU-T G.704 [3]
P12x	2048 kbit/s layer (transparent)
P21x	6312 kbit/s layer (transparent)
P22e	8448 kbit/s PDH path layer with 4 plesiochronous 2048 kbit/s
P22x	8448 kbit/s layer (transparent)

P31e	34 368 kbit/s PDH path layer with 4 plesiochronous 8448 kbit/s
P31s	34 368 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T G.832
P31x	34 368 kbit/s layer (transparent)
P32x	44 736 kbit/s layer (transparent)
P4a	139 264 kbit/s PDH path layer with 3 plesiochronous 44 736 kbit/s
P4e	139 264 kbit/s PDH path layer with 4 plesiochronous 34 368 kbit/s
P4s	139 264 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T G.832
P4x	139 264 kbit/s layer (transparent)
PHD	Plesiochronous Digital Hierarchy
PG	Pointer Generator
PLM	PayLoad Mismatch
PPI	PDH Physical Interface
PJC	Pointer Justification Count
PJE	Pointer Justification Event
PM	Performance Monitoring
POH	Path OverHead
PP	Pointer Processor
Pq	PDH path layer, bit rate order q (q=11, 12, 21, 22, 31, 32, 4)
PRC	Primary Reference Clock
PS	Protection Switching
PSE	Protection Switch Event
PTR	Pointer
RDI	Remote Defect Indication
REI	Remote Error Indication
RI	Remote Information
RP	Remote Point
RxSL	Received Signal Label
RxTI	Received Trace Identifier
S11	VC-11 path layer
S11D	VC-11 tandem connection sublayer
S11P	VC-11 path protection sublayer
S12	VC-12 path layer
S12D	VC-12 tandem connection sublayer
S12P	VC-12 path protection sublayer
S2	VC-2 path layer
S2D	VC-2 tandem connection sublayer
S2P	VC-2 path protection sublayer
S3	VC-3 path layer

S3D	VC-3 tandem connection sublayer using TCM definition according to Annex D/G.707 (option 2)
S3P	VC-3 path protection sublayer
S3T	VC-3 tandem connection sublayer using TCM definition according to Annex C/G.707 (option 1)
S4	VC-4 path layer
S4D	VC-4 tandem connection sublayer using TCM definition according to Annex D/G.707 (option 2)
S4P	VC-4 path protection sublayer
S4T	VC-4 tandem connection sublayer using TCM definition according to Annex C/G.707 (option 1)
SD	Signal Degrade
SDH	Synchronous Digital Hierarchy
SES	Severely Errored Second
SETG	Synchronous Equipment Timing Generator
SETPI	Synchronous Equipment Timing Physical Interface
SETS	Synchronous Equipment Timing Source
SF	Signal Fail
Sk	Sink
Sm	lower order VC-m layer (m=11,12,2,3)
SmD	VC-m (m=11,12,2,3) tandem connection sublayer
Smm	VC-m (m=11,12,2,3) path layer non-intrusive monitor
Sms	VC-m (m=11,12,2,3) path layer supervisory-unequipped
Sn	higher order VC-n layer (n=3, 4)
SnD	VC-n (n=3, 4) tandem connection sublayer using TCM definition according to Annex D/G.707 (option 2)
Snm	VC-n (n=3, 4) path layer non-intrusive monitor
SnP	VC-n (n=3, 4) path protection sublayer
Sns	VC-n (n=3, 4) path layer supervisory-unequipped
SnT	VC-n (n=3, 4) tandem connection sublayer using TCM definition according to Annex C/G.707 (option 1)
SNC	Sub-Network Connection
SNC/I	Inherently monitored Sub-Network Connection protection
SNC/N	Non-intrusively monitored Sub-Network Connection protection
SNC/S	Sublayer (tandem connection) monitored Sub-Network Connection protection
So	Source
SOH	Section Overhead
SPI	SDH Physical Interface
SPRING	Shared Protection Ring
SSD	Server Signal Degrade
SSF	Server Signal Fail
SSM	Synchronization Status Message

SSU	Synchronization Supply Unit
STM	Synchronous Transport Module
TCM	Tandem Connection Monitor
TCP	Termination Connection Point
TD	Transmit Degrade
TF	Transmit Fail
TFAS	Trail Trace identifier Frame Alignment Signal
TI	Timing Information
TIM	Trace Identifier Mismatch
TMN	Telecommunications Management Network
TP	Timing Point
TPmode	Termination Point mode
TS	Time Slot
TSD	Trail Signal Degrade
TSF	Trail Signal Fail
TSL	Trail Signal Label
TT	Trail Termination function
TTs	Trail Termination supervisory function
TTI	Trail Trace Identifier
TTP	Trail Termination Point
TU	Tributary Unit
Tu-m	Tributary Unit, level m
TUG	Tributary Unit Group
TUG-m	Tributary Unit Group, level m
TxSL	Transmitted Signal Label
TxTI	Transmitted Trace Identifier
UNEQ	UNEquipped
UNI	User Network Interface
USR	User channels
VC	Virtual Container
VC-n	Virtual Container, level n
VP	Virtual Path
W	Working

5 Conventions

This Recommendation uses the same specification methodology as defined in clause 5/G.806.

5.1 PDH specific transmission layer names

The layer names related to PDH are:

Name	Layer	Defined in
Sn	SDH VC-n path layer	ITU-T G.783 [9]
SnP	SDH VC-n trail protection sublayer	ITU-T G.783
SnD	SDH VC-n TCM option 2 sublayer	ITU-T G.783
SnT	SDH VC-n TCM option 1 sublayer	ITU-T G.783
Eq	PDH Electrical Section	ITU-T G.705
Pqe	Plesiochronous framed PDH layer	ITU-T G.705
Pqs	Synchronous framed PDH layer	ITU-T G.705
Pqx	Unframed PDH layer	ITU-T G.705
NS	Network Synchronization layer	ITU-T G.781 [8]
SD	Synchronization Distribution layer	ITU-T G.781

6 Supervision Processes and Management Information flows

Generic behaviour for supervision processes is described in clause 6/G.806 [11].

6.1 Trail Termination Point Mode and Port Mode

See 6.1/G.806.

6.2 Defects

6.2.1 Continuity Supervision

Generic continuity supervision defects are described in 6.2.1/G.806. PDH specific continuity supervision defects are described here.

6.2.1.1 Loss Of Signal defect (dLOS)

See ITU-T G.775 [7].

6.2.2 Connectivity Supervision

All connectivity supervision processes are generic and described in 6.2.2/G.806.

6.2.3 Signal quality supervision

All signal quality supervision processes are generic and described in 6.2.3/G.806.

6.2.4 Payload type supervision

All payload type supervision processes are generic and described in 6.2.4/G.806.

6.2.5 Alignment supervision

Generic alignment supervision defects are described in 6.2.5/G.806. PDH specific alignment supervision defects are described here.

6.2.5.1 P*q*e (*q*=4, 31, 22) Loss of Frame defect (dLOF)

The function shall detect a loss of frame defect (dLOF) for E4, E31, and E22 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.

6.2.5.2 P32e Loss of Frame defect (dLOF)

Loss of frame alignment (dLOF) shall be assumed to have taken place when a particular density of F-bit, and possibly M-bit errors in the P32 format are detected. Typical industry practice utilizes a criterion of three (or more) in 16 (or fewer) consecutive F-bits. When frame alignment is assumed to be lost, the frame alignment device shall decide that such alignment has effectively been recovered when it detects typically zero F-bit and M-bit errors in the frame alignment algorithm used. In addition, a Severely Errored Frame (dSEF) shall be assumed when three or more F-bits in 16 consecutive F-bits are detected. A SEF is terminated when the signal is in-frame and there are less than three F-bit errors in 16 consecutive F-bits.

6.2.5.3 P21e Loss of Frame defect (dLOF)

Loss of frame alignment (dLOF) shall be assumed to have taken place when a particular density of F-bit, and sometimes M-bit errors in the P21 format are detected. When frame alignment is assumed to be lost, the frame alignment device shall decide that such alignment has effectively been recovered when it detects typically zero F-bit and M-bit errors in the frame alignment algorithm used.

6.2.5.4 P12s Loss of Frame defect (dLOF)

The function shall detect and clear dLOF defects as specified by ITU-T G.706.

6.2.5.5 P*q*s (*q*=4, 31) Loss of Frame defect (dLOF)

If the frame alignment is deemed to be lost (OOF state), a P*q*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).

6.2.5.6 P*q*s Loss Of Multiframe defect (dLOM)

If the multiframe alignment process (see 8.2.5) is in the OOM state and the MA[6-7] multiframe is not recovered within X ms, a dLOM defect shall be declared. Once in a dLOM state, this state shall be exited when the multiframe is recovered (multiframe alignment process enter the IM state). X shall be a value in the range 1 ms to 5 ms. X is not configurable.

6.2.5.7 Loss Of Pointer defect (dLOP)

TU-m dLOP: See Annex A/G.783.

6.2.6 Maintenance signal supervision

All maintenance signal supervision processes are generic and described in 6.2.6/G.806.

6.2.7 Protocol supervision

All protocol supervision processes are generic and described in 6.2.7/G.806.

6.3 Consequent actions

All consequent actions are generic and described in 6.3/G.806.

6.4 Defect correlations

All defect correlations are generic and described in 6.4/G.806.

6.5 One second window for performance monitoring

The one second window for performance monitoring is generic and described in 6.5/G.806.

7 Information flow (XXX_MI) across the XXX_MP reference points

See clause 7/G.806 for generic description of information flow. PDH specific information flow is described in the applicable atomic functions.

8 Generic processes

8.1 Line coding and scrambling processes

Generic description of line coding and scrambling is described in 8.1/G.806. PDH specific line codings are described in the applicable atomic functions.

8.2 Alignment Processes

Generic description of alignment processes is described in 8.2/G.806. PDH specific alignment processes are described here.

8.2.1 P*q*e (*q*=4, 31, 22) frame alignment

The function shall perform the frame alignment of the P*q*e (*q*=4, 31, 22) to recover the frame start signal FS. Loss of frame alignment shall be assumed to have taken place when four consecutive frame alignment signals have been incorrectly received in their predicted positions.

When frame alignment is assumed to be lost, the frame alignment device shall decide that such alignment has effectively been recovered when it detects the presence of three consecutive frame alignment signals.

The frame alignment device having detected the appearance of a single correct frame alignment signal, shall begin a new search for the frame alignment signal when it detects the absence of the frame alignment signal in one of the two following frames.

8.2.2 P32 frame alignment

The function shall perform the frame alignment of the P32 to recover the frame start signal FS. Loss of frame alignment shall be assumed to have taken place when a particular density of F-bit, and possibly M-bit errors in the P32 format are detected. Typical industry practice utilizes a criterion of three (or more) in 16 (or fewer) consecutive F-bits. When frame alignment is assumed to be lost, the frame alignment device shall decide that such alignment has effectively been recovered when it detects typically zero F-bit and M-bit errors in the frame alignment algorithm used. In addition, a Severely Errored Frame (SEF) shall be assumed when three or more F-bits in 16 consecutive F-bits are detected. A SEF is terminated when the signal is in-frame and there are less than three F-bit errors in 16 consecutive F-bits.

8.2.3 P21e frame alignment

The function shall perform the frame alignment of the P21 to recover the frame start signal FS. Loss of frame alignment shall be assumed to have taken place when a particular density of F-bit, and sometimes M-bit errors in the P21 format are detected. When frame alignment is assumed to be lost, the frame alignment device shall decide that such alignment has effectively been recovered when it detects typically zero F-bit and M-bit errors in the frame alignment algorithm used.

8.2.4 P12s frame and multiframe alignment

The (250 µs) basic frame and (2 ms) CRC-4 multiframe phase recovery process shall operate as specified in ITU-T G.706 [4]. Either the manual, or the automatic, or both manual and automatic interworking modes shall be supported.

The process shall generate a multiframe present signal (CI_MFP) according the following rules:

– CI_MFP shall be FALSE when the CRC4mode is OFF.

– CI_MFP shall be FALSE when the CRC4mode is ON and the frame alignment process has not yet found multiframe alignment. CI_MFP shall be TRUE when multiframe alignment has been found.

– CI_MFP shall be FALSE when the CRC4mode is AUTO and the frame alignment process is in the states out-of-primary-BFA, in-primary-BFA, CRC-4 MFA search, assume-crc-to-non-crc-interworking. CI_MFP shall be TRUE if the frame alignment process is in the state assume-crc-to-crc-interworking.

8.2.5 P*q*s (*q*=4, 31) frame alignment

The frame alignment of the P*q*s (*q*=31, 4) shall be found by searching for the A1, A2 bytes contained in the 139 264 or 34 368 kbit/s signal. The frame signal shall be continuously checked with the presumed frame start position for the alignment. Figure 8-1 shows the frame alignment state diagram.

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);

– 986 or more frames with one or more BIP-8 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 1 – This process is identical with the BIP-8 violation process of the Pqs_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 2 – The above is required in order to avoid repeated alignment on to a simulation of the framing location.

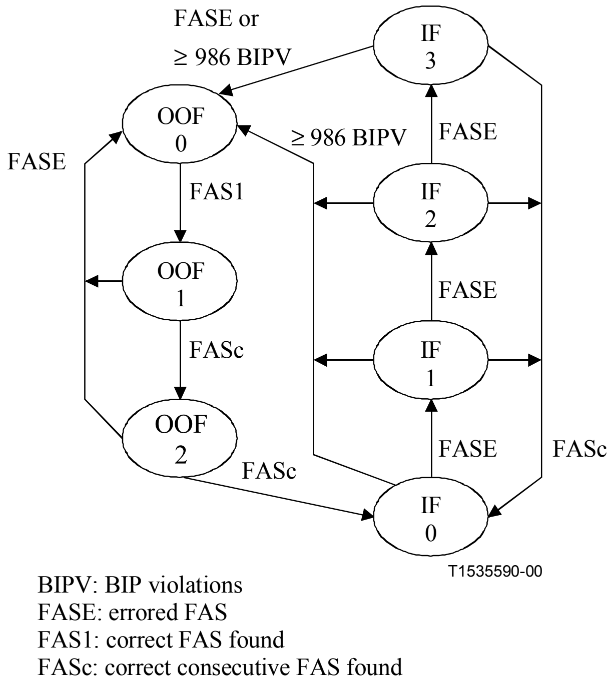


Figure 8-1/G.705 – Frame alignment state diagram

8.2.6 Lower order VC-1, VC-2 multiframe alignment

Lower order VC-1, VC-2 multiframe alignment is described in 6.2.5.2/G.783.

8.2.7 Tandem connection multiframe alignment

P31s, P4s: Multiframe alignment shall be performed on bits 7 and 8 of byte NR to recover the TTI, RDI, and ODI signals transported within the multiframed bits. The multiframe alignment shall be found by searching for the pattern "1111 1111 1111 1110" within the bits 7 and 8 of byte NR. The signal shall be continuously checked with the presumed multiframe start position for the alignment.

Frame alignment is deemed to have been lost [entering Out of Multiframe (OOM) state] when two consecutive FAS are detected in error (i.e. 1 error in each FAS).

Frame alignment is deemed to have been recovered [entering In Multiframe (IM) state] when one non-errored FAS is found.

8.3 Signal quality supervision processes

All signal quality supervision processes are generic and described in 8.3/G.806.

8.4 BIP compensation processes

All BIP compensation processes are generic and described in 8.4/G.806.

9 PDH Physical Layer (E*q*) (*q*=4, 31, 32, 22, 21, 12, 11)

The PDH physical section layers are the 139 264, 44 736, 34 368, 6312, 2048 and 1554 kbit/s section layers.

9.1 E*q* Section Layer Functions (*q*=4, 32, 31, 22, 21, 12, 11)

The PDH 1554 kbit/s hierarchy physical section layers are the 44 736, 6312, and 1554 kbit/s section layers. The PDH 2048 kbit/s hierarchy physical section layers are the 139 264, 34 368, 8448 and 2048 kbit/s section layers.

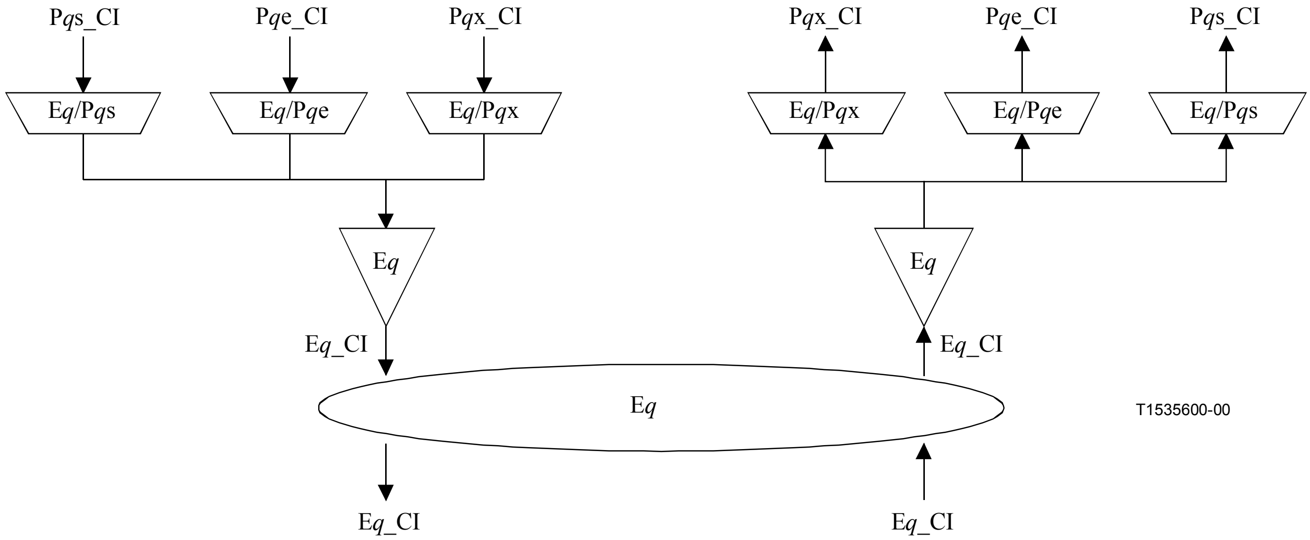


Figure 9-1/G.705 – PDH Electrical section layer (E*q*, (*q*=4, 32, 31, 22, 21, 12, 11)) atomic functions

(The E*q*_C function is for further study. It should be noted that it cannot be used for modelling of loopbacks.)

Figure 9-1 shows that more than one adaptation function exists in the Eq layer that can be connected to one Eq access point. For the case of the adaptation source functions, only one of these adaptation source functions is allowed to be activated. For this activated source, access to the access point by other adaptation source functions shall be denied. 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.

NOTE 1 – If one adaptation function only is connected to the AP, it will be activated. If one or more other functions are connected to the same AP, one out of the set of functions will be active.

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 ITU-T G.703 [2].

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 G.751 [19]. It contains four 34 368 kbit/s tributary signals (see Figure 9-2).

The information passing across the E4/P4s AP is a 139 264 kbit/s signal with co-directional bit timing specified by ITU-T G.832 (see Figure 9-3).

E32 layer CP

The Characteristic Information E32_CI on the intra-station electrical layer CP is a digital, B3ZS encoded, electrical signal of defined amplitude, bit rate and pulse shape as defined in ITU-T G.703.

E32 layer AP

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

The information passing across the E32/P32e AP is a 44 736 kbit/s signal with co-directional bit timing specified by ITU-T G.704 [3] or G.752 [6] (see Figure 9-4).

NOTE 2 – The signal specified by ITU-T G.752 is included for interworking with older G.752 equipment. It should only be supported when interworking with older G.752 equipment as it does not support far-end maintenance.

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 ITU-T G.703.

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 G.751. It contains four 8448 kbit/s tributary signals (see Figure 9-5).

The information passing across the E31/P31s AP is a 34 368 kbit/s signal with co-directional bit timing specified by ITU-T G.832 (see Figure 9-6).

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 ITU-T G.703.

E22 layer AP

The information passing across the E22/P22x AP is a 8448 kbit/s signal with co-directional bit timing.

The information passing across the E22/P22e AP is a 8448 kbit/s signal with co-directional bit timing. It contains four 2048 kbit/s tributary signals (see Figure 9-7).

E21 layer CP

The Characteristic Information E21_CI on the intra-station electrical layer CP is a digital, B6ZS encoded, electrical signal of defined amplitude, bit rate and pulse shape as defined in ITU-T G.703.

E21 layer AP

The information passing across the E21/P21x AP is a plesiochronous 6312 kbit/s signal of non-specified content with co-directional bit timing.

The information passing across the E21/P21e AP is a 6312 kbit/s signal with co-directional bit timing specified by ITU-T G.743 [5] or G.747.

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 ITU-T G.703.

NOTE 3 – This Recommendation is limited to the Network Node Interface (NNI).

E12 layer AP

The information passing across the E12/P12x AP is a 2048 kbit/s signal with co-directional bit timing.

The information passing across the E12/P12s AP is a 2048 kbit/s signal with co-directional bit timing with a frame structure specified by ITU-T G.703 (see Figure 9-8).

E11 layer CP

The Characteristic Information E11_CI on the intra-station electrical layer CP is a digital, B8ZS or AMI encoded, electrical signal of defined amplitude, bit rate and pulse shape as defined in ITU-T G.703.

NOTE 4 – B8ZS allows supporting unconstrained clear channel applications.

E11 layer AP

The information passing across the E11/P11x AP is a 1544 kbit/s signal with co-directional bit timing.

The information passing across the E11/P11s AP is a 1544 kbit/s signal with co-directional bit timing with a frame structure specified by ITU-T G.704.

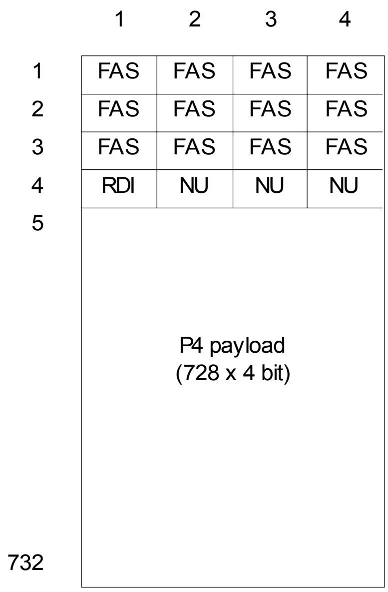


Figure 9-2/G.705 – Decoded E4/P4e_AI_D signal

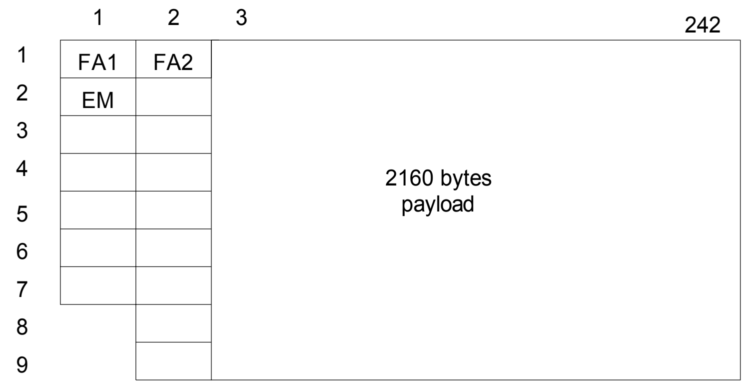
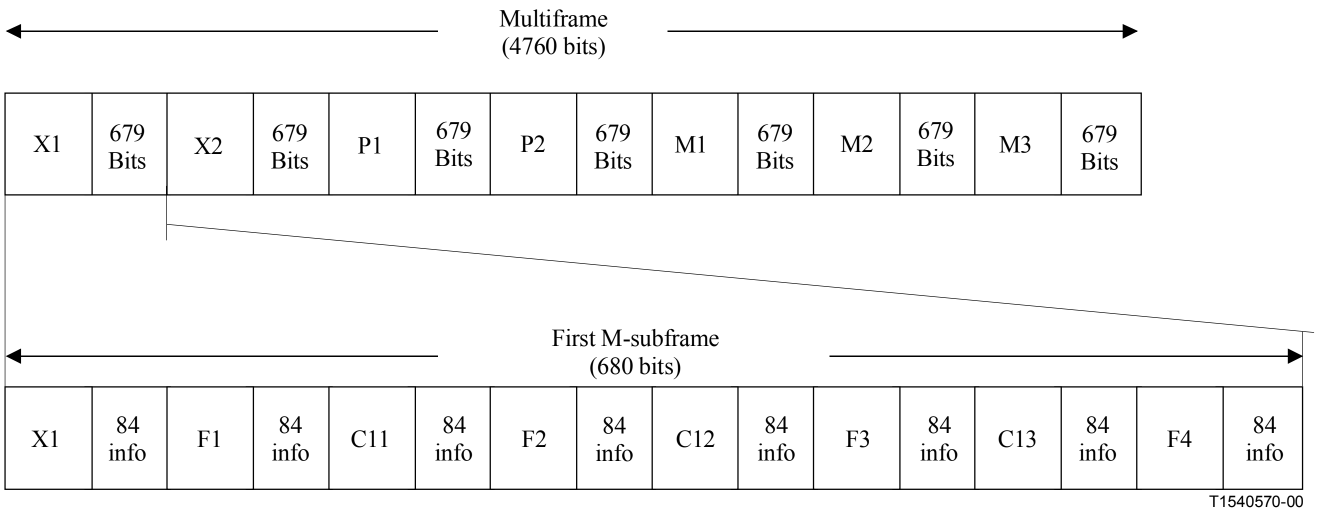


Figure 9-3/G.705 – Decoded E4/P4s_AI_D signal



The 56 overhead bits sequential positions as follows:							
X1	F1	C11	F2	C12	F3	X13	F4
X2	F1	C21	F2	C22	F3	X23	F4
P1	F1	C31	F2	C32	F3	C33	F4
P2	F1	C41	F2	C42	F3	C43	F4
M1	F1	C51	F2	C52	F3	C53	F4
M2	F1	C61	F2	C62	F3	C63	F4
M3	F1	C71	F2	C72	F3	C72	F4

Figure 9-4/G.705 – Decoded E32/P32e_AI_D signal

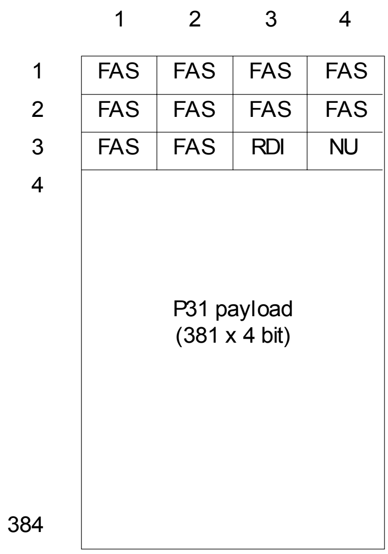


Figure 9-5/G.705 – Decoded E31/P31e_AI_D signal

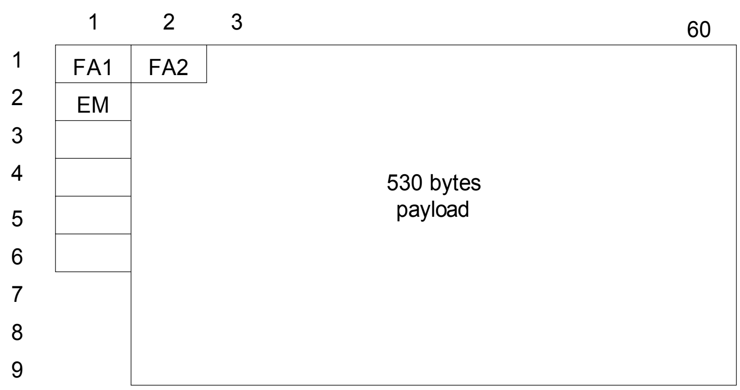


Figure 9-6/G.705 – Decoded E31/P31s_AI_D signal

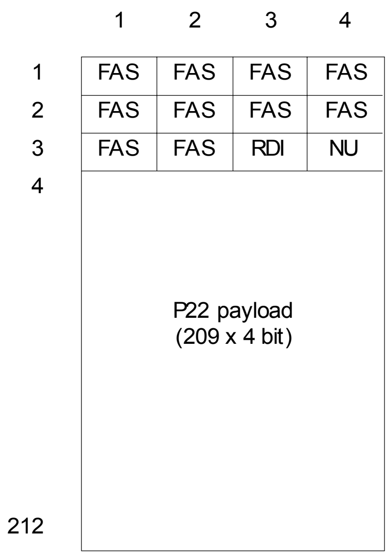


Figure 9-7/G.705 – Decoded E22/P22e_AI_D signal

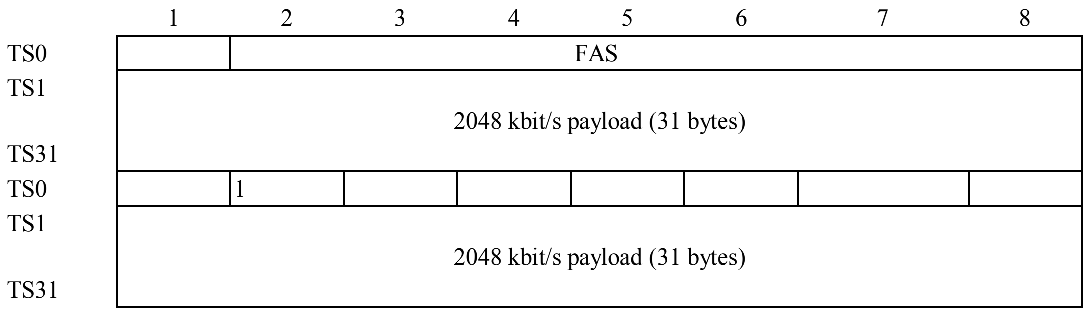


Figure 9-8/G.705 – Decoded E12/P12s_AI_D (without CRC-4 multiframe)

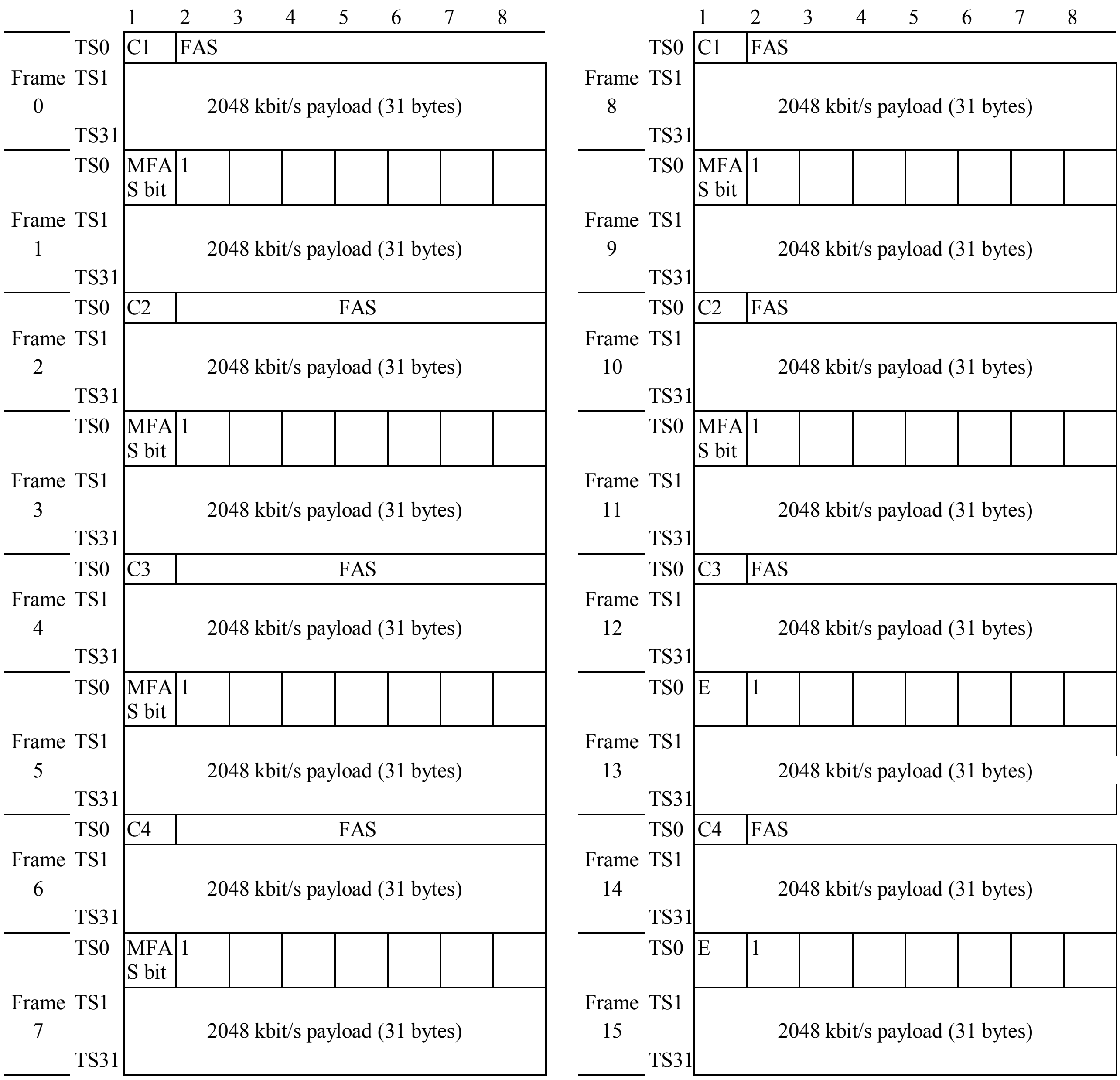


Figure 9-9/G.705 – Decoded E12/P12s_AI_D (with CRC-4 multiframe)

9.1.1 E*q* Connection functions (N/A)

For further study.

9.1.2 E*q* Trail Termination functions (*q*=4,31,22,12)

9.1.2.1 E*q* Trail Termination Source E*q*_TT_So (*q*=4, 32, 31, 22, 21, 11), E12-Z_TT_So

NOTE – E12-Z Z (Ω) will be one value out of the set: {75, 120} (Ω).

Symbol

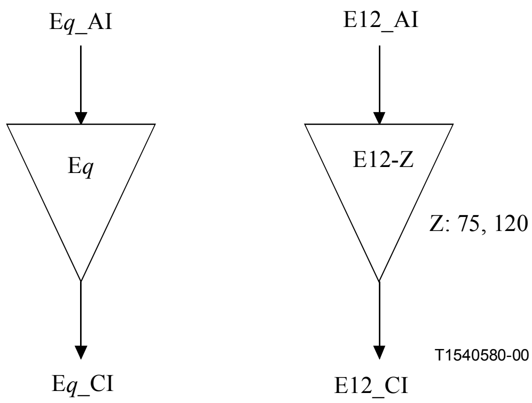


Figure 9-10/G.705 – E*q*_TT_So and E12-Z_TT_So symbol

Interfaces

Table 9-1/G.705 – E*q*_TT_So input and output signals

Input(s)	Meaning
Eq_AI_D	Eq_CI_D

Processes

This function generates the electrical Intra-station Section Layer signal E*q* specified by ITU-T G.703.

For E4:

Pulse shape: The function shall meet the requirement specified by ITU-T G.703.

Peak to Peak Voltage: The function shall meet the requirement specified by ITU-T G.703.

Rise time: The function shall meet the requirement specified by ITU-T G.703.

Pair(s) in each direction: The function shall meet the requirement specified by ITU-T G.703.

Output return loss: The function shall meet the requirement specified by ITU-T G.703.

For E32, E31, E22, E21, E12, E11:

Pulse shape: The function shall meet the requirement specified by ITU-T G.703.

Nominal Peak to Peak Voltage of a mark (pulse): The function shall meet the requirement specified by ITU-T G.703.

Peak voltage of a space (no pulse): The function shall meet the requirement specified by ITU-T G.703.

Nominal pulse width: The function shall meet the requirement specified by ITU-T G.703.

Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval: The function shall meet the requirement specified by ITU-T G.703.

Ratio of widths of positive and negative pulses at the nominal half amplitude: The function shall meet the requirement specified by ITU-T G.703.

Pair(s) in each direction: The function shall meet the requirement specified by ITU-T G.703.

Output return loss: The function shall meet the requirement specified by ITU-T G.703.

Output signal balance: For the case of a E12 120 Ω interface, the function shall meet the requirement specified by ITU-T G.703.

Defects: None.

Consequent Actions: None.

Defect Correlation: None.

Performance Monitoring: None.

9.1.2.2 E*q* Trail Termination Sink E*q*_TT_Sk (*q*=4, 32, 31, 22, 21, 11) E12-Z_TT_Sk

NOTE 1 – E12-Z Z (Ω) will be one value out of the set: {75, 120} (Ω).

Symbol

Figure 9-11/G.705 – E*q*_TT_Sk and E12-Z_TT_Sk symbol

Interfaces

Table 9-2/G.705 – E*q*_TT_Sk input and output signals

Input(s)	Output(s)
Eq_CI_D Eq_TT_Sk_MI_PortMode	Eq_AI_D Eq_AI_TSF Eq_TT_Sk_MI_cLOS

Processes

This function recovers the electrical Intra-station Section Layer signal E*q* specified by ITU-T G.703.

Input return loss: The function shall meet the requirement specified by ITU-T G.703.

Port Mode: The function shall have a port mode as specified by 6.1/G.806.

NOTE 2 – The AUTO state of the port mode process is optional.

Defects

The function shall detect Loss Of Signal defect (dLOS) according to ITU-T G.775.

Consequent Actions

aTSF ← dLOS

Defect Correlation

cLOS ← MON and dLOS

Performance Monitoring: None.

9.1.3 E*q* Adaptation functions (*q*=4, 32, 31, 22, 21, 12, 11)

9.1.3.1 E*q* to P*q*x Adaptation Source E*q*/P*q*x_A_So (*q*=4, 32, 31, 22, 21, 12, 11)

Symbol

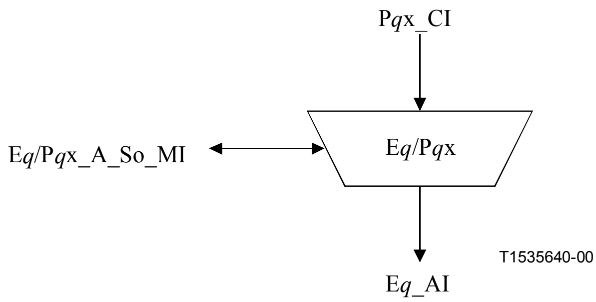


Figure 9-12/G.705 – E*q*/P*q*x_A_So symbol

Interfaces

Table 9-3/G.705 – E*q*/P*q*x_A_So input and output signals

Input(s)	Output(s)
Pqx_CI_D Pqx_CI_CK Eq/Pqx_A_So_MI_Active	Eq_AI_D

Processes

This function provides the CMI encoding of the 139 264 kbit/s information stream or the HDB3 encoding of the 34 368, 8448, 2048 kbit/s information stream or the B3ZS encoding of the 44 736 kbit/s or the B6ZS encoding of the 6312 kbit/s or the AMI or B8ZS encoding of the 1544 kbit/s as defined in ITU-T G.703.

CMI encoder: The function shall perform CMI encoding of the data specified by ITU-T G.703.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ITU-T G.703.

B3ZS encoder: The function shall perform B3ZS encoding of the data as specified in ITU-T G.703.

B6ZS encoder: The function shall perform B6ZS encoding of the data as specified in ITU-T G.703.

AMI or B8ZS encoder: The function shall perform AMI or B8ZS encoding of the data as specified in ITU-T G.703.

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.

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 Correlation: None.

Performance Monitoring: None.

9.1.3.2 E*q* to P*q*x Adaptation Sink E*q*/P*q*x_A_Sk (*q*=4, 32, 31, 22, 21, 12, 11)

Symbol

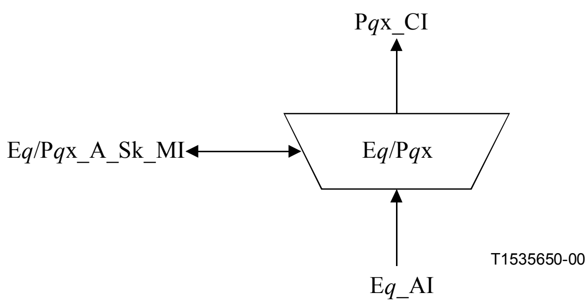


Figure 9-13/G.705 – E*q*/P*q*x_A_Sk symbol

Interfaces

Table 9-4/G.705 – E*q*/P*q*x_A_Sk input and output signals

Input(s)	Output(s)
Eq_AI_D Eq_AI_TSF Eq/Pqx_A_Sk_MI_Active	Pqx_CI_D Pqx_CI_CK Pqx_CI_SSF

Processes

This function regenerates the received signal, recovers bit timing (CK) from the received signal, and CMI decodes the incoming electrical 139 264 kbit/s signal, or the B3ZS decoding of the 44 736 kbit/s, or HDB3 decodes the incoming electrical 34 368, 8448 or 2048 signal, or the B6ZS decoding of the 6312 kbit/s, or the B8ZS (or AMI) decoding of the 1544 kbit/s as defined in ITU-T G.703.

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 ITU-T G.703;

– jitter modulation applied to the input signal with any value defined in ITU-T G.823 or G.824;

– the input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm, 44 736 kbit/s ± 20 ppm, 34 368 kbit/s ± 20 ppm, 8448 kbit/s ± 30 ppm, 6312 kbit/s ± 30 ppm, 2048 kbit/s ± 50 ppm, 1544 kbit/s ± 130 ppm;
– for E31, E22, E12 the input signal has an interfering signal specified by ITU-T G.703.
– for the case of a 120 Ω interface, the input signal has an longitudinal voltage specified by ITU-T G.703.

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 ITU-T G.703.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ITU-T G.703.

B3ZS decoding: The function shall perform B3ZS decoding of the data as specified in ITU-T G.703.

B6ZS decoding: The function shall perform B6ZS decoding of the data as specified in ITU-T G.703.

AMI or B8ZS decoding: The function shall perform AMI or B8ZS decoding of the data as specified in ITU-T G.703.

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) for all signals except the E32. For E32, it shall transmit the framed AIS signal as specified in ITU-T G.704 at its output (CI_D). It shall not report its status via the management point.

Defects: None.

Consequent Actions

aSSF ← AI_TSF

aAIS ← AI_TSF

On declaration of aAIS the function shall output an AIS signal (all-ONEs signal for E4, E31, E22, E21, E12 and E11; framed AIS signal as specified in ITU-T G.704 for E32) complying to the frequency limits for this signal (a bit rate in range 139 264 kbit/s ± 15 ppm (q=4), 44 736 ± 20 ppm (q=32), 34 368 kbit/s ± 20 ppm (q=31), 8448 kbit/s ± 30 ppm (q=22), 6312 kbit/s ± 30 ppm (q=21), 2048 kbit/s ± 50 ppm (q=12), 1544 kbit/s ± 32 ppm (q=11)) – within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlation: None.

Performance Monitoring: None.

9.1.3.3 E*q* to P*q*e Adaptation Source E*q*/P*q*e_A_So (*q*=4, 32, 31, 22)

Symbol

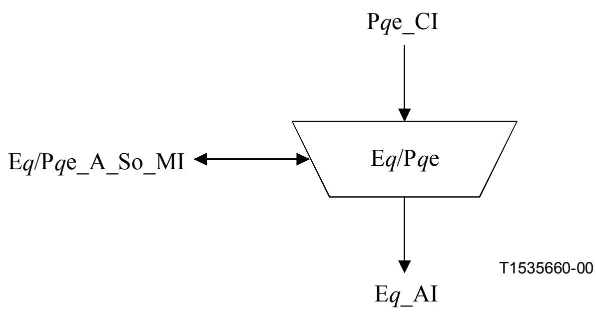


Figure 9-14/G.705 – E*q*/P*q*e_A_So symbol

Interfaces

Table 9-5/G.705 – E*q*/P*q*e_A_So input and output signals

Input(s)	Output(s)
Pqe_CI_D Pqe_CI_CK Eq/Pqe_A_So_MI_Active	Eq_AI_D

Processes

This function provides the CMI encoding of the 139 264 kbit/s information stream, or the B3ZS encoding of the 44 736 kbit/s, or HDB3 encoding the incoming electrical 34 368 or 8448 kbit/s, or the B6ZS encoding of the 6312 kbit/s, as defined in ITU-T G.703.

CMI encoder: The function shall perform CMI encoding of the data specified by ITU-T G.703.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ITU-T G.703.

B3ZS encoder: The function shall perform B3ZS encoding of the data as specified in ITU-T G.703.

B6ZS encoder: The function shall perform B6ZS encoding of the data as specified in ITU-T G.703.

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.

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 Correlation: None.

Performance Monitoring: None.

9.1.3.4 E*q* to P*q*e Adaptation Sink E*q*/P*q*e_A_Sk (*q*=4, 32, 31, 22, 21)

Symbol

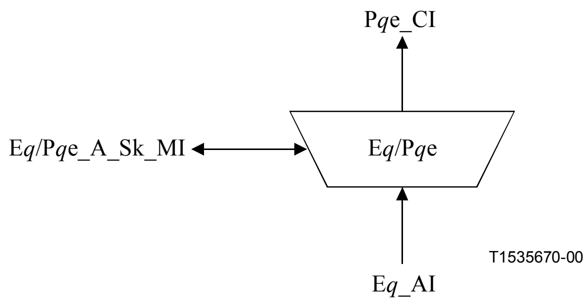


Figure 9-15/G.705 – E*q*/P*q*e_A_Sk symbol

Interfaces

Table 9-6/G.705 – E*q*/P*q*e_A_Sk input and output signals

Input(s)	Output(s)
Eq_AI_D	Pqe_CI_D Pqe_CI_CK Pqe_CI_FS
Eq_AI_TSF	Pqe_CI_SSF
Eq/Pqe_A_Sk_MI_AIS_Reported	Eq/Pqe_A_Sk_MI_cLOF
Eq/Pqe_A_Sk_MI_Active	Eq/Pqe_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 CMI decodes the incoming electrical 139 264 kbit/s or HDB3 decodes the incoming electrical 34 368 or 8448 kbit/s, or B3ZS decodes the incoming electrical 44 736 kbit/s, or B6ZS decodes the incoming electrical 6312 kbit/s E*q* 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 ITU-T G.703 [2];
– jitter modulation applied to the input signal with any value defined in ITU-T G.823 [14] or G.824 [15];
– the input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm, 44 736 kbit/s ± 20 ppm, 34 368 kbit/s ± 20 ppm, 8448 kbit/s ± 30 ppm, 6312 kbit/s ± 30 ppm;
– for E31 and E22, the input signal has a signal specified by ITU-T G.703.

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 ITU-T G.703.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ITU-T G.703.

B3ZS decoding: The function shall perform B3ZS decoding of the data as specified in ITU-T G.703.

B6ZS decoding: The function shall perform B6ZS decoding of the data as specified in ITU-T G.703.

For P4, P31, P22:

Frame alignment: See 8.2.

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.

For P32:

Frame alignment: See 8.2.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall transmit the framed AIS signal specified by ITU-T G.704 [3] and M.20 at its output (CI_D) and not report its status via the management point.

For P21:

Frame alignment: See 8.2.

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 for dLOF and dSEF defects according to the specification in 6.2. The function shall detect for an AIS defect (dAIS) according to the specification in 6.2/G.806 [11].

NOTE 2 – For P*q*e (q=32), other types of AIS have been defined. An earlier Recommendation specified AIS as all "1"s. An earlier national Recommendation specified AIS according to ITU-T G.775 [7] with the exception of the X-bits which were defined as "0". Equipment should support detection of these other types of AIS.

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 AIS signal (all-ONEs signal for E4, E31, E22, E21, E12 and E11; framed AIS signal as specified in ITU-T G.704 for E32) complying to the frequency limits for this interface (a bit rate in range 139 264 kbit/s ± 15 ppm (q=4), 34 368 kbit/s ± 20 ppm (q=31), 8448 kbit/s ± 30 ppm (q=22) – within 900 (q=4), 800 (q=31), 600 (q=22), 250 (q=21) µs; on clearing of aAIS the function shall output normal data within 900 (q=4), 800 (q=31), 600 (q=22), 250 (q=21) µs.

Defect Correlation

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

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

Performance Monitoring: None.

9.1.3.5 E*q* to P*q*s Adaptation Source E*q*/P*q*s_A_So (*q*=4, 31)

Symbol

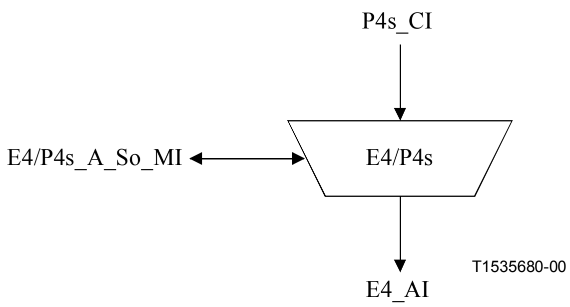


Figure 9-16/G.705 – E*q*/P*q*s_A_So symbol

Interfaces

Table 9-7/G.705 – E*q*/P*q*s_A_So input and output signals

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Eq/Pqs_A_So_MI_Active	Eq_AI_D

Processes

This function provides CMI encoding of the 139 264 kbit/s P4s signal or HDB3 encoding of the 34 368 kbit/s P31s signal.

CMI encoder: The function shall perform CMI encoding of the data as specified in ITU-T G.703.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ITU-T G.703.

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.

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 Correlation: None.

Performance Monitoring: None.

9.1.3.6 E*q* to P*q*s Adaptation Sink E*q*/P*q*s_A_Sk (*q*=4, 31)

Symbol

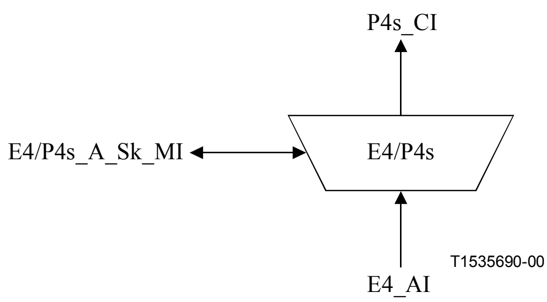


Figure 9-17/G.705 – E*q*/P*q*s_A_Sk symbol

Interfaces

Table 9-8/G.705 – E*q*/P*q*s_A_Sk input and output signals

Input(s)	Output(s)
Eq_AI_D	Pqs_CI_D Pqs_CI_CK Pqs_CI_FS
Eq_AI_TSF Eq/Pqs_A_Sk_MI_AIS_Reported Eq/Pqs_A_Sk_MI_Active Eq/Pqs_A_Sk_MI_1second	Pqs_CI_SSF Eq/Pqs_A_Sk_MI_cLOF Eq/Pqs_A_Sk_MI_cAIS Eq/Pqs_A_Sk_MI_pOFS

Processes

The function regenerates the received signal, recovers bit timing (CK), CMI 139 264 kbit/s E4 signal or HDB3 decodes the incoming electrical 34 368 kbit/s E31 signal, and recovers Frame Start reference (FS). It supplies the recovered timing signal to the synchronization 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 ITU-T G.703;

– jitter modulation applied to the input signal with any value defined in ITU-T G.823 [14];

– the input signal bit rate has any value in the range 139 264 kbit/s ± 15 ppm, 34 368 kbit/s ± 20 ppm.

– for E31 the input signal has an interfering signal specified by ITU-T G.703.

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 ITU-T G.703.

HDB3 decoding: The function shall perform the HDB3 decoding process specified by ITU-T G.703.

Frame alignment: see 8.2.

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 for dLOF defect according to the specification in 6.2. The function shall detect for an AIS defect (dAIS) as described here.

The AIS defect (dAIS) shall be detected if the incoming signal has 7 or less ZEROs in each of two consecutive 17 408 bits (q=4), 4 296 bits (q=31) periods. The defect shall be cleared if each of two consecutive 4 296 bit periods contains 8 or more ZEROs or the Frame Alignment Signal (FAS) has been found.

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 Correlation

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

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

Performance Monitoring: None.

9.1.3.7 E12 to P12s Adaptation Source E12/P12s_A_So

Symbol

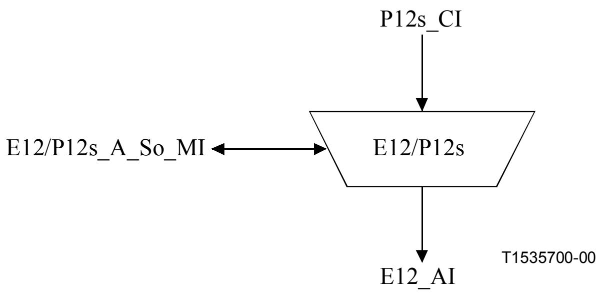


Figure 9-18/G.705 – E12/P12s_A_So symbol

Interfaces

Table 9-9/G.705 – E12/P12s_A_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 2048 kbit/s P12s signal specified by ITU-T G.703.

HDB3 encoder: The function shall perform HDB3 encoding of the data as specified in ITU-T G.703.

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.

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 Correlation: None.

Performance Monitoring: None.

9.1.3.8 E12 to P12s Adaptation Sink E12/P12s_A_Sk

Symbol

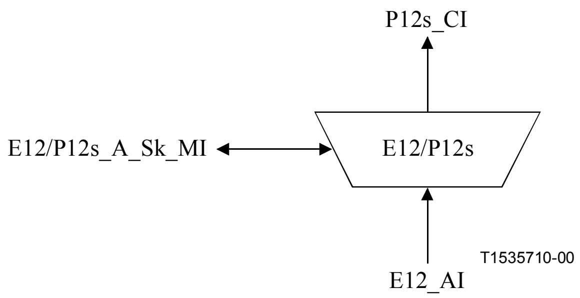


Figure 9-19/G.705 – E12/P12s_A_Sk symbol

Interfaces

Table 9-10/G.705 – E12/P12s_A_Sk input and output signals

Input(s)	Output(s)
E12_AI_D E12_AI_TSF E12/P12s_A_Sk_MI_AIS_Reported E12/P12s_A_Sk_MI_Active E12/P12s_A_Sk_MI_CRC4mode	P12s_CI_D P12s_CI_CK P12s_CI_SSF P12s_CI_FS P12s_CI_MFS P12s_CI_MFP E12/P12s_A_Sk_MI_cLOF E12/P12s_A_Sk_MI_cAIS E12/P12s_A_Sk_MI_NCI

Processes

The function regenerates the received signal, recovers bit timing (CK), decodes the incoming electrical 2048 kbit/s E12 signal, and recovers frame start information for the P12s. It supplies the recovered timing signal to the synchronization 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 ITU-T G.703;
– jitter modulation applied to the input signal with any value defined in ITU-T G.823;
– the input signal bit rate has any value in the range 2048 kbit/s ± 50 ppm;
– the input signal has an interfering signal specified by ITU-T G.703;
– for the case of a 120 Ω interface, the input signal has an longitudinal voltage applied as specified by ITU-T G.703.

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 ITU-T G.703.

Basic frame and CRC-4 Multiframe alignment: see 8.2.

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 and clear dLOF defect as specified in 6.2.

The function shall report NCI status in the automatic CRC-4 interworking mode as specified by ITU-T G.706.

The dAIS defect shall be detected according to ITU-T G.775.

Consequent Actions

aAIS $\leftarrow$ dAIS or dLOF or AI_TSF

aSSF $\leftarrow$ 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 2 ms; on clearing of aAIS the function shall output normal data within 2 ms.

Defect Correlation

cAIS $\leftarrow$ dAIS and (not AI_TSF) and AIS_Reported

cLOF $\leftarrow$ dLOF and (not dAIS) and (not AI_TSF)

Performance Monitoring: None.

10 PDH 2048 kbit/s hierarchy (P*q*e) path layer functions (*q*=4, 31, 22)

The higher order PDH path layers are the P4e (139 264 kbit/s), P31e (34 736 kbit/s) and P22e (8448 kbit/s) path layers.

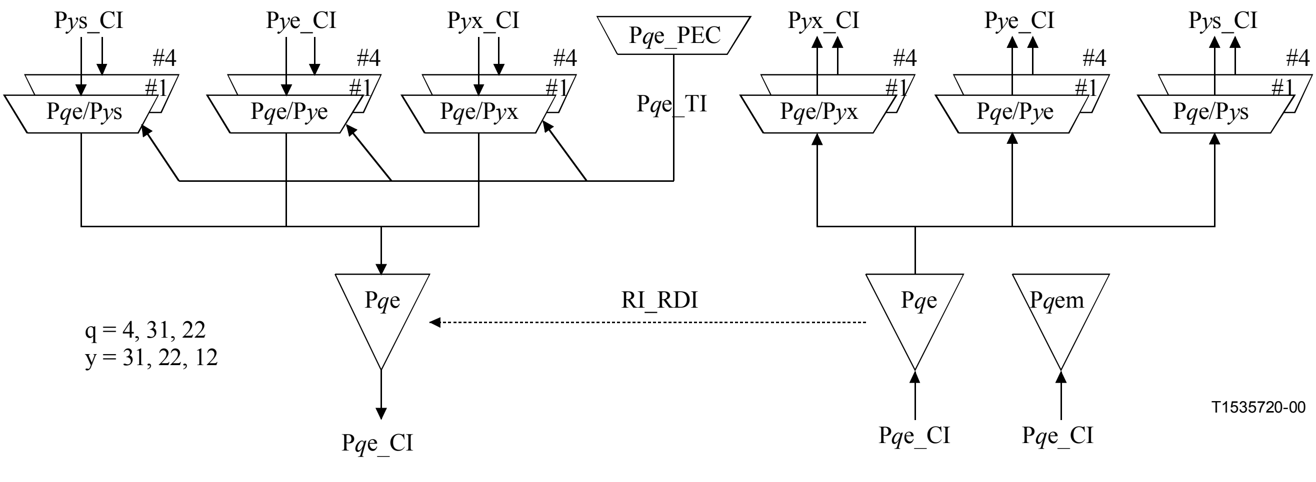


Figure 10-1/G.705 – PDH (P*q*e) path layer atomic functions

P4e layer CP

The Characteristic Information (CI) at this point is 139 264 kbit/s bit structured signal as specified in ITU-T G.751 [19] with co-directional bit timing and the frame start information FS. The CI is structured to form a 2 928 bit long frame with 16 bit frame overhead containing 12 bit FAS, one bit RDI and a three bit user CI.

NOTE 1 – The bits for National Use (NU) in row 4, columns 2 to 4 of Figure 10-2 are reserved for operator specific usage. Their processing is not within the province of this Recommendation.

P4e layer AP

The AI at this point is a multiplexed signal containing four (728/2 928) × 139 264 kbit/s (see Note 2) tributary signals (PU31) and (3/2 928) × 139 264 kbit/s (see Note 3) user CI (NU) with co-directional bit timing and frame start information.

NOTE 2 – This equation equals a bit rate of 34 625.748 633 879 8 kbit/s.

NOTE 3 – This equation equals a bit rate of 142.688 524 590 164 kbit/s.

The signal transported by an PU31 will be determined by the client layer application. Typical signals include:

– a 34 368 kbit/s signal P31x_CI without an assumed structure and justification overhead bits;

– a 34 368 kbit/s signal P31e_CI with a frame structure as specified in ITU-T G.751 and justification overhead bits;

– a 34 368 kbit/s signal P31s_CI with a frame structure as specified in ITU-T G.832 and justification overhead bits.

P31e layer CP

The CI at this point is 34 368 kbit/s bit structured signal as specified in ITU-T G.751 with co-directional bit timing and the frame start information FS. The CI is structured to form a 1 536 bit long frame with 12 bit frame overhead containing 10 bit FAS, one bit RDI and one bit user CI.

NOTE 4 – The bit for National Use (NU) in row 3, column 4 of Figure 10-4 are reserved for operator specific usage. Their processing is not within the province of this Recommendation.

P31e layer AP

The AI at this point is a multiplexed signal containing four (381/1 536) × 34 368 kbit/s (see Note 5) tributary signals (PU22) and 22 375 bit/s User Characteristic Information (NU) with co-directional bit timing and frame start information.

NOTE 5 – This equation equals a bit rate of 8 524.875 kbit/s.

The signal transported by an PU22 will be determined by the client layer application. Typical signals include:

– a 8448 kbit/s signal P22x_CI without an assumed structure and justification overhead bits;

– a 8448 kbit/s signal P22e_CI with a frame structure according ITU-T G.742 [18] and justification overhead bits.

P22e layer CP

The CI at this point is 8448 kbit/s bit structured signal as specified in ITU-T G.742 with co-directional bit timing and the frame start information FS. The CI is structured to form a 848 bit long frame with 12 bit frame overhead containing 10 bit FAS, one bit RDI and one bit user CI.

NOTE 6 – The bit for National Use (NU) in row 3, column 4 of Figure 10-6 are reserved for operator specific usage. Their processing is not within the province of this Recommendation.

P22e layer AP

The AI at this point is a multiplexed signal containing four (209/848) × 8448 kbit/s (see Note 7) tributary signals and (1/848) × 8448 kbit/s (see Note 8) User Characteristic Information (NU) with co-directional bit timing and frame start information.

NOTE 7 – This equation equals a bit rate of 2 082.113 207 547 kbit/s.

NOTE 8 – This equation equals a bit rate of 9.962 264 150 943 kbit/s.

The signal transported by an PU12 will be determined by the client layer application. Typical signals include:

– a 2048 kbit/s signal P12x_CI without an assumed structure and justification overhead bits;

– a 2048 kbit/s signal P12s_CI with a frame structure according ITU-T G.704 [3] and justification overhead bits.

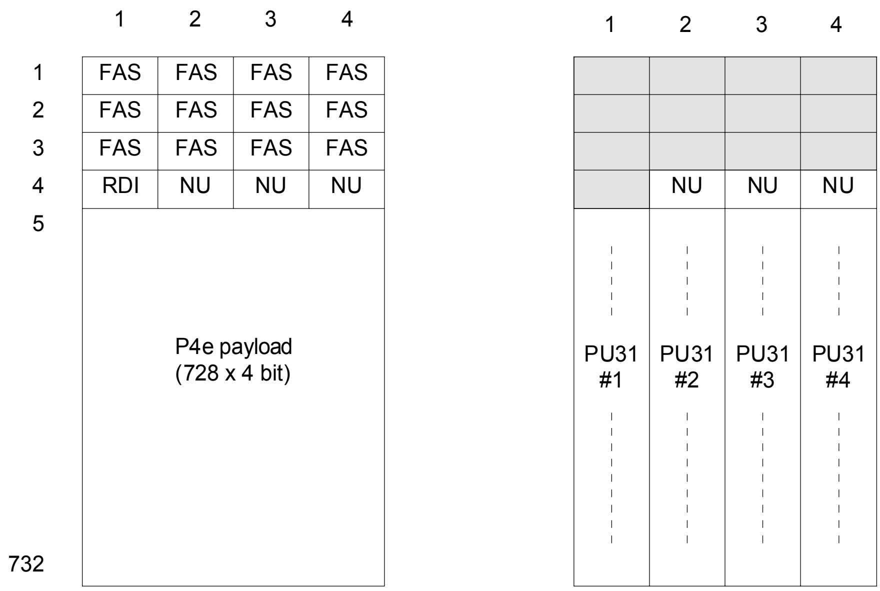


Figure 10-2/G.705 – P4e_CI_D (left) and P4e_AI_D (right) signals

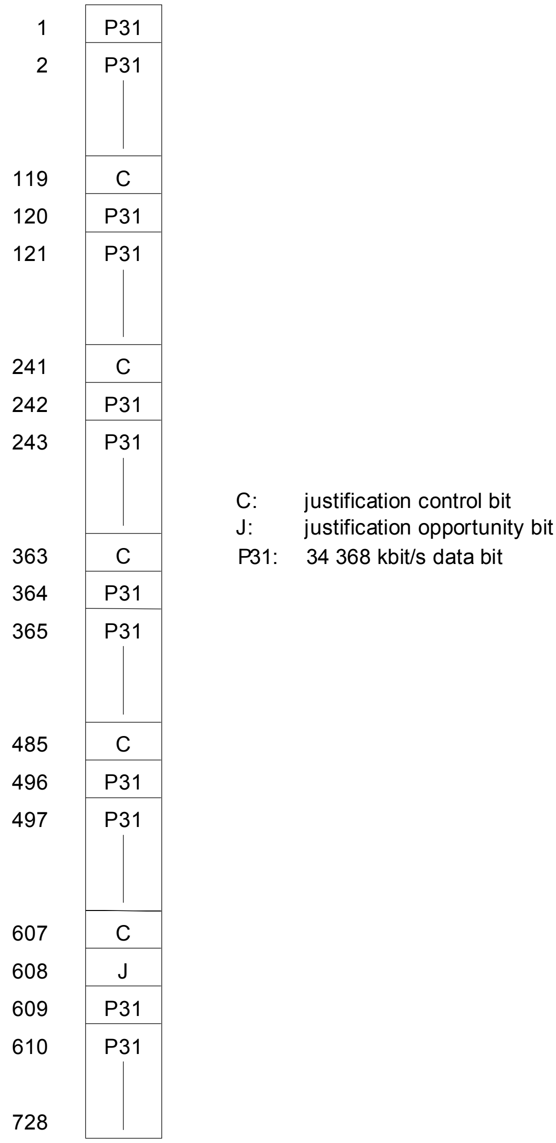


Figure 10-3/G.705 – PU31 #i (i=1,2,3,4) of P4e_AI_D

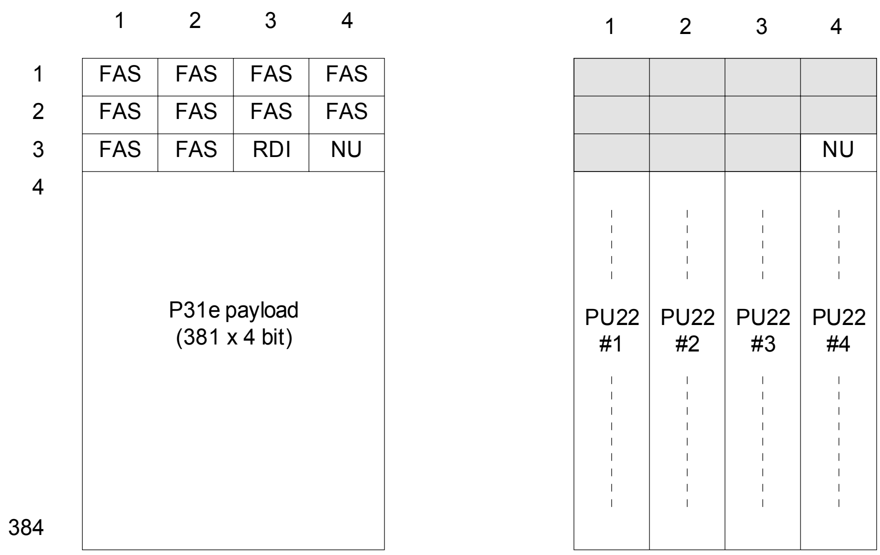


Figure 10-4/G.705 – P31e_CI_D (left) and P31e_AI_D (right) signals

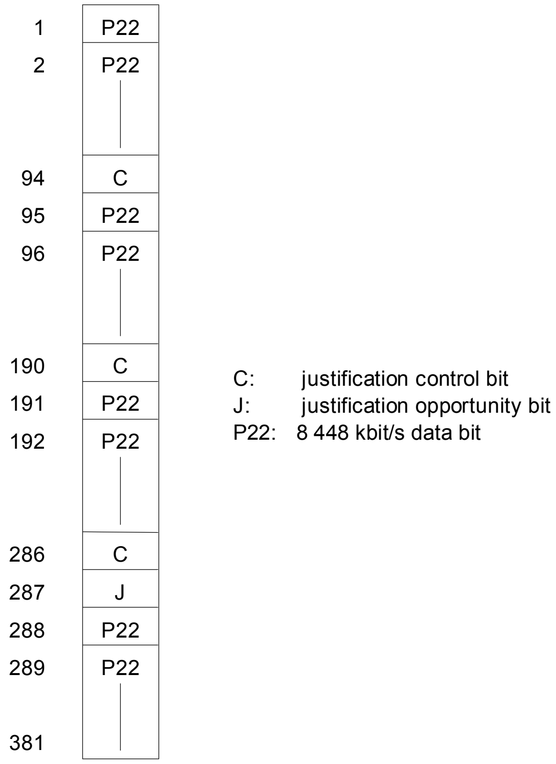


Figure 10-5/G.705 – PU22 #i (i=1,2,3,4) of P31e_AI_D

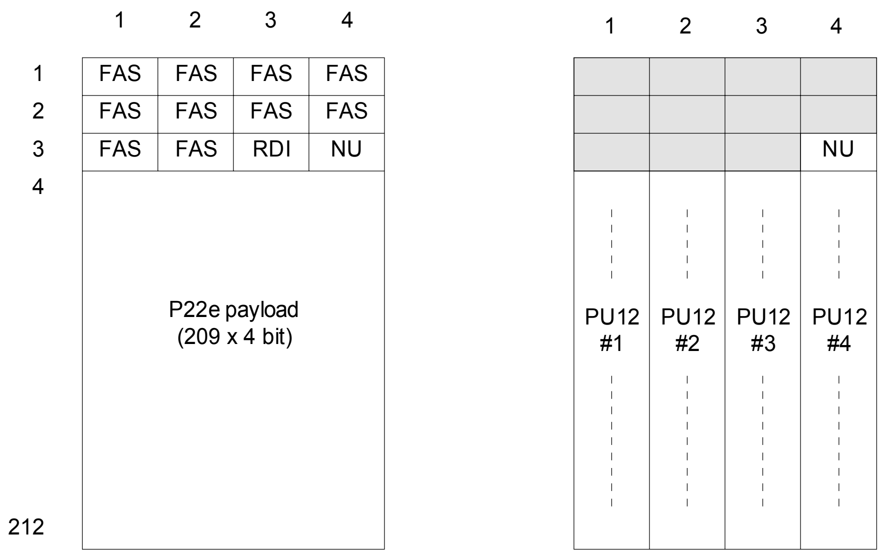


Figure 10-6/G.705 – P22e_CI_D (left) and P22e_AI_D (right) signals

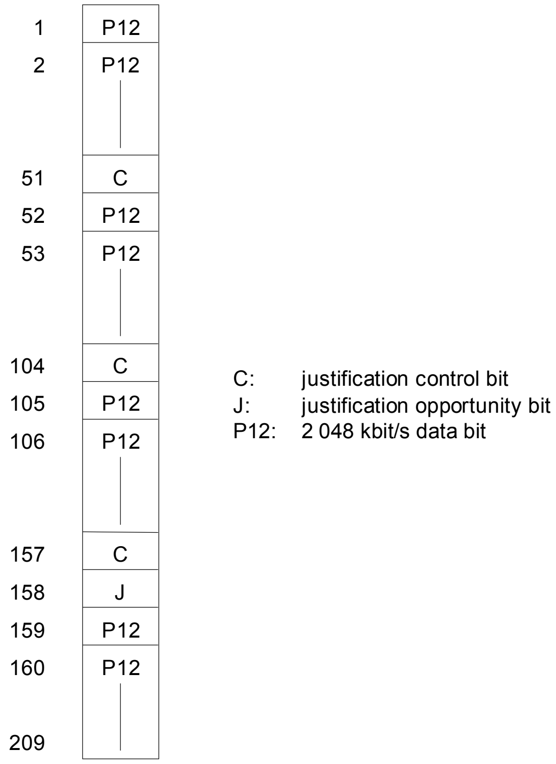


Figure 10-7/G.705 – PU12 #i (i=1,2,3,4) of P22e_AI_D

10.1 P*q*e connection functions

Generic description of the connection function is described in 5.6.1/G.806.

10.2 P*q*e trail termination functions P*q*e_TT and P*q*em_TT (*q*=4, 31, 22)

10.2.1 P*q*e trail termination source P*q*e_TT_So

Symbol

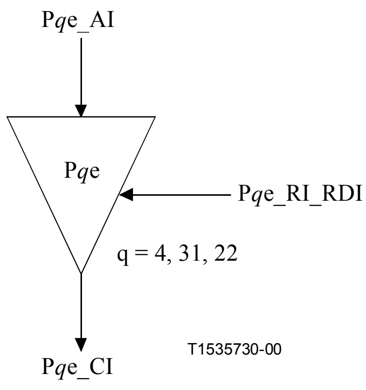


Figure 10-8/G.705 – P*q*e_TT_So symbol

Interfaces

Table 10-1/G.705 – P*q*e_TT_So input and output signals

Input(s)	Output(s)
Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_RI_RDI	Pqe_CI_D Pqe_CI_CK Pqe_CI_FS

Processes

This function adds the RDI information bit and the frame alignment signal into the frame overhead. The frame overhead is defined as the first 16 (q=4), 12 (q=31, 22) bits of this frame as specified in 1.5.2/G.751 [19] (q=4), 1.4.2/G.751 (q=31) and clause 5/G.742 [18] (q=22).

RDI: This bit represents the defect status of the associated P*q*e_TT_Sk. The RDI indication shall be set to "1" on activation of P*q*e_RI_RDI within 900 (q=4), 800 (q=31), 600 (q=22) µs, determined by the associated P*q*e_TT_Sk function, and set to "0" within 900 (q=4), 800 (q=31), 600 (q=22) µs on the P*q*e_RI_RDI removal.

Frame Alignment Signal (FAS): (q=4) The function shall insert the 139 264 kbit/s frame alignment signal (111110100000) into the frame overhead. (q=31,22) The function shall insert the 34 368 or 8 488 kbit/s frame alignment signal (1111010000) into the frame overhead.

Defects: None.

Consequent Actions: None.

Defect Correlation: None.

Performance Monitoring: None.

10.2.2 P*q*e trail termination sink P*q*e_TT_Sk

Symbol

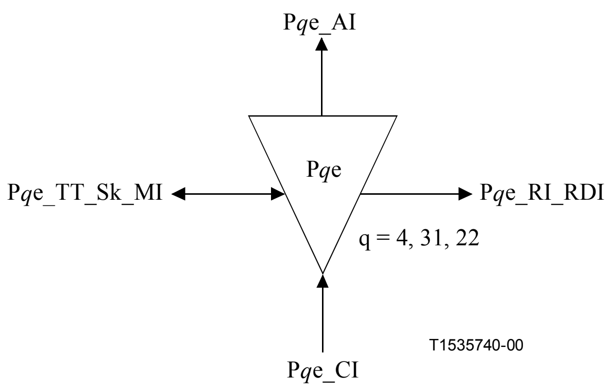


Figure 10-9/G.705 – P*q*e_TT_Sk symbol

Interfaces

Table 10-2/G.705 – P*q*e_TT_Sk input and output signals

Input(s)	Output(s)
Pqe_CI_D Pqe_CI_CK Pqe_CI_FS Pqe_CI_SSF Pqe_TT_Sk_MI_TPmode Pqe_TT_Sk_MI_SSF_Reported Pqe_TT_Sk_MI_RDI_Reported Pqe_TT_Sk_MI_1second	Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_AI_TSF Pqe_RI_RDI Pqe_TT_Sk_MI_cRDI Pqe_TT_Sk_MI_cSSF Pqe_TT_Sk_MI_pN_DS Pqe_TT_Sk_MI_pN_EBC Pqe_TT_Sk_MI_pF_DS

Processes

This function recovers the RDI information bit of the frame overhead as specified in 1.5.2/G.751 (q=4), 1.4.2/G.751 (q=31) and clause 5/G.742 (q=22).

FAS: The FAS bits of each received frame are compared to their expected value "111110100000" (q=4), "1111010000" (q=31,22). A difference is taken as evidence of one or more errors (nN_B) in the block.

RDI: The information carried in the RDI bit shall be extracted to enable single ended maintenance of a bidirectional Trail (Path). The RDI (row 4, column 1 (q=4), row 3, column 3 (q=31,22)) provides information as to the status of the remote receiver. A "1" indicates an RDI state, while a "0" indicates the normal, working state. The application process is described in Appendix II/G.806.

Defects

The function shall detect an RDI defect (dRDI) according the specification in ITU-T G.775 [7].

Consequent actions

aTSF ← CI_SSF

aRDI ← CI_SSF

Defect correlation

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance monitoring

The performance monitoring process shall be performed according to the specification in ITU-T G.806.

NOTE – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

Every second, the number of errored near-end blocks (N_Bs) within that second is counted as the Near-end Error Block Count (pN_EBC).

A "Near-end Block" (N_B) is errored (nN_B) if one or more FAS bits are errored.

pN_EBC ← Σ nN_B

Every second with at least one occurrence of aTSF or dEQ shall be indicated as a Near-end Defect Second (pN_DS).

pN_DS ← aTSF or dEQ

Every second with at least one occurrence of dRDI shall be indicated as a Far-end Defect Second (pF_DS).

pF_DS ← dRDI

10.2.3 P*q*e layer non-intrusive monitoring function P*q*em_TT_Sk

Symbol

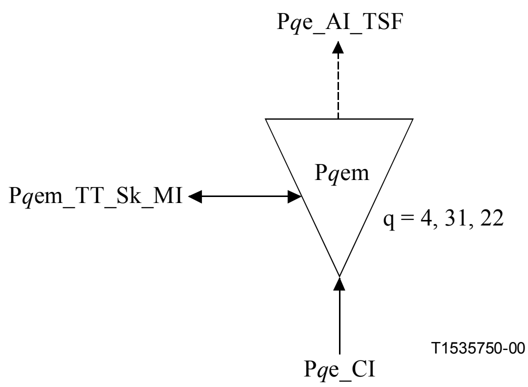


Figure 10-10/G.705 – P*q*em_TT_Sk symbol

Interfaces

Table 10-3/G.705 – P*q*em_TT_Sk input and output signals

Input(s)	Output(s)
Pqe_CI_D Pqe_CI_CK Pqe_CI_FS Pqe_CI_SSF Pqem_TT_Sk_MI_TPmode Pqem_TT_Sk_MI_SSF_Reported Pqem_TT_Sk_MI_RDI_Reported Pqem_TT_Sk_MI_1second	Pqe_AI_TSF Pqem_TT_Sk_MI_cRDI Pqem_TT_Sk_MI_cSSF Pqem_TT_Sk_MI_pN_DS Pqem_TT_Sk_MI_pN_EBC Pqem_TT_Sk_MI_pF_DS

Processes

This function recovers the RDI information bit of the frame overhead as specified in 1.5.2/G.751 (q=4), 1.4.2/G.751 (q=31) and clause 5/G.742 (q=22).

FAS: The FAS bits of each received frame are compared to their expected value "111110100000" (q=4), "1111010000" (q=31,22). A difference is taken as evidence of one or more errors (nN_B) in the block.

RDI: The information carried in the RDI bit shall be extracted to enable single ended maintenance of a bidirectional Trail (Path). The RDI (row 4, column 1 (q=4), row 3, column 3 (q=31, 22)) provides information as to the status of the remote receiver. A "1" indicates an RDI state, while a "0" indicates the normal, working state. The application process is described in Appendix II/G.806.

Defects

The function shall detect an RDI defect (dRDI) according the specification in ITU-T G.775 [7].

Consequent Actions

aTSF ← CI_SSF

Defect Correlation

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance Monitoring

The performance monitoring process shall be performed according to the specification in ITU-T G.806.

NOTE – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

Every second, the number of errored near-end blocks (N_Bs) within that second is counted as the Near-end Error Block Count (pN_EBC).

A "Near-end Block" (N_B) is errored (nN_B) if one or more FAS bits are errored.

pN_EBC ← Σ nN_B

Every second with at least one occurrence of aTSF or dEQ shall be indicated as a Near-end Defect Second (pN_DS).

pN_DS ← aTSF or dEQ

Every second with at least one occurrence of dRDI shall be indicated as a Far-end Defect Second (pF_DS).

pF_DS ← dRDI

10.3 P*q*e adaptation functions (*q*=4, 31, 22)

10.3.1 P*q*e to P*y*x adaptation source P*q*e/P*y*x_A_So ((*q*,*y*) = (4,31), (31,22), (22,12))

Symbol

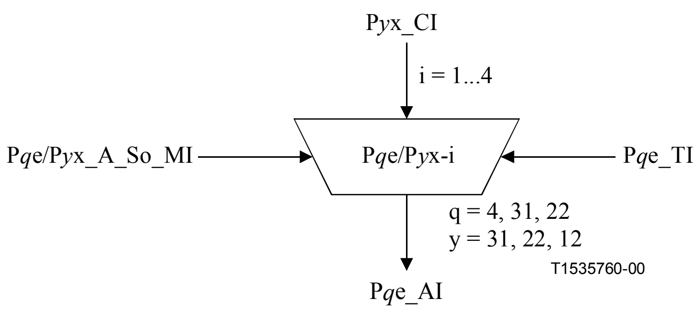


Figure 10-11/G.705 – P*q*e/P*y*x_A_So symbol

Interfaces

Table 10-4/G.705 – P*q*e/P*y*x_A_So input and output signals

Input(s)	Output(s)
Pyx_CI_D Pyx_CI_CK Pqe_TI_CK Pqe_TI_FS Pqe/Pyx_A_So_MI_Active	Pqe_AI_D Pqe_AI_CK Pqe_AI_FS

Processes

This function maps one plesiochronous, 34 368, 8448, 2048 kbit/s, P*y* (y=31,22,12) information stream into the P*q*e frame, as specified in 1.5.2/G.751 (y=31), 1.4.2/G.751 (y=22) and clause 5/G.742 (y=12). It takes P*y*x_CI, a bit-stream with a rate of 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22), or 2048 kbit/s ± 50 ppm (y=12), present at its input and inserts it into the PU31, PU22, or PU12 #i having a capacity of 728 (y=31), 381 (y=22), or 209 (y=12) bits and justification frame as depicted in Figures 10-3, 10-5 and 10-7. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

Frequency justification and bit rate adaptation: The function shall provide for an elastic store (buffer) process. The data signal shall be written into the buffer under control of the associated input clock. The data signal shall be read out of the buffer under control of the P*q*e clock, frame position (P*q*e_TI), and justification decisions.

The justification decisions determine the phase error introduced by the P*q*e/P*y*x_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the justification control bits C (Figures 10-3, 10-5 and 10-7).

Each justification decision results in a corresponding positive justification action. Upon a positive justification action, the reading of 1 data bit shall be cancelled once and no data is written at the justification opportunity bit J.

NOTE – A requirement for maximum introduced phase error generated by the justification process is for further study.

Buffer size: This justification process shall not introduce any errors when the input clock (P*y*x_CI_CK) has a frequency within the range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22), or 2048 kbit/s ± 50 ppm (y=12) and a jitter specified by ITU-T G.823, and the P*q*e clock (P*q*e_TI_CK) has a frequency and jitter within the range specified in 4.4. Any step in frequency of the input clock within this range shall not cause any errors.

C bits – *Justification control generation*: The function shall generate the justification control (CCCCC (y=31), CCC (y=22,12)) bits according the specification in ITU-T G.751 [19] (y=31), ITU-T G.742 [18] (y=22,12). It shall insert the justification control bits in the appropriate C bit positions.

PU-w time slot: The adaptation source function has access to a specific PU-w of the P*q*e access point. The PU-w is defined by the parameter i (i=1 to 4).

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 Correlation: None.

Performance Monitoring: None.

10.3.2 P*q*e to P*y*x Adaptation Sink P*q*e/P*y*x_A_Sk ((*q*,*y*) = (4,31), (31,22), (22,12))

Symbol

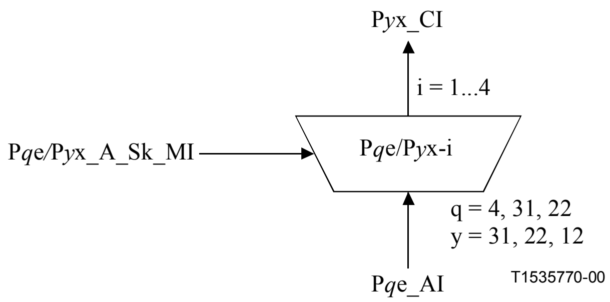


Figure 10-12/G.705 – P*q*e/P*y*x_A_Sk symbol

Interfaces

Table 10-5/G.705 – P*q*e/P*y*x_A_Sk input and output signals

Input(s)	Output(s)
Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_AI_TSF Pqe/Pyx_A_Sk_MI_Active	Pyx_CI_D Pyx_CI_CK Pyx_CI_SSF

Processes

This function recovers one plesiochronous, 34 368, 8448, 2048 kbit/s, information stream P*y* from the P*q*e frame as specified in 1.5.2/G.751 (y=31), 1.4.2/G.751 (y=22) and clause 5/G.742 (y=12). The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

C bits – *Justification control interpretation*: The function shall perform justification control interpretation according ITU-T G.751 (y=31,22), ITU-T G.742 (y=12) to recover the 34 368, 8448, 2048 kbit/s signal (P*y*) from the 139 264, 34 368, 8448 kbit/s (P*q*e) payload signal. If the majority of the C bits is "0" the J bit shall be taken as a data bit, otherwise (majority of C bits is "1") J bit shall be taken as a justification bit and consequently ignored.

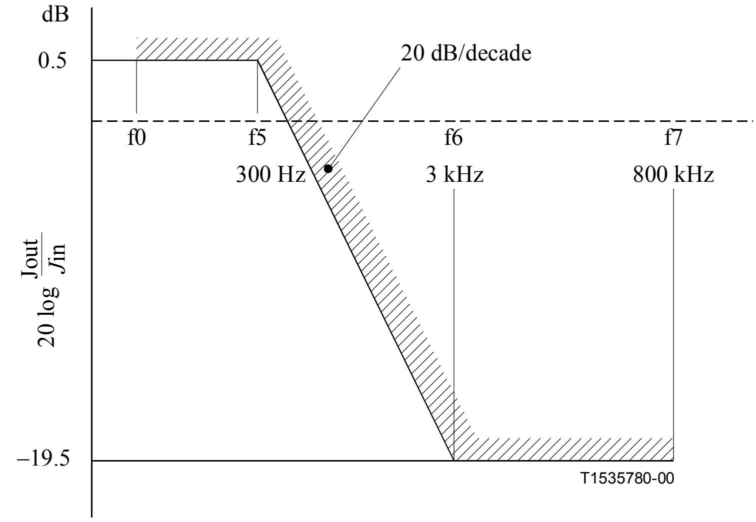
Smoothing and jitter limiting process: The function shall provide for a clock smoothing and elastic store (buffer) process. The 34 368, 8448, 2048 kbit/s data signal shall be written into the buffer under control of the associated (gapped) input clock. The data signal shall be read out of the buffer under control of a smoothed (equally spaced) 34 368 kHz ± 20 ppm (y=31), 8448 kHz ± 30 ppm (y=22), 2048 kHz ± 50 ppm (y=12) clock (the rate is determined by the 34, 8, 2 Mbit/s signal at the input of the remote P*q*e/P*y*x_A_So, P*q*e/P*y*e_A_So, or P*q*e/P*y*s_A_So).

The residual jitter caused by bit justifications (measured at the 34 368, 8448, 2048 kbit/s interface) shall be such that the peak-to-peak jitter at the 34 368, 8448, 2048 kbit/s output (being a tributary) in the absence of input jitter shall not exceed 0.3 UI when measured in the frequency range up to 800 kHz (y=31), 0.25 UI when measured in the frequency range up to 400 kHz (W=22), 0.25 UI when measured in the frequency range up to 100 kHz (y=12).

When measured with an instrument incorporating a band pass filter having a lower cut-off frequency of 10 (y=31), 3 (y=22), 18 (y=12) kHz, a roll-off of 20 dB/decade and an upper limit of 800 (y=31), 400 (y=22), 100 (y=12) kHz, the peak-to-peak output jitter shall not exceed 0.05 UI with a probability of 99.9 % during a measurement period of 10 s.

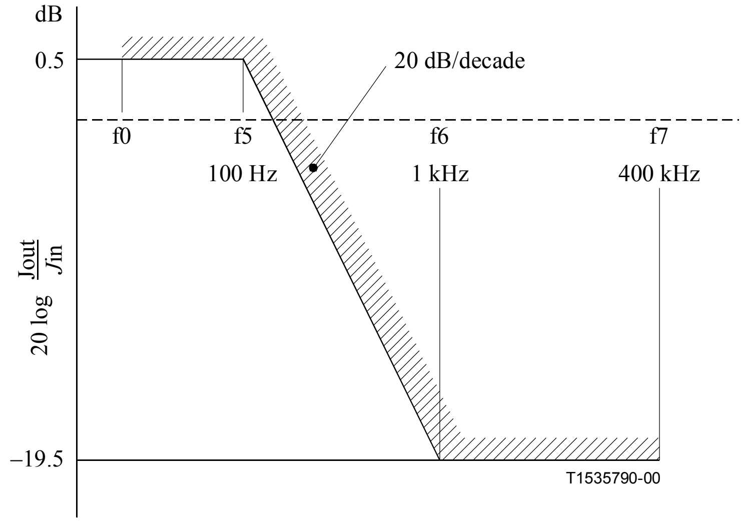
NOTE – For 2048 interfaces meeting the national high Q option, detailed in ITU-T G.703, the lower cut-off frequency for the above measurement should be 700 Hz (y=12).

Jitter transfer characteristic: A 34 368, 8448, 2048 kbit/s signal, modulated by sinusoidal jitter, applied to an adaptation source and retrieved from the adaptation sink, shall have a jitter transfer characteristic within the gain/frequency limits given in Figures 10-13, 10-14 and 10-15. The equivalent binary content of the test signal should be 1000.



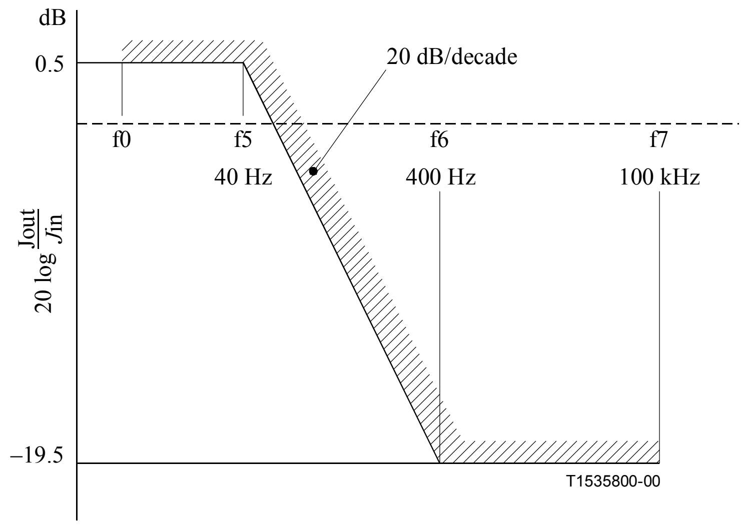
NOTE – The frequency f_0 shall be less than 20 Hz and as low as possible (e.g. 10 Hz), taking into account the limitations of measuring equipment.

Figure 10-13/G.705 – Jitter transfer for 34 368 kbit/s signal



NOTE – The frequency f_0 shall be less than 20 Hz and as low as possible (e.g. 10 Hz), taking into account the limitations of measuring equipment.

Figure 10-14/G.705 – Jitter transfer for 8448 kbit/s signal



NOTE – The frequency f_0 shall be less than 20 Hz and as low as possible (e.g. 10 Hz), taking into account the limitations of measuring equipment.

Figure 10-15/G.705 – Jitter transfer for 2048 kbit/s signal

Buffer size: In the presence of jitter as specified in ITU-T G.823 [14] and a frequency within the range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22), 2048 kbit/s ± 50 ppm (y=12) this justification process shall not introduce any errors.

Following a step in frequency of the P*y*x signal transported by the P*q*e_AI (for example due to reception of P*y*x CI from a new P*y*x_TT_So at the far end or removal of all-ONEs (AIS) signal with a frequency offset) there will be a maximum recovery time of X seconds after which this process shall not generate any bit errors.

The value of X is for further study; a value of 1 second has been proposed.

PU-w time slot: The adaptation sink function has access to a specific PU-w of the P*q*e access point. The PU-w is defined by the parameter i (i=1 to 4).

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

aSSF ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal – complying to the frequency limits for this signal (a bit rate in range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22), 2048 kbit/s ± 50 ppm (y=12)) – within 900 (y=31), 800 (y=22), 600 (y=12) µs; on clearing of aAIS the function shall output normal data within 900 (y=31), 800 (y=22), 600 (y=12) µs.

Defects Correlation: None.

Performance Monitoring: None.

10.3.3 P*q*e to P*y*e adaptation source P*q*e/P*y*e_A_So ((*q*,*y*) = (4,31), (31,22))

Symbol

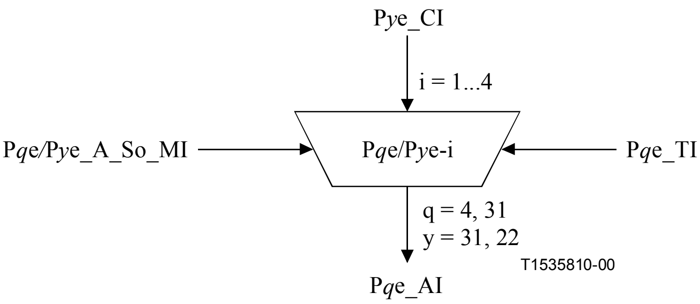


Figure 10-16/G.705 – P*q*e/P*y*e_A_So symbol

Interfaces

Table 10-6/G.705 – P*q*e/P*y*e_A_So input and output signals

Input(s)	Output(s)
Pye_CI_D Pye_CI_CK Pye_CI_FS Pqe_TI_CK Pqe_TI_FS Pqe/Pye_A_So_MI_Active	Pqe_AI_D Pqe_AI_CK Pqe_AI_FS

Processes

This function maps one plesiochronous, 34 368, 8448 kbit/s, P*y* (y=31,22) information stream into the P*q*e frame, as specified in 1.5.2/G.751 (y=31) and 1.4.2/G.751 (y=22). It takes P*y*e_CI, a bit-stream with a rate of 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22) present at its input and inserts it into the PUw #i having a capacity of 728 (y=31), 381 (y=22) bits and the justification frame. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

Frequency justification and bit rate adaptation: The function shall provide for an elastic store (buffer) process. The data signal shall be written into the buffer under control of the associated input clock. The data signal shall be read out of the buffer under control of the P*q*e clock, frame position (P*q*e_TI), and justification decisions.

The justification decisions determine the phase error introduced by the P*q*e/P*y*e_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the justification control bits C.

Each justification decision results in a corresponding positive justification action. Upon a positive justification action, the reading of 1 data bit shall be cancelled once and no data is written at the justification opportunity bit J.

NOTE – A requirement for maximum introduced phase error generated by the justification process is for further study.

Buffer size: This justification process shall not introduce any errors when the input clock (P*y*x_CI_CK) has a frequency within the range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22) and a jitter specified by ITU-T G.823, and the P*q*e clock (P*q*e_TI_CK) has a frequency and jitter within the range specified in 4.4. Any step in frequency of the input clock within this range shall not cause any errors.

C bits – *Justification control generation*: The function shall generate the justification control (CCCCC (y=31), CCC (y=22)) bits according the specification in ITU-T G.751 (y=31), ITU-T G.742 (y=22). It shall insert the justification control bits in the appropriate C bit positions.

PU-w time slot: The adaptation source function has access to a specific PU-w of the P*q*e access point. The PU-w is defined by the parameter i (i=1 to 4).

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 Correlation: None.

Performance Monitoring: None.

10.3.4 P*q*e to P*y*e adaptation sink P*q*e/P*y*e_A_Sk ((*q*,*y*) = (4,31), (31,22))

Symbol

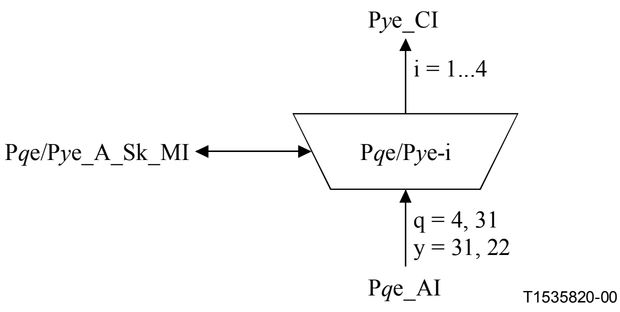


Figure 10-17/G.705 – P*q*e/P*y*e_A_Sk symbol

Interfaces

Table 10-7/G.705 – P*q*e/P*y*e_A_Sk input and output signals

Input(s)	Output(s)
Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_AI_TSF Pqe/Pye_A_Sk_MI_Active Pqe/Pye_A_Sk_MI_AIS_Reported	Pye_CI_D Pye_CI_CK Pye_CI_FS Pye_CI_SSF Pqe/Pye_A_Sk_MI_cLOF Pqe/Pye_A_Sk_MI_cAIS

Processes

This function recovers one plesiochronous, 34 368, 8448 kbit/s, information stream P*y* from the P*q*e frame as specified in 1.5.2/G.751 (y=31) and 1.4.2/G.751 (y=22). Further it recovers the frame start information for the P*y* tributary signal. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

C bits – *Justification control interpretation*: The function shall perform justification control interpretation according ITU-T G.751 to recover the 34 368, 8448 kbit/s signal (P*y*) from the 139 264, 34 368 kbit/s (P*q*e) payload signal. If the majority of the C bits is "0" the J bit shall be taken as a data bit, otherwise (majority of C bits is "1") J bit shall be taken as a justification bit and consequently ignored.

Smoothing and jitter limiting process: The function shall provide for a clock smoothing and elastic store (buffer) process. The 34 368, 8448 kbit/s data signal shall be written into the buffer under control of the associated (gapped) input clock. The data signal shall be read out of the buffer under control of a smoothed (equally spaced) 34 368 kHz ± 20 ppm (y=31), 8448 kHz ± 30 ppm (y=22) clock (the rate is determined by the 34,8 Mbit/s signal at the input of the remote P*q*e/P*y*e_A_So).

The residual jitter caused by bit justifications is for further study.

Buffer size: In the presence of jitter as specified in ITU-T G.823 and a frequency within the range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22), this justification process shall not introduce any errors.

Following a step in frequency of the P*y*e signal transported by the P*q*e_AI (for example due to reception of P*y*e CI from a new P*y*e_TT_So at the far end or removal of all-ONEs (AIS) signal with a frequency offset) there will be a maximum recovery time of X seconds after which this process shall not generate any bit errors.

The value of X is for further study; a value of 1 second has been proposed.

PU-w time slot: The adaptation sink function has access to a specific PU-w of the P*q*e access point. The PU-w is defined by the parameter i (i=1 to 4).

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.

Frame alignment: The function shall perform the frame alignment of the 34 368, 8448 kbit/s signal as specified in 8.2.

Defects

The function shall detect and clear dLOF as specified in 6.2.

The function shall detect an AIS defect (dAIS) according the specification in ITU-T G.775.

Consequent Actions

aAIS ← dAIS or dLOF

aSSF ← dAIS or dLOF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal – complying to the frequency limits for this signal (a bit rate in range 34 368 kbit/s ± 20 ppm (y=31), 8448 kbit/s ± 30 ppm (y=22)) – within 900 (y=31), 800 (y=22) µs; on clearing of aAIS the function shall output normal data within 900 (y=31), 800 (y=22) µs.

Defect Correlation

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and not dAIS

Performance Monitoring: None.

10.3.5 P4e to P31s adaptation source P4e/P31s_A_So

Symbol

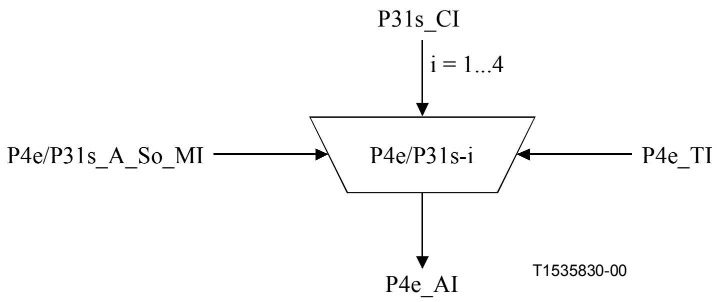


Figure 10-18/G.705 – P4e/P31s_A_So symbol

Interfaces

Table 10-8/G.705 – P4e/P31s_A_So input and output signals

Input(s)	Output(s)
P31s_CI_D P31s_CI_CK P4e_TI_CK P4e_TI_FS P4e/P31s_A_So_MI_Active	P4e_AI_D P4e_AI_CK P4e_AI_FS

Processes

This function maps one synchronous, 34 368 kbit/s, P31s information stream into the P4e frame (Figure 10-2), as specified in 1.5.2/G.751. It takes P31s_CI, a bit-stream with a rate of 34 368 kbit/s ± 4.6 ppm (see Note 1), present at its input and inserts it into the PU31 #i having a capacity of 728 bits and the justification frame as depicted in Figure 10-3. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

NOTE 1 – The 34 368 Mbit/s with a 125 µs frame according ITU-T G.832 [14] is nominally locked to a PRC.

Frequency justification and bit rate adaptation: The function shall provide for an elastic store (buffer) process. The data signal shall be written into the buffer under control of the associated input clock. The data signal shall be read out of the buffer under control of the P4e clock, frame position (P4e_TI), and justification decisions.

The justification decisions determine the phase error introduced by the P4e/P31s_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the justification control bits C (Figure 10-3).

Each justification decision results in a corresponding positive justification action. Upon a positive justification action, the reading of 1 data bit shall be cancelled once and no data are written at the justification opportunity bit J.

NOTE 2 – A requirement for maximum introduced phase error generated by the justification process is for further study.

Buffer size: This justification process shall not introduce any errors when the input clock (P31s CI_CK) has a frequency within the range 34 368 kbit/s ± 20 ppm and a jitter specified by ITU-T G.823, and the P*q*e clock (P*q*e_TI_CK) has a frequency and jitter within the range specified in 4.4. Any step in frequency of the input clock within this range shall not cause any errors.

C bits – *Justification control generation*: The function shall generate the justification control (CCCCC) bits according the specification in ITU-T G.751. It shall insert the justification control bits in the appropriate C bit positions.

PU-31 time slot: The adaptation source function has access to a specific PU-31 of the P4e access point. The PU-31 is defined by the parameter i (i=1 to 4).

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 Correlation: None.

Performance Monitoring: None.

10.3.6 P4e to P31s adaptation sink P4e/P31s_A_Sk

Symbol

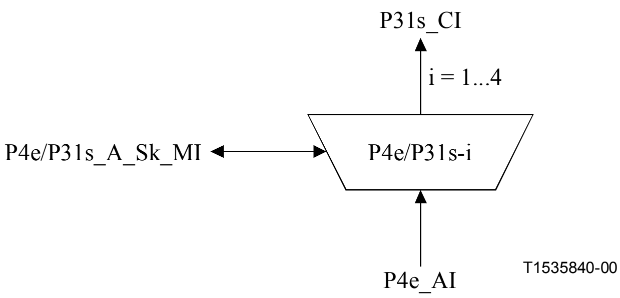


Figure 10-19/G.705 – P4e/P31s_A_Sk symbol

Interfaces

Table 10-9/G.705 – P4e/P31s_A_Sk input and output signals

Input(s)	Output(s)
P4e_AI_D P4e_AI_CK P4e_AI_FS P4e_AI_TSF P4e/P31s_A_Sk_MI_Active P4e/P31s_A_Sk_MI_AIS_Reported	P31s_CI_D P31s_CI_CK P31s_CI_FS P31s_CI_SSF P4e/P31s_A_Sk_MI_cLOF P4e/P31s_A_Sk_MI_cAIS

Processes

This function recovers one plesiochronous, 34 368 kbit/s, information stream P31 (Figures 10-2 and 10-3) from the P4e frame as specified in 1.5.2/G.751. Further, it recovers the frame start information for the P31 tributary signal. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point. It supplies the recovered timing signal to the synchronization distribution layer.

C bits – *Justification control interpretation*: The function shall perform justification control interpretation according ITU-T G.751 to recover the 34 368 kbit/s signal (P31) from the 139 264 kbit/s (P4e) payload signal. If the majority of the C bits is "0" the J bit shall be taken as a data bit, otherwise (majority of C bits is "1") J bit shall be taken as a justification bit and consequently ignored.

Smoothing and jitter limiting process: The function shall provide for a clock smoothing and elastic store (buffer) process. The 34 368 kbit/s data signal shall be written into the buffer under control of the associated (gapped) input clock. The data signal shall be read out of the buffer under control of a smoothed (equally spaced) 34 368 kHz ± 20 ppm clock (the rate is determined by the 34 Mbit/s signal at the input of the remote P4e/P31s_A_So).

NOTE – The P31s signal is nominally locked to a PRC. Under fault conditions, however, the P31s signal is replaced by an all-ONEs (AIS) signal with 20 ppm frequency tolerance.

The residual jitter caused by bit justifications is for further study.

Buffer size: In the presence of jitter as specified ITU-T G.823 and a frequency within the range 34 368 kbit/s ± 20 ppm, this justification process shall not introduce any errors.

Following a step in frequency of the P31s signal transported by the P*q*e_AI (for example due to reception of P31s CI from a new P31s_TT_So at the far end or removal of all-ONEs (AIS) signal with a frequency offset) there will be a maximum recovery time of X seconds after which this process shall not generate any bit errors.

The value of X is for further study; a value of 1 second has been proposed.

PU-31 time slot: The adaptation sink function has access to a specific PU-31 of the P4e access point. The PU-31 is defined by the parameter i (i=1 to 4).

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.

Frame alignment: The function shall perform the frame alignment of the 34 368 kbit/s signal as specified in 8.2.

Defects

The function shall detect and clear for dLOF according to the specification in 6.2.

The AIS defect (dAIS) shall be detected and cleared as specified in 6.2.6/G.806 [11].

Consequent Actions

aAIS ← dAIS or dLOF

aSSF ← dAIS or dLOF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal – complying to the frequency limits for this signal (a bit rate in range 34 368 kbit/s ± 20 ppm) – within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlation

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOF ← dLOF and (not dAIS)

Performance Monitoring: None.

10.3.7 P22e to P12s adaptation source P22e/P12s_A_So

Symbol

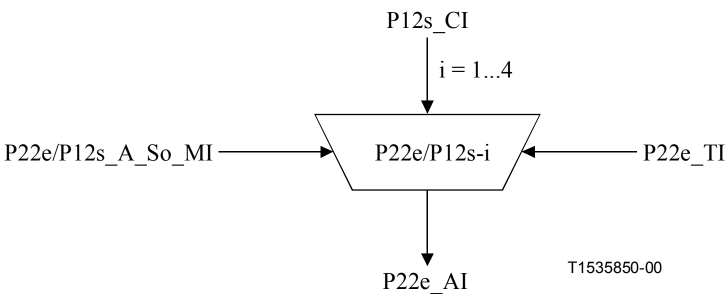


Figure 10-20/G.705 – P22e/P12s_A_So symbol

Interfaces

Table 10-10/G.705 – P22e/P12s_A_So input and output signals

Input(s)	Output(s)
P12s_CI_D P12s_CI_CK P22e_TI_CK P22e_TI_FS P22e/P12s_A_So_MI_Active	P22e_AI_D P22e_AI_CK P22e_AI_FS

Processes

This function maps one synchronous, 2048 kbit/s, P12s information stream into the P22e frame (Figure 10-6), as specified in clause 5/G.742. It takes P12s_CI, a bit-stream with a rate of 2048 kbit/s ± 50 ppm (see Note 1), present at its input and inserts it into the PU12 #i having a capacity of 209 bits and the justification frame as depicted in Figure 10-7. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point.

NOTE 1 – The 2048 kbit/s with a 125 µs frame as specified in ITU-T G.704 is nominally locked to a PRC.

Frequency justification and bit rate adaptation: The function shall provide for an elastic store (buffer) process. The data signal shall be written into the buffer under control of the associated input clock. The data signal shall be read out of the buffer under control of the P22e clock, frame position (P22e_TI), and justification decisions.

The justification decisions determine the phase error introduced by the P22e/P12s_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the justification control bits C (Figure 10-7).

Each justification decision results in a corresponding positive justification action. Upon a positive justification action, the reading of 1 data bit shall be cancelled once and no data are written at the justification opportunity bit J.

NOTE 2 – A requirement for maximum introduced phase error generated by the justification process is for further study.

Buffer size: This justification process shall not introduce any errors when the input clock (P12s_CI_CK) has a frequency within the range 2048 kbit/s ± 50 ppm and a jitter specified by ITU-T G.823, and the P22e clock (P22e_TI_CK) has a frequency and jitter within the range specified in 5.5. Any step in frequency of the input clock within this range shall not cause any errors.

C bits – *Justification control generation*: The function shall generate the justification control (C) bits according the specification in ITU-T G.742. It shall insert the justification control bits in the appropriate C bit positions.

PU-12 time slot: The adaptation source function has access to a specific PU-12 of the P22e access point. The PU-12 is defined by the parameter i (i=1 to 4).

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 Correlation: None.

Performance Monitoring: None.

10.3.8 P22e to P12s adaptation sink P22e/P12s_A_Sk

Symbol

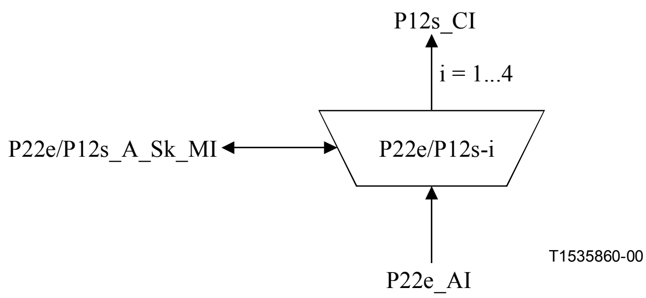


Figure 10-21/G.705 – P22e/P12s_A_Sk symbol

Interfaces

Table 10-11/G.705 – P22e/P12s_A_Sk input and output signals

Input(s)	Output(s)
P22e_AI_D P22e_AI_CK P22e_AI_FS P22e_AI_TSF P22e/P12s_A_Sk_MI_Active P22e/P12s_A_Sk_MI_AIS_Reported P22e/P12s_A_Sk_MI_CRC4mode	P12s_CI_D P12s_CI_CK P12s_CI_SSF P12s_CI_FS P12s_CI_MFS P12s_CI_MFP P22e/P12s_A_Sk_MI_cLOF P22e/P12s_A_Sk_MI_cAIS P22e/P12s_A_Sk_MI_NCI

Processes

This function recovers one synchronous, 2048 kbit/s, information stream P12s (Figures 10-5, 10-6 and 10-7) from the P22e frame as specified in clause 5/G.742. Further it recovers the frame start information for the P12s tributary signal. The function can be activated/deactivated when multiple payload adaptation functions are connected to the access point. It supplies the recovered timing signal to the synchronization distribution layer.

C bits – *Justification control interpretation*: The function shall perform justification control interpretation as specified in ITU-T G.742 to recover the 2048 kbit/s signal (P12) from the 8448 kbit/s (P22e) payload signal. If the majority of the C bits is "0" the J bit shall be taken as a data bit, otherwise (majority of C bits is "1") J bit shall be taken as a justification bit and consequently ignored.

Smoothing and jitter limiting process: The function shall provide for a clock smoothing and elastic store (buffer) process. The 2048 kbit/s data signal shall be written into the store under control of the associated (gapped) input clock. The data signal shall be read out of the store under control of a smoothed (equally spaced) 2048 kHz ± 50 ppm clock (the rate is determined by the 2 Mbit/s signal at the input of the remote P22e/P12s_A_So).

NOTE 1 – The P12s signal is nominally locked to a PRC. Under fault conditions however, the P12s signal is replaced by an all-ONEs (AIS) signal with 50 ppm frequency tolerance.

The residual jitter caused by bit justifications is for further study.

NOTE 2 – For interfaces meeting the national high Q option, detailed in ITU-T G.703 [2], the lower cut-off frequency for the above measurement should be 700 Hz.

Buffer size: In the presence of jitter as specified in ITU-T G.823 [14] and a frequency within the range 2048 kbit/s ± 50 ppm, this justification process shall not introduce any errors.

Following a step in frequency of the P12s signal transported by the P22e_AI (for example due to reception of P12s CI from a new P12s_TT_So at the far end or removal of all-ONEs (AIS) signal with a frequency offset) there will be a maximum recovery time of X seconds after which this process shall not generate any bit errors.

The value of X is for further study; a value of 1 second has been proposed.

PU-12 time slot: The adaptation sink function has access to a specific PU-12 of the P22e access point. The PU-12 is defined by the parameter i (i=1 to 4).

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.

Basic frame and CRC-4 Multiframe alignment: The function shall perform alignment as specified in 8.2.

Defects

The function shall detect dLOF defect as specified by ITU-T G.706 [4].

The function shall clear dLOF defect as specified by ITU-T G.706.

The function shall report NCI status in the automatic CRC-4 interworking mode as specified by ITU-T G.706.

The dAIS defect shall be detected as defined by ITU-T G.775 [7].

Consequent Actions

aAIS ← dAIS or dLOF

aSSF ← dAIS or dLOF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal – complying to the frequency limits for this signal (a bit rate in range 2048 kbit/s ± 50 ppm) – within 2 ms; on clearing of aAIS the function shall output normal data within 2 ms.

Defect Correlation

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

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

Performance Monitoring: None.

10.4 P*q*e PDH equipment clock adaptation source P*q*e_PEC (q=4, 31, 22)

Symbol

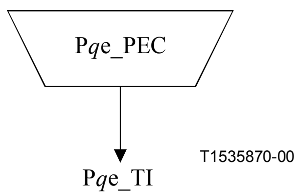


Figure 10-22/G.705 – P*q*e_PEC_A_So symbol

Interfaces

Table 10-12/G.705 – P*q*e_PEC_A_So input and output signals

Input(s)	Output(s)
	Pqe_TI_CK Pqe_TI_FS

Processes

This function performs the 140 (q=4), 34 (q=31), 8 (q=22) Mbit/s clock and frame start signal generation to time the adaptation source functions in this layer.

Clock generation: The function shall generate the clock (bit) reference signal P*q*e_TI_CK for the P*q*e signal. The P*q*e_TI_CK bit rate shall be in range of 139 264 kbit/s ± 15 ppm (q=4), 34 368 kbit/s ± 20 ppm (q=31), 8448 kbit/s ± 30 ppm (q=22).

Jitter limiter: The function shall generate the clock signal such that the peak-to-peak jitter at the 139 264, 34 368 kbit/s output shall not exceed 0.05 UI when it is measured within the frequency range from 200 Hz to 3 500 kHz (q=4), 100 Hz to 800 kHz (q=31), 20 Hz to 400 kHz (q=22).

Frame Start signal generation: The function shall generate the frame start reference signal P*q*e_TI_FS for the P*q*e signal. The P*q*e_TI_FS signal shall be active once per 2 928 (q=4), 1 536 (q=31), 848 (q=22) bits.

Defects: None.

Consequent Actions: None.

Defect Correlation: None.

Performance Monitoring: None.

11 P*q*s path layer functions (*q*=4, 31)

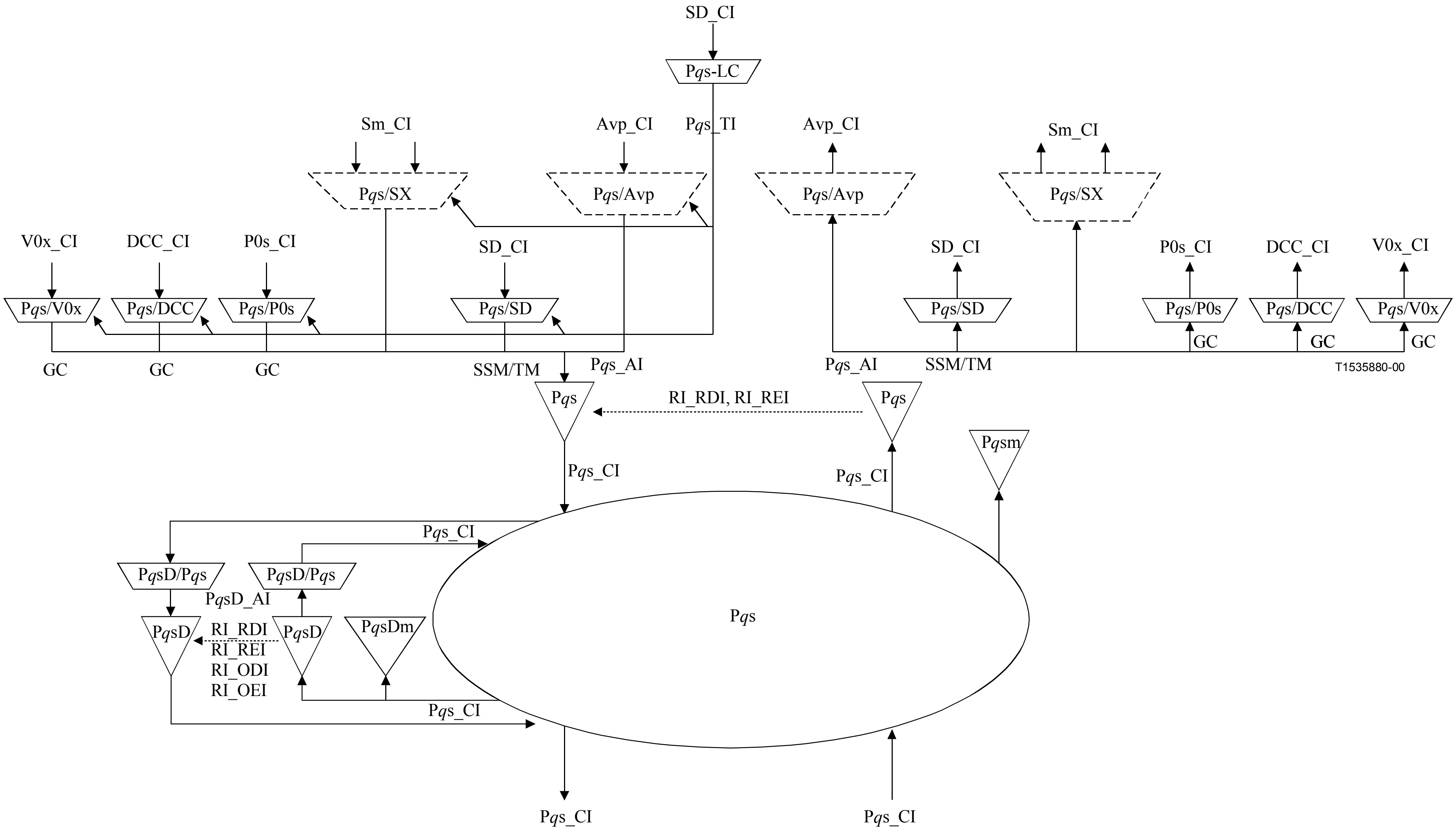


Figure 11-1/G.705 – P*qs* path layer atomic functions

P4s layer CP

The Characteristic Information CI at this point is octet structured with an 125 µs frame (Figure 11-2). Its format is characterized as P4s_AI plus the P4s trail termination overhead in the TR, EM, and MA locations as defined in ITU-T G.832. For the case the signal has passed the tandem connection sublayer, P4s_CI has defined P4s tandem connection trail termination overhead in location NR.

NOTE 1 – NR will be undefined when the signal P4s_CI has not been processed in a tandem connection adaptation and trail termination function.

NOTE 2 – An unequipped P4s signal is for further study.

P4s layer AP

The Adaptation Information AI at this point is octet structured with an 125 µs frame (Figure 11-2). It represents adapted client layer information comprising 2 160 bytes of client layer information, the signal label bits in byte MA, the multiframe indicator in byte MA, the synchronization status message/timing marker bit in byte MA, and a 64 kbit/s general communication channel in byte GC. For the case the signal has passed the trail protection sublayer, P4s_AI has defined APS in bytes P1P2.

NOTE 3 – Bytes P1P2 will be undefined when the signal P4s_AI has not been processed in a trail protection connection function P4sP_C.

NOTE 4 – The structure of bytes P1P2 is not yet defined.

NOTE 5 – GC will be undefined when no GC byte adaptation source function is connected to the AP.

The composition of the payload transported by an P4s will be determined by the client layer application. Typical compositions of the payload include:

– a TUG3 structured signal;

– a TUG2 structured signal;

– an ATM 138 240 kbit/s cell stream signal.

P31s layer CP

The Characteristic Information (CI) at this point is octet structured with an 125 µs frame (Figure 11-3). Its format is characterized as P31s_AI plus the P31s trail termination overhead in the TR, EM, and MA locations as defined in ITU-T G.832. For the case the signal has passed the tandem connection sublayer, P31s_CI has defined P31s tandem connection trail termination overhead in location NR.

NOTE 6 – NR will be undefined when the signal P31s_CI has not been processed in a tandem connection adaptation and trail termination function.

NOTE 7 – An unequipped P31s signal is for further study.

P31s layer AP

The Adaptation Information (AI) at this point is octet structured with an 125 µs frame (Figure 11-3). It represents adapted client layer information comprising 530 bytes of client layer information, the signal label bits in byte MA, the multiframe indicator in byte MA, the synchronization status message/timing marker bit in byte MA, and a 64 kbit/s general communication channel in byte GC.

NOTE 8 – GC will be undefined when no GC byte adaptation source function is connected to the AP.

The composition of the payload transported by an P31s will be determined by the client layer application. Typical compositions of the payload include:

– a TU-12 structured signal;

– an ATM 33 920 kbit/s cell stream signal.

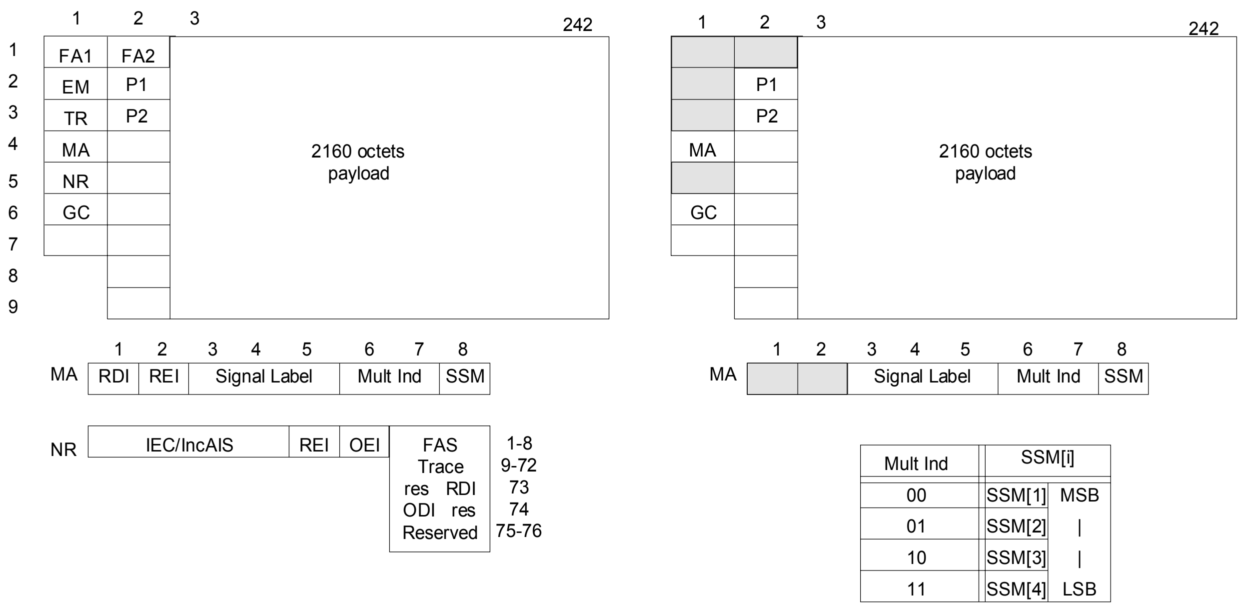


Figure 11-2/G.705 – P4s_CI_D (left) and P4s_AI_D (right)

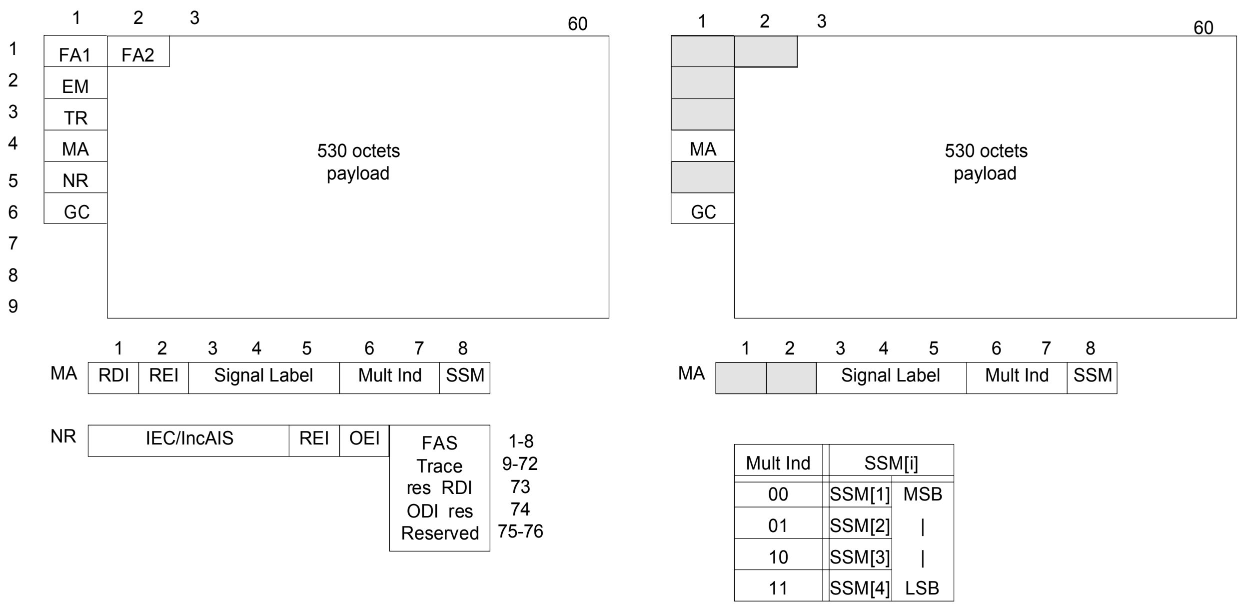


Figure 11-3/G.705 – P31s_CI_D (left) and P31s_AI_D (right)

Figure 11-1 shows that more than one adaptation function exists in this P*q*s layer that can be connected to one P*q*s access point. For the case of the adaptation source functions, only one of these adaptation source functions is allowed to be activated. For this activated source, access to the access point by other adaptation source functions must be denied. 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.

NOTE 9 – If one adaptation function only is connected to the AP, it will be activated. If one or more other functions are connected to the same AP, one out of the set of functions will be active.

11.1 P*q*s connection functions

Generic description of the connection function is described in 5.6.1/G.806.

11.2 P*q*s trail termination functions P*q*s_TT and P*q*sm_TT

11.2.1 P*q*s trail termination source P*q*s_TT_So

Symbol

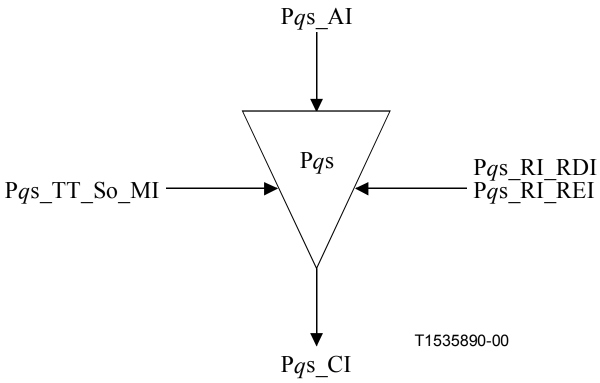


Figure 11-4/G.705 – P*q*s_TT_So symbol

Interfaces

Table 11-1/G.705 – P*q*s_TT_So input and output signals

Input(s)	Output(s)
Pqs_AI_D Pqs_AI_CK Pqs_AI_FS Pqs_RI_RDI Pqs_RI_REI Pqs_TT_So_MI_TxTI	Pqs_CI_D Pqs_CI_CK Pqs_CI_FS

Processes

This function adds error monitoring, status overhead bytes, trace identifier and the frame alignment signal to the P*q*s_AI presented at its input, to form the P*q*s layer Characteristic Information. The processing of the trail termination overhead bytes is defined as follows:

TR: In this byte the function shall insert the Transmitted Trail Trace Identifier TxTI. Its format is described in G.832.

MA[1]: Bit 1, a RDI indication, shall be set to "1" on activation of the RI_RDI within 250 µs, determined by the associated P*q*s_TT_Sk function, and set to "0" within 250 µs on clearing of RI_RDI.

MA[2]: Bit 2, a REI (Remote Error Indication) indication, shall be set to "1" on declaration of RI_REI – determined by the associated P*q*s_TT_Sk function if one or more errors were detected by the BIP-8 process – and shall be otherwise set to zero.

EM: In this byte the function shall insert the BIP-8 EDC with even bit parity. Each bit n of current EM is computed to provide even parity over the nth bit of every byte in the previous frame of the Characteristic Information P*q*s_CI, i.e. EM is calculated over the entire previous P*q*s signal.

FA1FA2 – *Frame Alignment Signal (FAS)*: The function shall insert the 125 μs frame alignment signal FA1FA2 into the frame overhead as defined in ITU-T G.832.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.2.2 P*q*s trail termination sink P*q*s_TT_Sk

Symbol

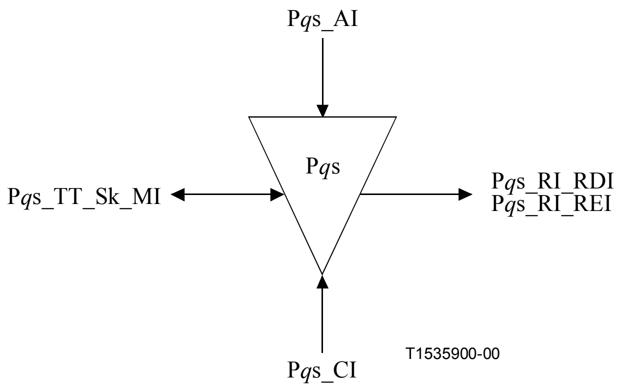


Figure 11-5/G.705 – P*q*s_TT_Sk symbol

Interfaces

Table 11-2/G.705 – P*q*s_TT_Sk input and output signal

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF Pqs_TT_Sk_MI_TPmode Pqs_TT_Sk_MI_SSF_Reported Pqs_TT_Sk_MI_ExTI Pqs_TT_Sk_MI_RDI_Reported Pqs_TT_Sk_MI_DEGTHR Pqs_TT_Sk_MI_DEGM Pqs_TT_Sk_MI_1second Pqs_TT_Sk_MI_TIMdis	Pqs_AI_D Pqs_AI_CK Pqs_AI_FS Pqs_AI_TSF Pqs_AI_TSD Pqs_TT_Sk_MI_cTIM Pqs_TT_Sk_MI_cUNEQ Pqs_TT_Sk_MI_cDEG Pqs_TT_Sk_MI_cRDI Pqs_TT_Sk_MI_cSSF Pqs_TT_Sk_MI_AcTI Pqs_RI_RDI Pqs_RI_REI Pqs_TT_Sk_MI_pN_EBC Pqs_TT_Sk_MI_pF_EBC Pqs_TT_Sk_MI_pN_DS Pqs_TT_Sk_MI_pF_DS

Processes

This function monitors for 34 Mbit/s (q=31) and 140 Mbit/s (q=4) frame errors and recovers the trail termination status as defined in ITU-T G.832. It extracts the payload independent overhead bytes EM, TR, MA bits 1, 2 from the P*q*s layer Characteristic information:

EM: Even bit parity (BIP-8) shall be computed for each bit n of every byte of the preceding frame and compared with bit n of EM recovered from the current frame (n=1 to 8 inclusive). A difference between the computed and recovered EM values shall be taken as evidence of one or more errors (nN_B) in the computation block.

TR: The 16 byte Trail Trace Identifier (TTI) shall be recovered from the TR byte and shall be made available for network management purposes. The acceptance and mismatch detection process shall be performed as described in 6.2.2.2/G.806.

MA[1-2]: The relevant information carried in the MA byte (RDI in bit 1, REI in bit 2) shall be extracted to enable single ended maintenance of a bi-directional Trail. The REI (nF_B) shall be used to monitor the error performance of the reverse direction of transmission; the RDI provides information as to the status of the remote receiver. A "1" indicates a RDI state, while a "0" indicates the normal working state.

MA[3-5]: The information in the signal label bits shall be extracted to allow unequipped P*q*s defect detection.

Defects

The detection and removal conditions and processes for dUNEQ, dDEG, dRDI and dTIM are described in 6.2/G.806.

Consequent Actions

aAIS ← dUNEQ or dTIM

aRDI ← CI_SSF or dUNEQ or dTIM

aTSF ← CI_SSF or dUNEQ or dTIM

aTSD ← dDEG

aREI ← "#EDCV"

On declaration of an aAIS the function shall output an all ONEs signal within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs.

Defect Correlations

cUNEQ← MON and dUNEQ

cTIM ← MON and dTIM (and not dUNEQ)

cDEG ← MON and dDEG and (not dUNEQ) and (not dTIM)

cRDI ← MON and dRDI and (not dTIM) and (not dUNEQ) and RDI_Reported

cSSF ← MON and CI_SSF and SSF_Reported

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

It shall be an option to report RDI as a fault cause. This is controlled by means of the parameter RDI_Reported. The default shall be RDI_Reported = false.

Performance Monitoring

The performance monitoring process shall be performed as specified in ITU-T G.806.

pN_DS ← aTSF or dEQ

pF_DS ← dRDI

pN_EBC ← ΣnN_B

pF_EBC ← ΣnF_B

11.2.3 P*q*s non-intrusive monitoring function P*q*sm_TT_Sk

NOTE 1 – This non-intrusive monitor trail termination sink function has no associated source function.

Symbol

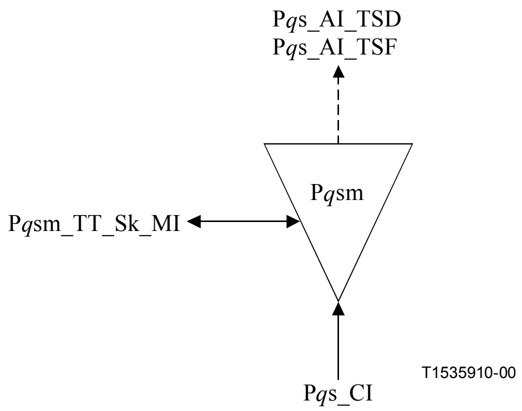


Figure 11-6/G.705 – P*q*sm_TT_Sk symbol

Interfaces

Table 11-3/G.705 – P*q*sm_TT_Sk input and output signal

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF Pqsm_TT_Sk_MI_TPmode Pqsm_TT_Sk_MI_SSF_Reported Pqsm_TT_Sk_MI_ExTI Pqsm_TT_Sk_MI_RDI_Reported Pqsm_TT_Sk_MI_DEGTHR Pqsm_TT_Sk_MI_DEGM Pqsm_TT_Sk_MI_1second Pqsm_TT_Sk_MI_TIMdis	Pqs_AI_TSF Pqs_AI_TSD Pqsm_TT_Sk_MI_cTIM Pqsm_TT_Sk_MI_cUNEQ Pqsm_TT_Sk_MI_cDEG Pqsm_TT_Sk_MI_cRDI Pqsm_TT_Sk_MI_cSSF Pqsm_TT_Sk_MI_AcTI Pqsm_TT_Sk_MI_pN_EBC Pqsm_TT_Sk_MI_pF_EBC Pqsm_TT_Sk_MI_pN_DS Pqsm_TT_Sk_MI_pF_DS

Processes

This function monitors for 34 Mbit/s (q=31) and 140 Mbit/s (q=4) frame errors and recovers the trail termination status as defined in ITU-T G.832. It extracts the payload independent overhead bytes EM, TR, MA bits 1, 2 from the P*q*sm layer Characteristic information:

EM: Even bit parity (BIP-8) shall be computed for each bit n of every byte of the preceding frame and compared with bit n of EM recovered from the current frame (n=1 to 8 inclusive). A difference between the computed and recovered EM values shall be taken as evidence of one or more errors (nN_B) in the computation block.

TR: The 16 byte Trail Trace Identifier (TTI) shall be recovered from the TR byte and shall be made available for network management purposes. The acceptance and mismatch detection process shall be performed as described in 6.2.2.2/G.806.

MA[1-2]: The relevant information carried in the MA byte (RDI in bit 1, REI in bit 2) shall be extracted to enable single ended maintenance of a bi-directional Trail. The REI (nF_B) shall be used to monitor the error performance of the reverse direction of transmission; the RDI provides information as to the status of the remote receiver. A "1" indicates a RDI state, while a "0" indicates the normal working state.

MA[3-5]: The information in the signal label bits shall be extracted to allow unequipped P*q*s and P*q*s-AIS defect detection.

Defects

The detection and removal conditions and processes for dUNEQ, dDEG, dRDI and dTIM are described in 6.2/G.806 with the condition "aSSF" read as "aSSF or P*q*s dAIS". To use the function within e.g. a tandem connection (see Note 2), it shall be possible to disable the trace id mismatch detection (TIMdis).

NOTE 2 – Presumably, in such case the Trace Id. will be unknown to the tandem connection operator.

P*q*s AIS

The function shall detect for an AIS condition by monitoring the P*q*s PSL for code "111". If 5 consecutive frames contain the "111" pattern in bits 3 to 5 of the MA byte a dAIS defect shall be detected. dAIS shall be cleared if in 5 consecutive frames any pattern other than the "111" is detected in bits 3 to 5 of the MA byte.

Consequent Actions

aTSF ← CI_SSF or dAIS or dUNEQ or dTIM

aTSD ← dDEG

Defect Correlations

cUNEQ ← MON and dUNEQ

cTIM ← MON and dTIM (and not dUNEQ)

cDEG ← MON and dDEG and (not dUNEQ) and (not dTIM)

cRDI ← MON and dRDI and (not dTIM) and (not dUNEQ) and RDI_Reported

cSSF ← MON and (CI_SSF or dAIS) and SSF_Reported

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

It shall be an option to report RDI as a fault cause. This is controlled by means of the parameter RDI_Reported. The default shall be RDI_Reported = false.

Performance Monitoring

The performance monitoring process shall be performed as specified in ITU-T G.806.

pN_DS ← aTSF or dEQ

pF_DS ← dRDI

pN_EBC ← ΣnN_B

pF_EBC   ← ΣnF_B

NOTE 3 – pF_DS/pF_EBC represent the performance of the total trail while pN_DS/pN_EBC represents only part of the trail up to the point of the non-intrusive monitor.

11.3 P*q*s adaptation functions

11.3.1 P31s layer to VC-12, VC-11 layer compound adaptation source function P31s/SX_A_So

Symbol

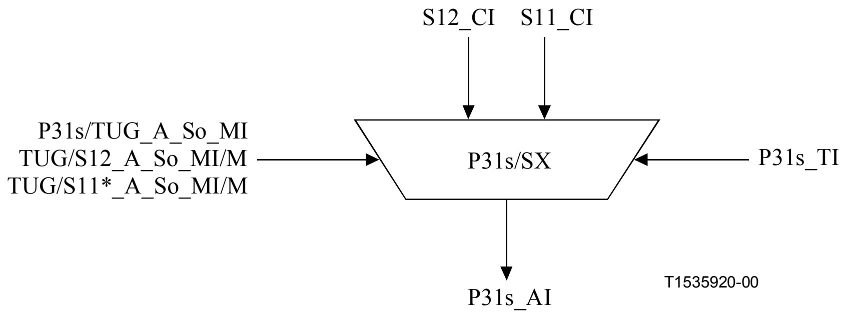


Figure 11-7/G.705 – P31s/SX_A_So symbol

Interfaces

Table 11-4/G.705 – P31s/SX_A_So input and output signals

Input(s)	Output(s)
P31s/TUG_A_So_MI P31s_TI maximum 14 inputs: S12_CI TUG/S12_A_So_MI/M maximum 14 inputs: S11_CI TUG/S11*_A_So_MI/M	P31s_AI

Processes

The P31s/SX_A_So compound function provides adaptation from the VC-12/11 layers to the P31s layer. This process is performed by a combination of several atomic functions as shown in Figure 11-8. The P31s/TUG_A_So function performs the P31s layer specific signal label and multiframe processing, while the TUG/S12_A_So and TUG/S11*_A_So functions perform the lower order VC specific frequency justification and bit-rate adaptation. Each of these TUG/Sm_A_So functions is characterized by the parameter M, which define the number of the TU within the P31s the function has access to (TU numbering scheme as specified in 3.1/G.832). According to the TUG multiplex structures supported by the NE, a variety of possible combinations of these TUG/Sm_A_So functions exists. Table 11-5 lists all possible TUG/Sm_A_So functions within a P31s/SX_A_So compound functions.

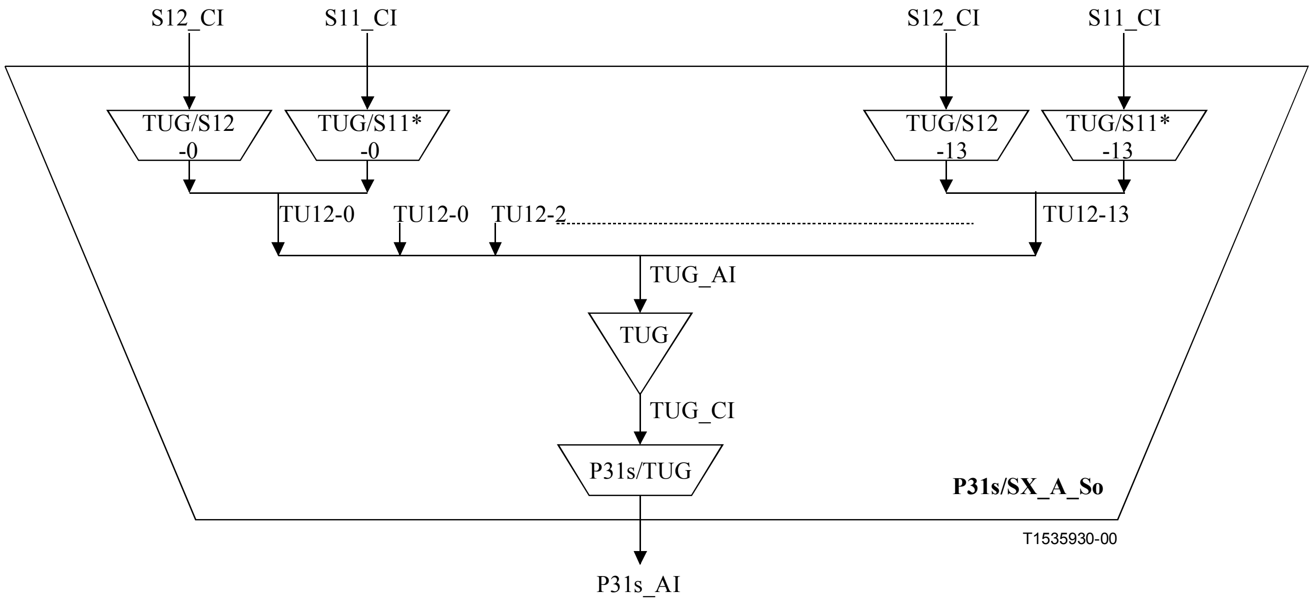


Figure 11-8/G.705 – P31s/SX_A_So compound function with set of P31s/Sm_A_So atomic functions

Table 11-5/G.705 – Possible TUG/Sm_A_So functions of a P31s/SX_A_So compound function

Atomic function	TU-12 number M
TUG/S12_A_So/M	0 to 13
TUG/S11*_A_So/M	0 to 13

For specific implementations only a subset of these TUG/Sm_A_So functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 14 TUG/S12_A_So functions). If a flexible TUG multiplex structure is supported, several TUG/Sm_A_So functions may have access to the same TU timeslot. For such case, only one of these adaptation source functions is allowed to be activated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG multiplex structure.

NOTE 1 – The P31s/TUG_A_So, TUG_T_So and TUG/Sm_A_So (m = 12, 11*) defined in the following clauses can only be used in a P31s/SX_A_So compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG is a virtual sub-layer only applicable in a P31s/SX_A compound function.

NOTE 3 – The number of TUG/Sm_A (m=12,11*) functions that is active shall completely fill the P31s payload.

11.3.1.1 P31s layer to TUG adaptation source function P31s/TUG_A_So

NOTE – The P31s/TUG_A_So functions can only be used in a P31s/SX_A_So compound function. It cannot be used as a stand-alone function.

Symbol

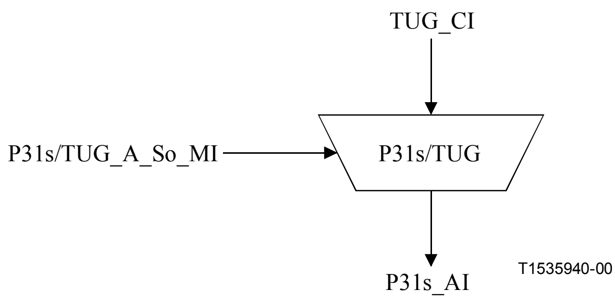


Figure 11-9/G.705 – P31s/TUG_A_So symbol

Interfaces

Table 11-6/G.705 – P31s/TUG_A_So input and output signals

Input(s)	Output(s)
TUG_CI_D TUG_CI_CK TUG_CI_FS TUG_CI_MFS P31s/TUG_A_So_MI_Active	P31s_AI_D P31s_AI_CK P31s_AI_FS

Processes

The function adds two payload specific signals (bits MA[3-5] and MA[6-7]) to the P31s POH and fixed stuff (R) bytes to the P31s payload (Figure 11-11).

MA[3-5]: In this byte the function shall insert code "011" (TU-12 structure) as defined in ITU-T G.832.

MA[6-7]: The value of the multiframe indicator bits shall be set as specified by ITU-T G.832, 500 µs TU multiframe sequence, and aligned with TUG_CI_MFS.

					TU multiframe indicator		
1	2	3	4	5	6	7	8

Figure 11-10/G.705 – TU multiframe indicator bits in byte MA

R – *Fixed Stuff bytes*: The fixed stuff bytes R are undefined.

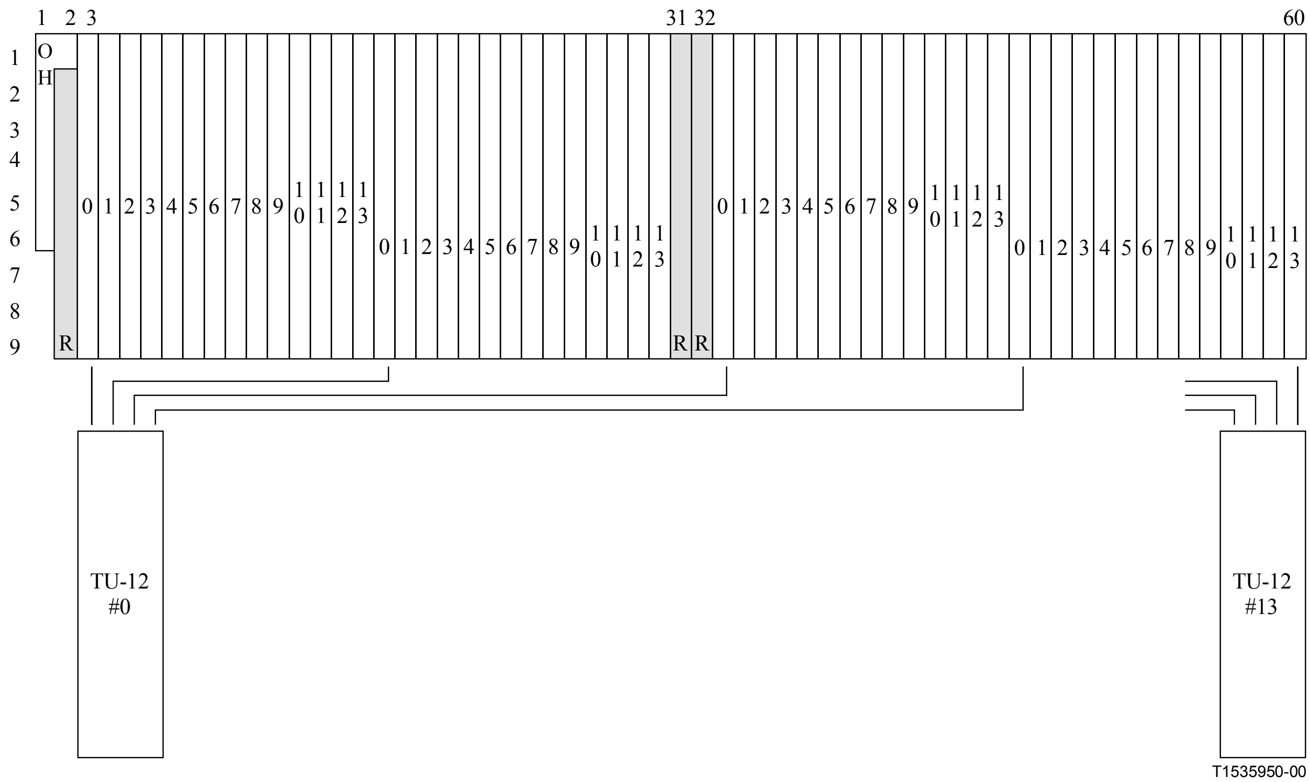


Figure 11-11/G.705 – P31s payload (TU-12s and fixed stuff "R" bytes) and TU-12 numbering scheme

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.

11.3.1.2 TUG termination source function TUG_T_So

NOTE – The TUG_T_So function can only be used in a P31s/SX_A_So compound function. It cannot be used as a stand-alone function.

Symbol

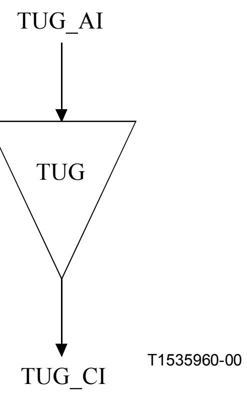


Figure 11-12/G.705 – TUG_T_So symbol

Interfaces

Table 11-7/G.705 – TUG_T_So input and output signals

Input(s)	Output(s)
TUG_AI_D TUG_AI_CK TUG_AI_FS TUG_AI_MFS	TUG_CI_D TUG_CI_CK TUG_CI_FS TUG_CI_MFS

Processes: None.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.3.1.3 TUG to VC-m layer adaptation source function TUG/Sm_A_So/M

NOTE 1 – The TUG/Sm_A_So (m = 12, 11*) function can only be used in a P31s/SX_A_So compound function. It cannot be used as a stand-alone function.

Symbol

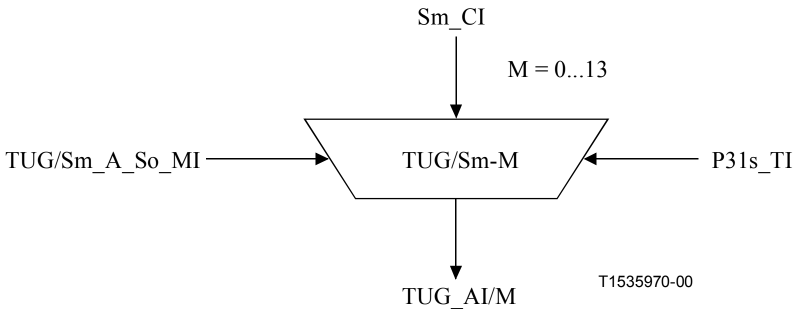


Figure 11-13/G.705 – TUG/Sm_A_So symbol

Interfaces

Table 11-8/G.705 – TUG/Sm_A_So input and output signals

Input(s)	Output(s)
Sm_CI_D Sm_CI_CK Sm_CI_FS Sm_CI_SSF P31s_TI_CK P31s_TI_FS P31s_TI_MFS TUG/Sm_A_So_MI_Active	TUG_AI_D TUG_AI_CK TUG_AI_FS

Processes

This function provides frequency justification and bit-rate adaptation for:

– a VC-12 signal (TUG/S12_A_So), represented by a nominally (140 × 64/4) = 2 240 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P31s signal via a TU-12.

– a VC-11 signal (TUG/S11*_A_So), represented by a nominally (104 × 64/4) = 1 664 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P31s signal. The VC-11 is transported within a TU-12; 9 bytes of fixed stuff (Figure 11-15) are added per 125 µs to the VC-11 as specified by ITU-T G.707 to map the VC-11 into the TU-12 payload (see Note 2).

NOTE 2 – Mapping a VC-11 into a TU-12 allows the VC-11 signal to be transported in a VC-12 based network (via S12_C and TUG/S12_A functions) and to non-intrusively monitor this VC-11 by means of a VC-12 non-intrusive monitor (S12m_TT_Sk). The TUG/S11*_A function will be used at the junction of VC-11 and VC-12 networks.

NOTE 3 – Degraded performance may be observed when equipment having a 4.6 ppm network element clock source interworks with equipment having a ± 20 ppm network element clock source.

The (500 µs) frame phase of the VC-m (m=12, 11) is coded in the related TU-12 pointer. Frequency justification, if required, is performed by pointer adjustments. The accuracy of this coding process is specified below.

Frequency justification and bit-rate adaptation: The function shall provide an elastic store (buffer) process. The data and frame start signals shall be written into the buffer under control of the associated input clock. The data and frame start signals shall be read out of the buffer under control of the P31s clock, frame position, and justification decision.

The justification decisions determine the phase error introduced by the TUG/Sm_A_So function (m=12, 11*). The amount of this phase error can be measured at the physical interfaces by monitoring the TU-12 pointer actions.

Each justification decision results in a corresponding negative/positive justification action. Upon a positive justification action, the reading of 8 data bits shall be cancelled once and no data are written at the justification opportunity position V3+1(Figures 11-14 and 11-15). Upon a negative justification action, an extra 8 data bits shall be read out once into the justification opportunity position V3.

NOTE 4 – A requirement for maximum introduced phase error cannot be defined until a reference path is defined from which the requirements for network elements can be deduced. Such a requirement would also limit excessive phase error caused by pointer processors under fixed frequency offset conditions.

Buffer size: For further study.

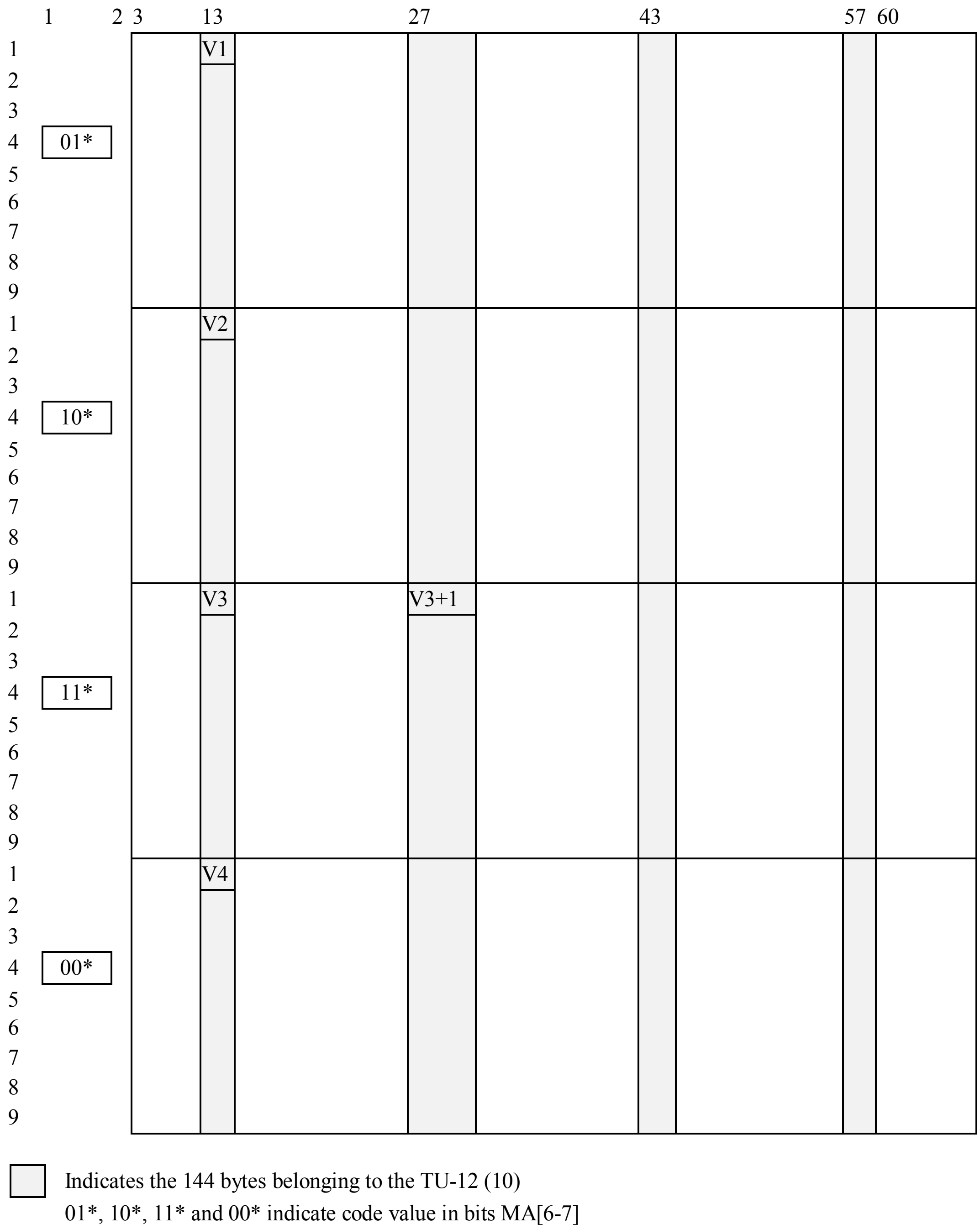
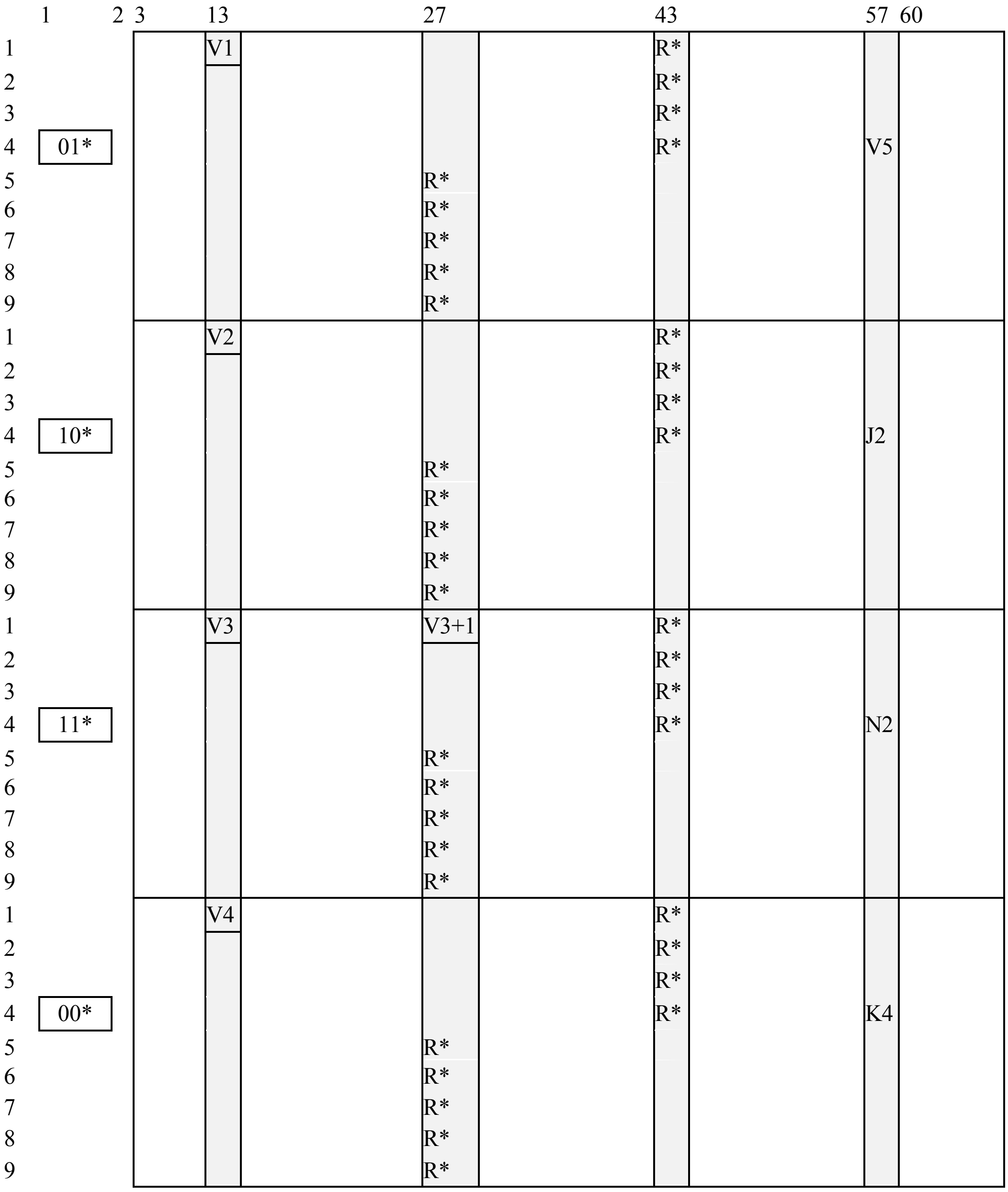


Figure 11-14/G.705 – TUG_AI_D/10 signal for TUG/S12_A_So



Indicates the 144 bytes belonging to the TU-12 (10)
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]
R* indicates fixed stuff with even parity
The positions of the V5, J2, N2, K4 and R* bytes is relative to the position of the VC-11 in the TU-12. The start of the VC-11 (V5 byte) is defined by the TU-12 pointer.

Figure 11-15/G.705 – TUG_AI_D/10 signal for TUG/S11*_A_So

The TU-12 pointer is carried in bytes V1 and V2 of payload specific OH per 500 µs multiframe (Figures 11-14 and 11-15). The TU-12 pointer is aligned in the P31s payload in fixed positions relative to the P31s frame and multiframe. The format of the TU-12 pointer and its location in the frame/multiframe are defined in ITU-T G.832.

V1, V2 – *Pointer generation*: The function shall generate the TU-12 pointer as is described in ITU-T G.707. It shall insert the pointer in the appropriate V1, V2 positions with the SS field set to 10 to indicate TU-12.

NOTE 5 – The byte V4 is undefined.

TU-12 timeslot: The adaptation source function has access to a specific TU-12 of the TUG access point. The TU-12 is defined by the parameter M (M=0 to 13).

Figure 11-8 shows that more than one adaptation source function exists in the TUG virtual sub-layer that can be connected to one TUG access point. For such case, a subset of these adaptation source functions is allowed to be activated together, but only one adaptation source function may have access to a specific TU timeslot. Access to the same TU timeslot by other adaptation source functions shall 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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 6 – If CI_SSF is not connected (when connected to a Sm_TT_So (m=12, 11)), CI_SSF is assumed to be false.

Defect Correlations: None.

Performance Monitoring: None.

11.3.2 P31s layer to VC-12, VC-11 layer compound adaptation sink function P31s/SX_A_Sk

Symbol

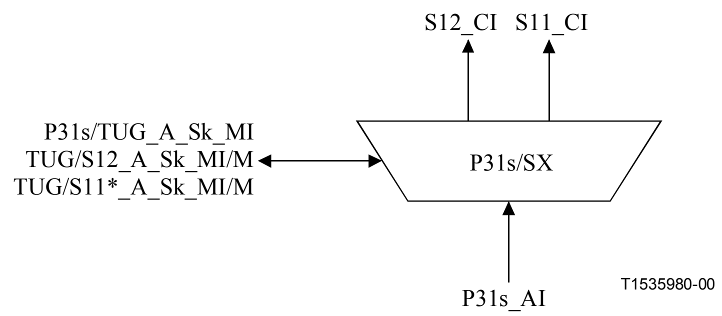


Figure 11-16/G.705 – P31s/TUG_A_Sk symbol

Interfaces

Table 11-9/G.705 – P31s/TUG_A_Sk input and output signals

Input(s)	Output(s)
P31s_AI P31s/TUG_A_Sk_MI maximum 14 inputs: TUG/S12_A_Sk_MI/M maximum 14 inputs: TUG/S11*_A_Sk_MI/M	P31s/TUG_A_Sk_MI maximum 14 outputs: S12_CI TUG/S12_A_Sk_MI/M maximum 14 outputs: S11_CI TUG/S11*_A_Sk_MI/M

Processes

The P31s/SX_A_Sk compound function provides adaptation from the P31s layer to the VC-12/11 layers. This process is performed by a combination of several atomic functions as shown in Figure 11-17. The P31s/TUG_A_Sk function performs the P31s layer specific signal label and multiframe processing, while the TUG/S12_A_Sk and TUG/S11*_A_Sk functions perform the lower order VC specific frequency justification and bit-rate adaptation. Each of these TUG/Sm_A_Sk functions is characterized by the parameter M, which define the number of the TU within the P31s the function has access to (TU numbering scheme as specified in 3.1/G.832). According to the TUG multiplex structures supported by the NE, a variety of possible combinations of these TUG/Sm_A_Sk functions exists. Table 11-10 lists all possible TUG/Sm_A_Sk functions within a P31s/SX_A_Sk compound function.

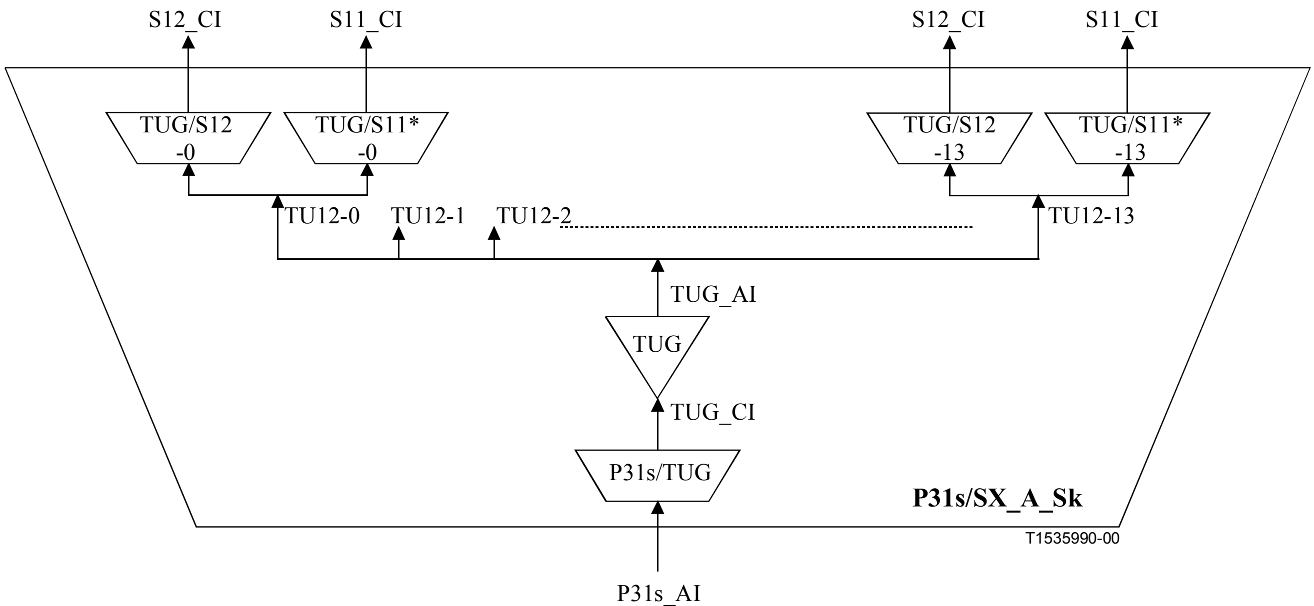


Figure 11-17/G.705 – P31s/SX_A_Sk compound function with set of P31s/Sm_A_Sk atomic functions

Table 11-10/G.705 – Possible TUG/Sm_A_Sk functions of a P31s/SX_A_Sk compound function

Atomic function	TU-12 number M
TUG/S12_A_Sk/M	0 to 13
TUG/S11*_A_Sk/M	0 to 13

For specific implementations only a subset of these TUG/Sm_A_Sk functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 14 TUG/S12_A_Sk functions). If a flexible TUG multiplex structure is supported, several TUG/Sm_A_Sk functions may have access to the same TU timeslot. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) to be detected and reported. To prevent this an adaptation sink function can be deactivated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG multiplex structure.

NOTE 1 – The P31s/TUG_A_Sk, TUG_T_Sk and TUG/Sm_A_Sk (m=12, 11*) defined in the following subclauses can only be used in a P31s/SX_A_Sk compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG is a virtual sub-layer only applicable in a P31s/SX_A compound function.

11.3.2.1 P31s layer to TUG adaptation sink function P31s/TUG_A_Sk

NOTE 1 – The P31s/TUG_A_Sk function can only be used in a P31s/SX_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

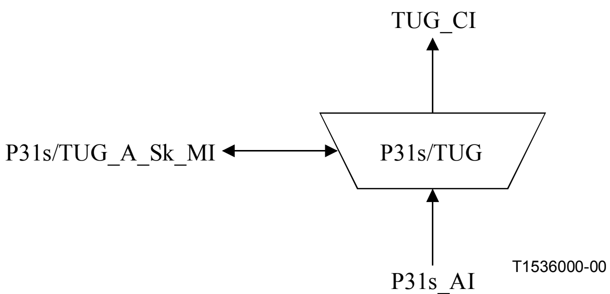


Figure 11-18/G.705 – P31s/TUG_A_Sk symbol

Interfaces

Table 11-11/G.705 – P31s/TUG_A_Sk input and output signals

Input(s)	Output(s)
P31s_AI_D P31s_AI_CK P31s_AI_FS P31s_AI_TSF P31s/TUG_A_Sk_MI_Active	TUG_CI_D TUG_CI_CK TUG_CI_FS TUG_CI_MFS TUG_CI_SSF P31s/TUG_A_Sk_MI_cPLM P31s/TUG_A_Sk_MI_cLOM

Processes

The function monitors two payload specific signals (bits MA[3-5] and MA[6-7]) of the P31s POH.

MA[3-5]: The function shall compare the content of the accepted MA[3-5] bits with the expected value code "011" (TU-12 structure) as a check on consistency between the provisioning operation at each end.

MA[6-7]: the function shall recover the 500 μs (multi)frame start phase performing multiframe alignment on bits 6 and 7 of byte MA. Out-of-multiframe (OOM) shall be assumed once when an error is detected in the MA bit 6 and 7 sequence. Multiframe alignment shall be assumed to be recovered, and the in-multiframe (IM) state shall be entered, when in four consecutive P31s frames an error free MA sequence is found.

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

Defects

The function shall detect for the dPLM defect as specified in 6.2.4.2/G.806.

If the multiframe alignment process is in the OOM state and the MA[6-7] multiframe is not recovered within X ms, a dLOM defect shall be declared. Once in a dLOM state, this state shall be exited when the multiframe is recovered (multiframe alignment process enter the IM state). X shall be a value in the range 1 to 5 (ms). X is not configurable.

Consequent Actions

aSSF ← dPLM or dLOM

Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLOM ← dLOM and (not AI_TSF) and (not dPLM)

NOTE 2 – There may be another parallel adaptation function, e.g. P31s/SD_A_Sk that generate also cLOM. The EMF should take care that fLOM is reported only once.

Performance Monitoring: None.

11.3.2.2 TUG termination sink function TUG_T_Sk

NOTE – The TUG_T_Sk function can only be used in a P31s/SX_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

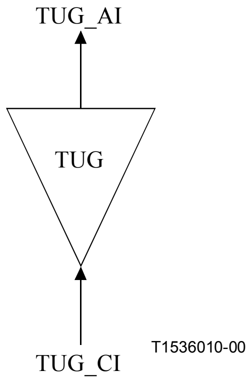


Figure 11-19/G.705 – TUG_T_Sk symbol

Interfaces

Table 11-12/G.705 – TUG_T_Sk input and output signals

Input(s)	Output(s)
TUG_CI_D TUG_CI_CK TUG_CI_FS TUG_CI_SSF	TUG_AI_D TUG_AI_CK TUG_AI_FS TUG_AI_TSF

Processes: None.

Defects: None.

Consequent Actions

aTSF ← CI_SSF

Defect Correlations: None.

Performance Monitoring: None.

11.3.2.3 TUG to VC-m layer adaptation sink function TUG/Sm_A_Sk/M

NOTE – The TUG/Sm_A_Sk (m=12, 11*) function can only be used in a P31s/SX_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

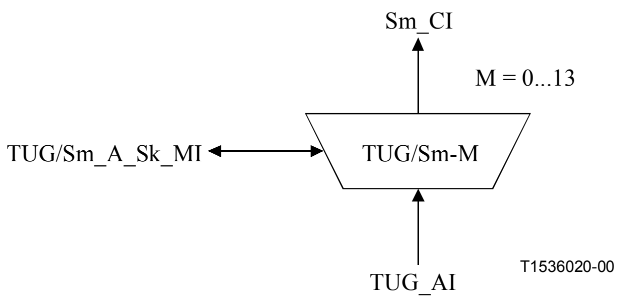


Figure 11-20/G.705 – TUG/Sm_A_Sk symbol

Interfaces

Table 11-13/G.705 – TUG/Sm_A_Sk input and output signals

Input(s)	Output(s)
TUG_AI_D TUG_AI_CK TUG_AI_FS TUG_AI_TSF TUG/Sm_A_Sk_MI_AIS_Reported TUG/Sm_A_Sk_MI_Active	Sm_CI_D Sm_CI_CK Sm_CI_FS Sm_CI_SSF TUG/Sm_A_Sk_MI_cLOP TUG/Sm_A_Sk_MI_cAIS

Processes

The TUG/S12_A_Sk (respectively TUG/S11*_A_Sk) function recovers VC-12 (respectively VC-11) data with frame phase information from a TU-12.

V1, V2 – *TU-12 pointer interpretation*: The function shall perform TU-12 pointer interpretation as specified in Annex A/G.783 to recover the VC-m (m=12, 11) frame phase within a TU-12 of a P31s.

TU-12 timeslot: The adaptation sink function has access to a specific TU-12 of the TUG access point. The TU-12 is defined by the parameter M (M=0 to 13).

Figure 11-17 shows that more than one adaptation sink function exists in this TUG virtual sub-layer that can be connected to one TUG access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) 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 its management point.

Defects

The function shall detect for dAIS and dLOP defect according the algorithm described under the pointer interpreter process in Annex A/G.783.

Consequent Actions

aAIS ← dAIS or dLOP or AI_TSF

aSSF ← dAIS or dLOP or AI_TSF

On declaration of aAIS the function shall output all ONEs signal within 1 ms; on clearing of aAIS the function shall output the recovered data within 1 ms.

Defect Correlations

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOP ← dLOP and (not AI_TSF)

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

Performance Monitoring: None.

11.3.3 P4s layer to VC-3, VC-2, VC-12, and VC-11 layer compound adaptation source function P4s/SX-TUG3_A_So

Symbol

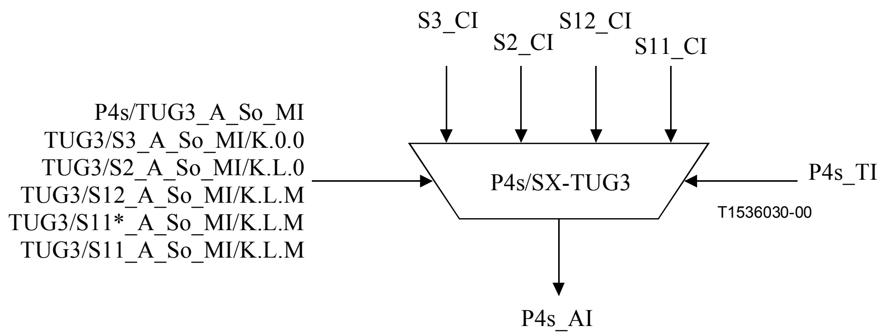


Figure 11-21/G.705 – P4s/SX-TUG3_A_So symbol

Interfaces

Table 11-14/G.705 – P4s/SX-TUG3_A_So input and output signals

Input(s)	Output(s)
P4s/SX-TUG3_A_So_MI P4s_TI maximum 2 inputs: S3_CI TUG3/S3_A_So_MI/K.0.0 maximum 19 inputs: S2_CI TUG3/S2_A_So_MI/K.L.0 maximum 57 inputs: S12_CI TUG3/S12_A_So_MI/K.L.M maximum 57 inputs: S11_CI TUG3/S11*_A_So_MI/K.L.M maximum 76 inputs: S11_CI TUG3/S11_A_So_MI/K.L.M	P4s_AI

Processes

The P4s/SX-TUG3_A_So compound function provides adaptation from the VC-3/2/12/11 layers to the P4s layer. This process is performed by a combination of several atomic functions as shown in Figure 11-22. The P4s/TUG3_A_So function performs the P4s layer specific signal label and multiframe processing, while the TUG3/S3_A_So, TUG3/S2_A_So, TUG3/S12_A_So, TUG3/S11*_A_So and TUG3/S11_A_So functions perform the lower order VC specific frequency justification and bit rate adaptation. Each of these TUG3/Sm_A_So functions is characterized by the K.L.M parameters, which define the number of the TU within the P4s the function has access to (TU numbering scheme according to Appendix II). According to the TUG3 multiplex structures supported by the NE, a variety of possible combinations of these TUG3/Sm_A_So functions exists. Table 11-15 lists all possible TUG3/Sm_A_So functions within a P4s/SX-TUG3_A_So compound functions.

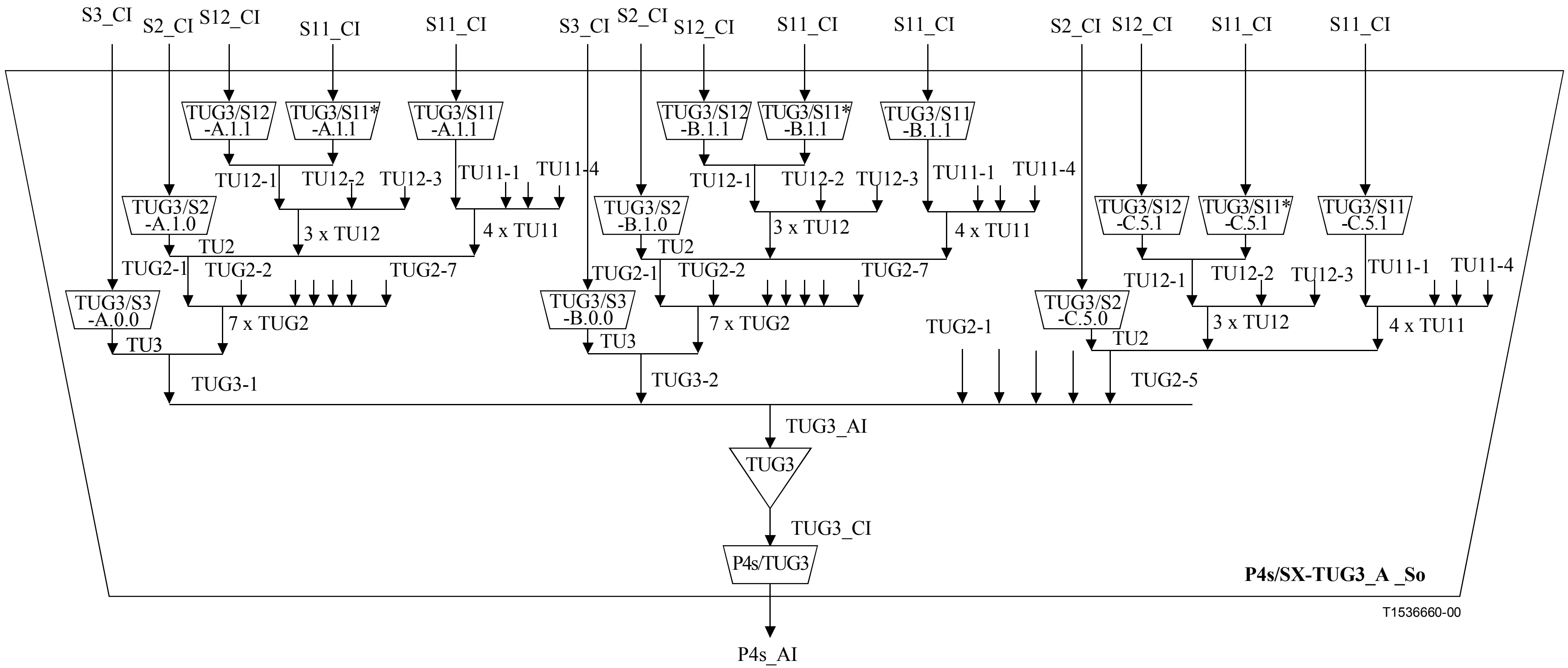


Figure 11-22/G.705 − P4s/SX-TUG3_A_So compound function with set of TUG/Sm_A_So atomic functions

Table 11-15/G.705 – Possible TUG3/Sm_A_So functions of a P4s/SX-TUG3_A_So compound function

Atomic function	TU-3/TUG-3 number K	TU-2/TUG-2 number L	TU-12 number M
TUG3/S3_A_Sk/K.0.0	A,B	0	0
TUG3/S2_A_Sk/K.L.0	A,B,C	1 to 7 (A,B) 1 to 5 (C)	0
TUG3/S12_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 3
TUG3/S11*_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 3
TUG3/S11_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 4

For specific implementations only a subset of these TUG3/Sm_A_So functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 57 TUG/S12_A_So functions). If a flexible TUG3 multiplex structure is supported, several TUG3/Sm_A_So functions may have access to the same TU timeslot. For such case, only one of these adaptation source functions is allowed to be activated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG3 multiplex structure.

NOTE 1 – The P4s/TUG3_A_So, TUG3_T_So and TUG3/Sm_A_So (m = 3, 2, 12, 11*, 11) defined in the following clauses can only be used in a P4s/SX-TUG3_A_So compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG3 is a virtual sublayer only applicable in a P4s/SX-TUG3_A compound function.

The number of TUG3/Sm_A (m=3,2,12,11*,11) functions that are active shall completely fill the P4s payload.

11.3.3.1 P4s layer to TUG3 adaptation source function P4s/TUG3_A_So

NOTE 1 – The P4s/TUG3_A_So function can only be used in a P4s/SX-TUG3_A_So compound function. It cannot be used as a stand-alone function.

Symbol

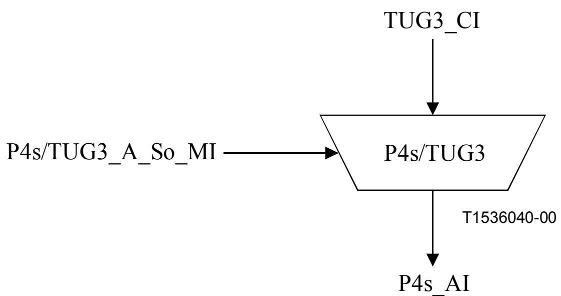


Figure 11-23/G.705 – P4s/TUG3_A_So symbol

Interfaces

Table 11-16/G.705 – P4s/TUG3_A_So input and output signals

Input(s)	Output(s)
TUG3_CI_D TUG3_CI_CK TUG3_CI_FS TUG3_CI_MFS P4s/TUG3_A_So_MI_Active P4s/TUG3_A_So_MI_TU3_1 P4s/TUG3_A_So_MI_TU3_2	P4s_AI_D P4s_AI_CK P4s_AI_FS

NOTE 2 – P4s/TUG3_A_So_MI_TU3_1 is true if TUG3/S3_A_So/A.0.0_MI_Active is true. P4s/TUG3_A_So_MI_TU3_2 is true if TUG3/S3_A_So/B.0.0_MI_Active is true.

Processes

The function adds two payload specific signals (bits MA[3-5] and MA[6-7]) to the P4s POH and fixed stuff (R0) bytes to the P4s payload (Figure 11-25). The fixed stuff bytes R1 and R2 are added depending on the TUG3 multiplex structure.

NOTE 3 – The fixed stuff bytes (R0, R1, R2) are undefined.

MA[3-5]: In this byte the function shall insert code "100" (SDH elements mapping II: 2 × TUG-3 and 5 × TUG-2 structure) as defined in ITU-T G.832.

MA[6-7]: The value of the multiframe indicator MA[6-7] shall be set as specified by ITU-T G.832, 500 µs TU multiframe sequence, and aligned with TUG3_CI_MFS.

					multiframe indicator		
1	2	3	4	5	6	7	8

Figure 11-24/G.705 – TU multiframe indicator bits in byte MA

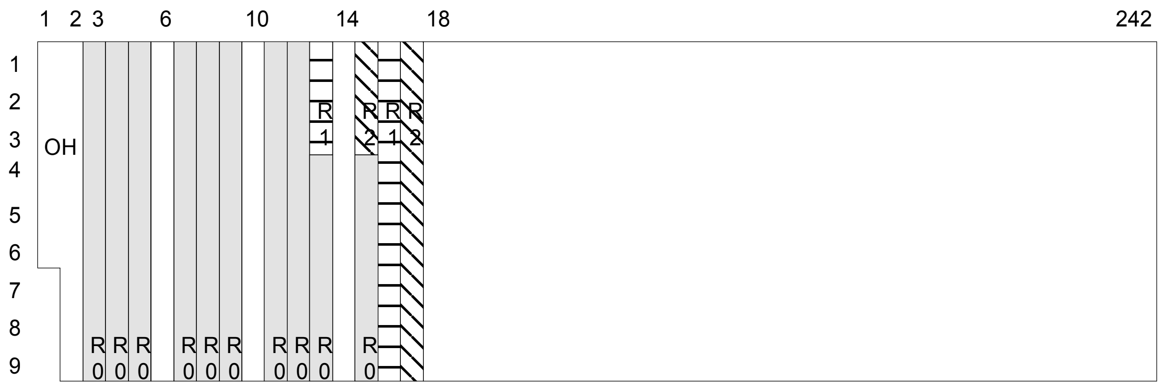


Figure 11-25/G.705 – P4s payload (TUGs and fixed stuff "R" bytes)

Fixed Stuff bytes: The R0 bytes are always added. The R1 bytes are added if the TUG-3-A contains TUG-2s (MI_TU3_1 is false). The R2 bytes are added if the TUG-3-B contains TUG-2s (MI_TU3_2 is false).

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.

11.3.3.2 TUG3 trail termination source function TUG3_T_So

NOTE – The TUG3_T_So functions can only be used in a P4s/SX-TUG3_A_So compound function. It cannot be used as a stand-alone function.

Symbol

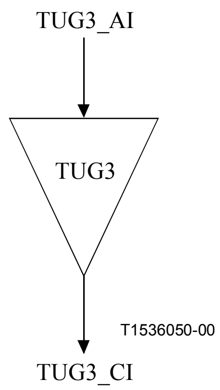


Figure 11-26/G.705 – TUG3_T_So symbol

Interfaces

Table 11-17/G.705 – TUG3_T_So input and output signals

Input(s)	Output(s)
TUG3_AI_D TUG3_AI_CK TUG3_AI_FS TUG3_AI_MFS	TUG3_CI_D TUG3_CI_CK TUG3_CI_FS TUG3_CI_MFS

Processes: None.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.3.3.3 TUG3 to VC-3 layer adaptation source function TUG3/S3_A_So/K.0.0

NOTE 1 – The TUG3/S3_A_So functions can only be used in a P4s/SX-TUG3_A_So compound function. It cannot be used as a stand-alone function.

Symbol

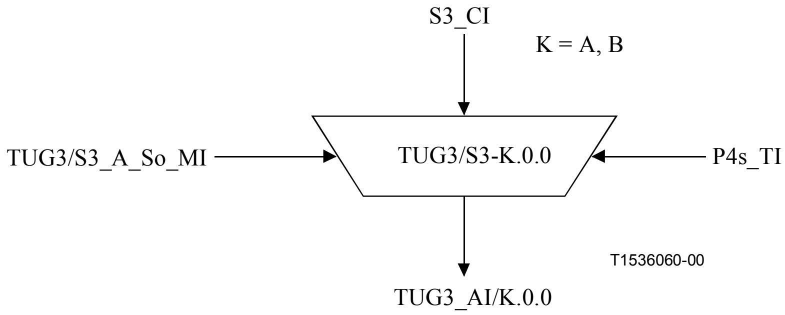


Figure 11-27/G.705 – TUG3/S3_A_So symbol

Interfaces

Table 11-18/G.705 – TUG3/S3_A_So input and output signals

Input(s)	Output(s)
S3_CI_D S3_CI_CK S3_CI_FS S3_CI_SSF P4s_TI_CK P4s_TI_FS TUG3/S3_A_So_MI_Active	TUG3_AI_D TUG3_AI_CK TUG3_AI_FS

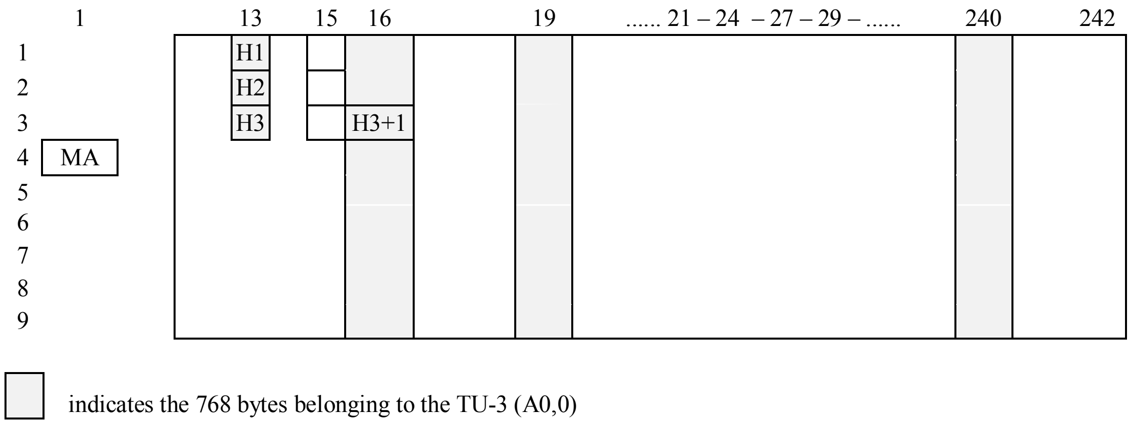


Figure 11-28/G.705 – TUG3_AI_D/A.0.0 signal

Processes

This function provides frequency justification and bit rate adaptation for a VC-3 signal, represented by a nominally (765 × 64) = 48 960 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-3.

NOTE 2 – Degraded performance may be observed when equipment having a ± 4.6 ppm network element clock source interworks with equipment having a ± 20 ppm network element clock source.

The frame phase of the VC-3 is coded in the related TU-3 pointer. Frequency justification, if required, is performed by pointer adjustments. The accuracy of this coding process is specified below.

Frequency justification and bit rate adaptation: The function shall provide an elastic store (buffer) process. The data and frame start signals shall be written into the buffer under control of the associated input clock. The data and frame start signals shall be read out of the buffer under control of the P4s clock, frame position, and justification decision.

The justification decisions determine the phase error introduced by the TUG3/S3_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the TU-3 pointer actions.

Each justification decision results in a corresponding negative/positive justification action. Upon a positive justification action, the reading of 8 data bits shall be cancelled once and no data are written at the justification opportunity position H3+1. Upon a negative justification action, an extra 8 data bits shall be read out once into the justification opportunity position H3.

NOTE 3 – A requirement for maximum introduced phase error cannot be defined until a reference path is defined from which the requirements for network elements can be deduced. Such a requirement would also limit excessive phase error caused by pointer processors under fixed frequency offset conditions.

Buffer size: For further study.

The TU-3 pointer is carried in 2 bytes of payload specific OH in each container frame. The TU-3 pointer is aligned in the P4s payload in fixed position relative to the P4s frame. The TU-3 pointer points to the begin of the VC-3 frame within the P4s. The format of the TU-3 pointer and its location in the frame are defined in ITU-T G.832.

H1, H2 – *Pointer generation*: The function shall generate the TU-3 pointer as is described in ITU-T G.707. It shall insert the pointer in the appropriate H1, H2 positions with the SS field set to 10 to indicate TU-3.

TU-3 timeslot: The adaptation source function has access to a specific TU-3 of the TUG3 access point. The TU-3 is defined by the parameter K (K=A,B).

Figure 11-22 shows that more than one adaptation source function exists in the TUG3 virtual sublayer that can be connected to one TUG3 access point. For such case, a subset of these adaptation source functions is allowed to be activated together, but only one adaptation source function may have access to a specific TU *timeslot*. Access to the same TU *timeslot* by other adaptation source functions shall 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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all-ONEs signal within 250 μs; on clearing of aAIS the function shall output normal data within 250 μs.

NOTE 4 – If CI_SSF is not connected (when connected to a S3_TT_So), CI_SSF is assumed to be false.

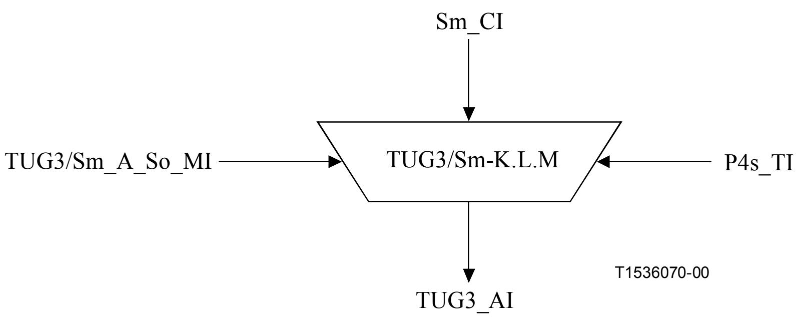
Defect Correlations: None.

Performance Monitoring: None.

11.3.3.4 TUG3 to VC-m layer adaptation source function TUG3/Sm_A_So/K.L.M

NOTE 1 – The TUG3/Sm_A_So (m=2, 12, 11*, 11) function can only be used in a P4s/SX-TUG3_A_So compound function. It cannot be used as a stand-alone function.

Symbol



NOTE – The allowed values for K, L, M for each TUG3/Sm_A_So function are given in Table 11-15.

Figure 11-29/G.705 – TUG3/Sm_A_So symbol

Interfaces

Table 11-19/G.705 – TUG3/Sm_A_So input and output signals

Input(s)	Output(s)
Sm_CI_D Sm_CI_CK Sm_CI_FS Sm_CI_SSF P4s_TI_CK P4s_TI_FS P4s_TI_MFS TUG3/Sm_A_So_MI_Active	TUG3_AI_D TUG3_AI_CK TUG3_AI_FS TUG3_AI_MFS

Processes

This function provides frequency justification and bit rate adaptation for:

– a VC-2 signal (TUG3/S2_A_So), represented by a nominally (428 × 64/4) = 6 848 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-2;

– a VC-12 signal (TUG3/S12_A_So), represented by a nominally (140 × 64/4) = 2 240 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-12;

– a VC-11 signal (TUG3/S11*_A_So), represented by a nominally (104 × 64/4) = 1 664 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal. The VC-11 is transported within a TU-12; 9 bytes of fixed stuff (Figure 11-32) are added per 125 µs to the VC-11 as specified by ITU-T G.707 to map the VC-11 into the TU-12 payload (see Note 2);

– a VC-11 signal (TUG3/S11_A_So), represented by a nominally (104 × 64/4) = 1 664 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-11.

NOTE 2 – Mapping a VC-11 into a TU-12 allows the VC-11 signal to be transported in a VC-12 based network (via S12_C and TUG/S12_A functions) and to non-intrusively monitor this VC-11 by means of a VC-12 non-intrusive monitor (S12m_TT_Sk). The TUG3/S11*_A function will be used at the junction of VC-11 and VC-12 networks.

NOTE 3 – Degraded performance may be observed when equipment having a ± 4.6 ppm network element clock source interworks with equipment having a ± 20 ppm network element clock source.

The (500 µs) frame phase of the VC-m (m=2, 12, 11) is coded in the related TU pointer. Frequency justification, if required, is performed by pointer adjustments. The accuracy of this coding process is specified below.

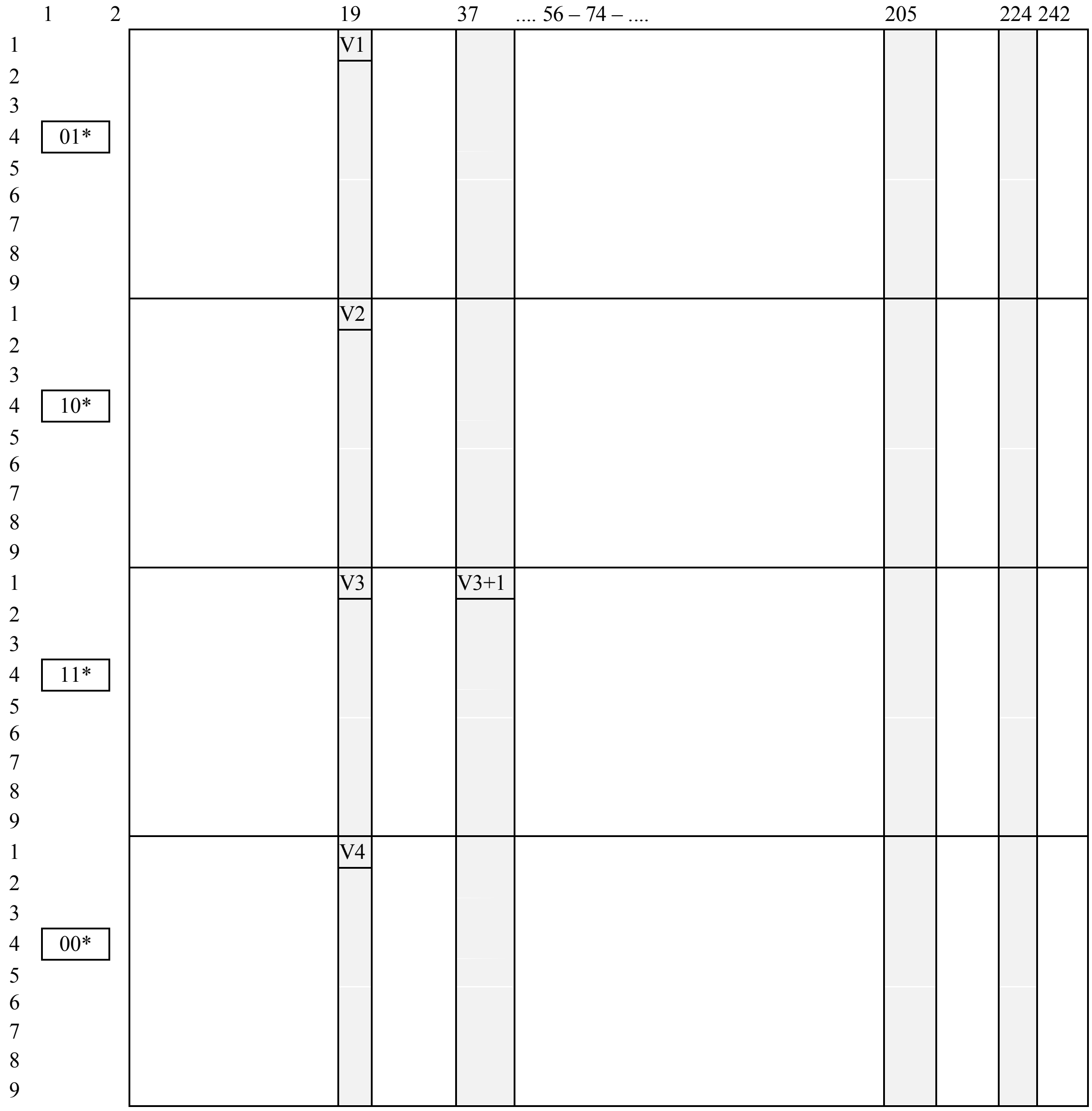
Frequency justification and bit rate adaptation: The function shall provide an elastic store (buffer) process. The data and frame start signals shall be written into the buffer under control of the associated input clock. The data and frame start signals shall be read out of the buffer under control of the P4s clock, frame position, and justification decision.

The justification decisions determine the phase error introduced by the TUG3/Sm_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the TU pointer actions.

Each justification decision results in a corresponding negative/positive justification action. Upon a positive justification action, the reading of 8 data bits shall be cancelled once and no data are written at the justification opportunity position V3+1 (see Figure 11-30 to Figure 11-33). Upon a negative justification action, an extra 8 data bits shall be read out once into the justification opportunity position V3.

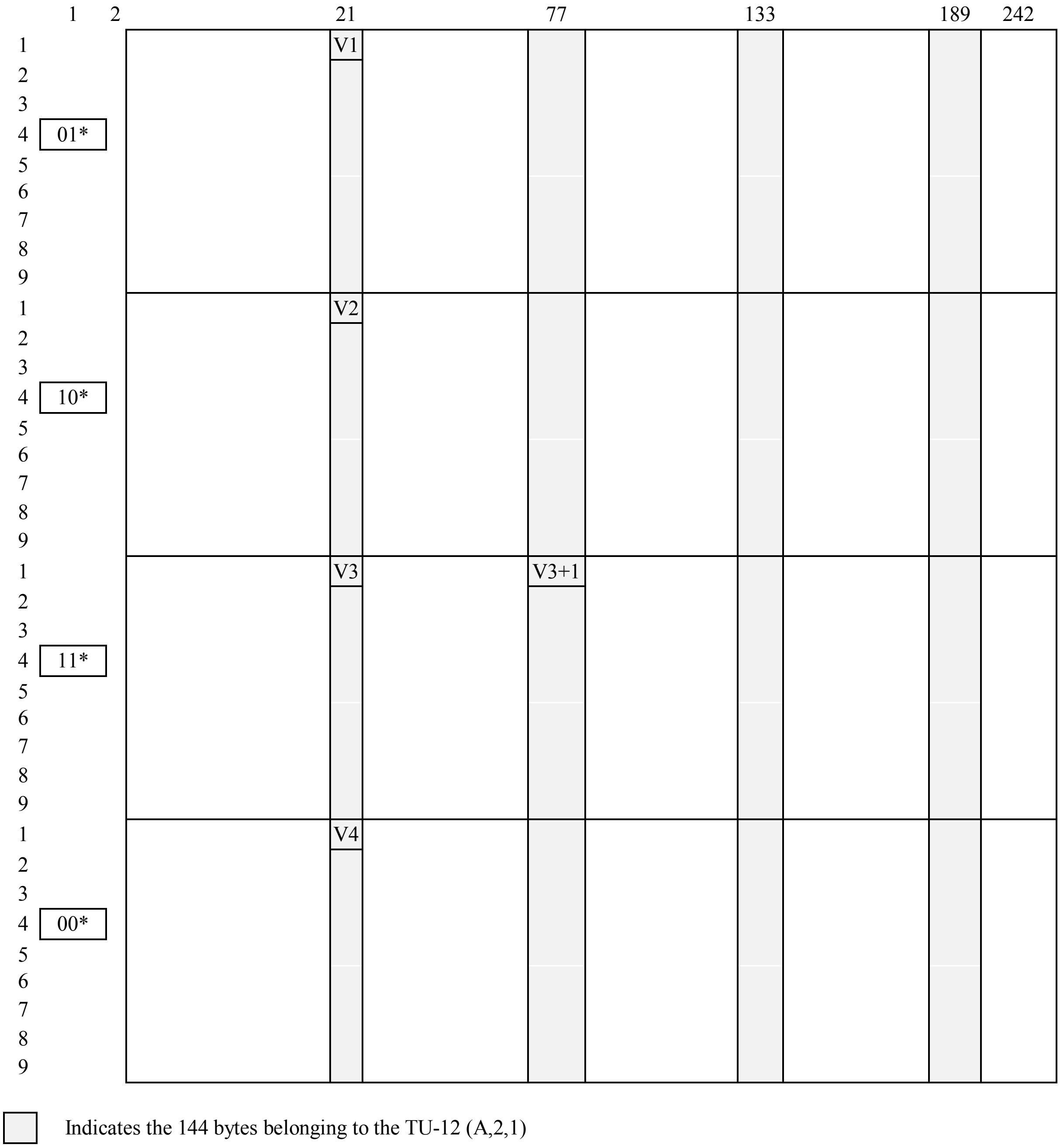
NOTE 4 – A requirement for maximum introduced phase error cannot be defined until a reference path is defined from which the requirements for network elements can be deduced. Such a requirement would also limit excessive phase error caused by pointer processors under fixed frequency offset conditions.

Buffer size: For further study.



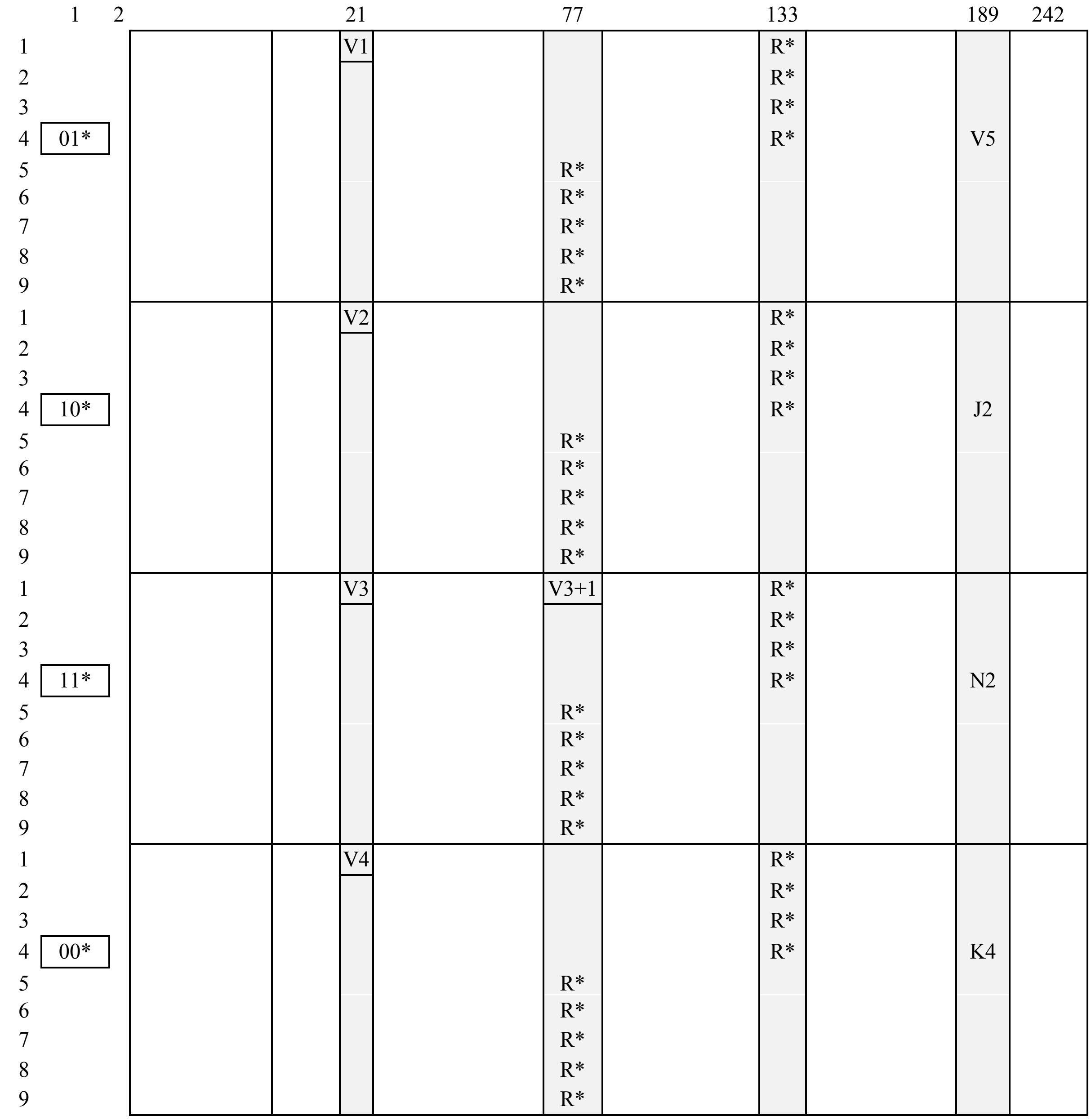
Indicates the 432 bytes belonging to the TU-2 (A,1,0)
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]

Figure 11-30/G.705 – TUG_AI_D/A.1.0 signal for TUG3/S2_A_So



Indicates the 144 bytes belonging to the TU-12 (A,2,1)
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]

Figure 11-31/G.705 – TUG3_AI_D/A.2.1 signal for TUG3/S12_A_So



Indicates the 144 bytes belonging to the TU-12 (A,2,1)

01*, 10*, 11* and 00* indicate code value in bits MA[6-7]

R* indicates fixed stuff with even parity

The positions of the V5, J2, N2, K4 and R* bytes are relative to the position of the VC-11 in the TU-12. The start of the VC-11 (V5 byte) is defined by the TU-12 pointer.

Figure 11-32/G.705 – TUG3_AI_D/A.2.1 signal for TUG3/S11*_A_So

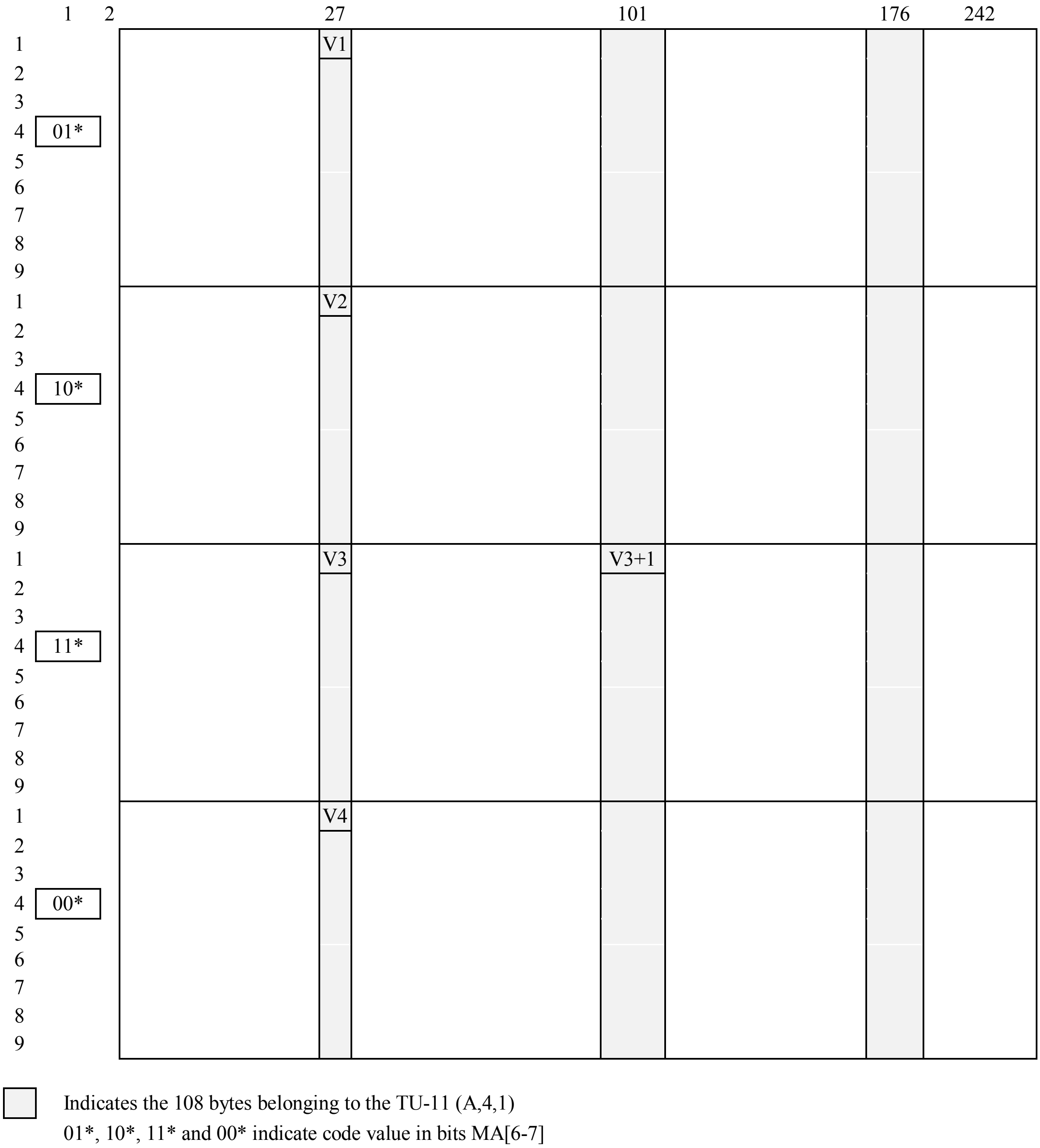


Figure 11-33/G.705 – TUG3_AI_D/A.4.1 signal for TUG3/S11_A_So

The TU pointer is carried in bytes V1 and V2 of payload specific OH once per 500 µs multiframe (see Figures 11-30 to 11-33). The TU pointer is aligned in the P4s payload in fixed positions relative to the P4s frame and multiframe. The format of the TU pointer and its location in the frame/multiframe are defined in ITU-T G.832.

V1, V2 – *Pointer generation*: The function shall generate the TU pointer as is described in ITU-T G.707. It shall insert the pointer in the appropriate V1, V2 positions with the SS field set to 00 to indicate TU-2, 10 to indicate TU-12 and 11 to indicate TU–11.

NOTE 5 – The byte V4 is undefined.

TU timeslot: The adaptation source function has access to a specific TU of the TUG3 access point. The TU is defined by the parameters K, L and M:

– for TU-2: K=A,B, L=1 to 7, M=0 and K=C, L=1 to 5, M=0;

– for TU-12: K=A to C, L=1 to 7, M=1 to 3;

– for TU-11: K=A to C, L=1 to 7, M=1 to 4.

Figure 11-22 shows that more than one adaptation source function exists in the TUG3 virtual sublayer that can be connected to one TUG3 access point. For such case, a subset of these adaptation source functions is allowed to be activated together, but only one adaptation source function may have access to a specific TU timeslot. Access to the same TU timeslot by other adaptation source functions shall 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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 6 – If CI_SSF is not connected (when connected to a Sm_TT_So (m=2, 12, 11)), CI_SSF is assumed to be false.

Defect Correlations: None.

Performance Monitoring: None.

11.3.4 P4s layer to VC-3, VC-2, VC-12, and VC-11 layer compound adaptation sink function P4s/SX-TUG3_A_Sk

Symbol

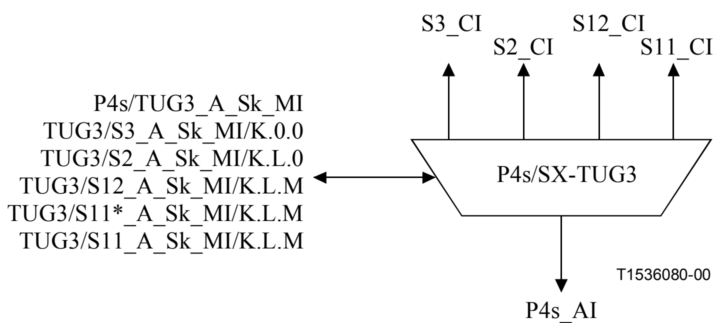


Figure 11-34/G.705 – P4s/SX-TUG3_A_Sk symbol

Interfaces

Table 11-20/G.705 – P4s/SX-TUG3_A_Sk input and output signals

Input(s)	Output(s)
P4s_AI P4s/SX-TUG3_A_Sk_MI maximum 2 outputs: TUG3/S3_A_Sk_MI/K.0.0 maximum 19 outputs: TUG3/S2_A_Sk_MI/K.L.0 maximum 57 outputs: TUG3/S12_A_Sk_MI/K.L.M maximum 57 outputs: TUG3/S11*_A_Sk_MI/K.L.M maximum 76 outputs: TUG3/S11_A_Sk_MI/K.L.M	P4s/SX-TUG3_A_Sk_MI maximum 2 outputs: S3_CI TUG3/S3_A_Sk_MI/K.0.0 maximum 19 outputs: S2_CI TUG3/S2_A_Sk_MI/K.L.0 maximum 57 outputs: S12_CI TUG3/S12_A_Sk_MI/K.L.M maximum 57 outputs: S11_CI TUG3/S11*_A_Sk_MI/K.L.M maximum 76 outputs: S11_CI TUG3/S11_A_Sk_MI/K.L.M

Processes

The P4s/SX_A_Sk compound function provides adaptation from the P4s layer to the VC-3/2/12/11 layers. This process is performed by a combination of several atomic functions as shown in Figure 11-35. The P4s/TUG3_A_Sk function performs the P4s layer specific signal label and multiframe processing, while the TUG3/S3_A_Sk, TUG3/S2_A_Sk, TUG3/S12_A_Sk, TUG3/S11*_A_Sk and TUG3/S11_A_Sk functions perform the lower order VC specific frequency justification and bit rate adaptation. Each of these TUG3/Sm_A_Sk functions is characterized by the K.L.M parameters, which define the number of the TU within the P4s the function has access to (TU numbering scheme according to Appendix II). According to the TUG3 multiplex structures supported by the NE, a variety of possible combinations of these TUG3/Sm_A_Sk functions exists. Table 11-21 lists all possible TUG3/Sm_A_Sk functions within a P4s/SX-TUG3_A_Sk compound functions.

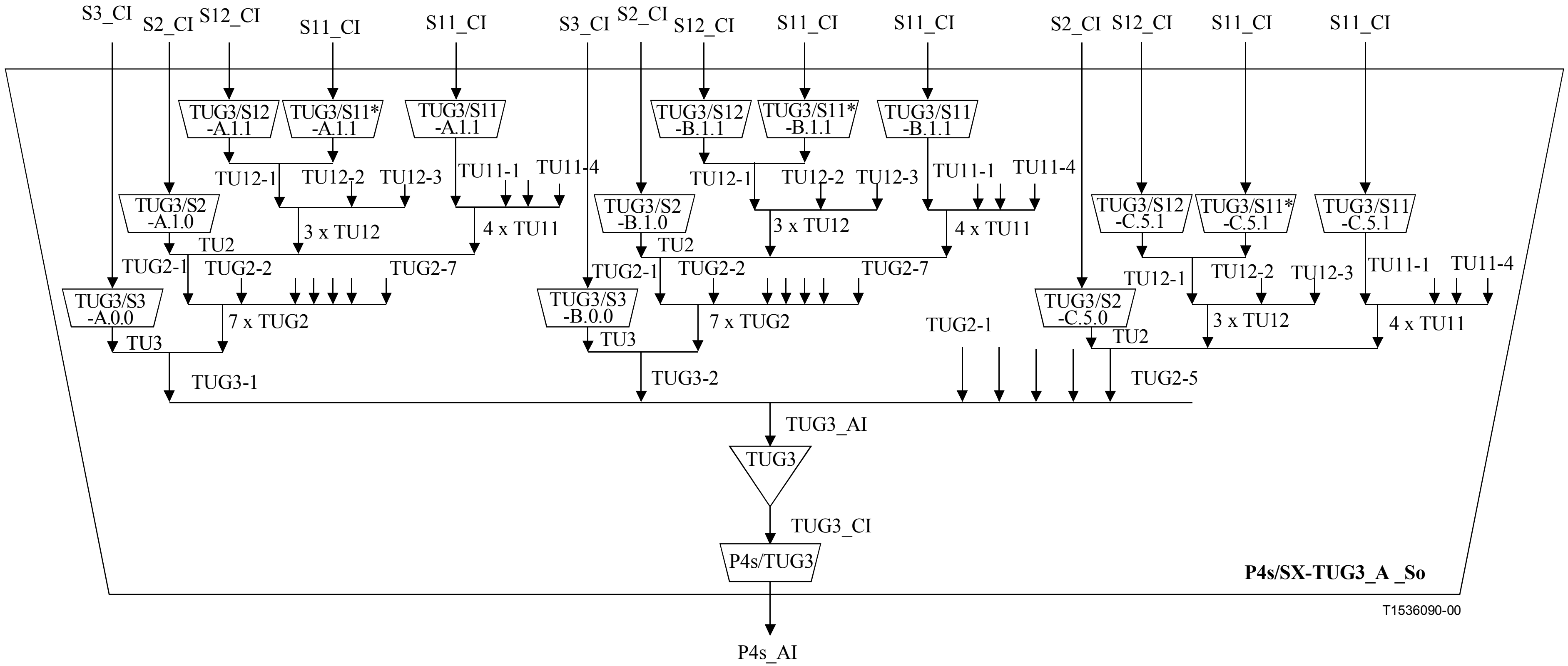


Figure 11-35/G.705 − P4s/SX-TUG3_A_Sk compound function with set of TUG3/Sm_A_Sk atomic functions

Table 11-21/G.705 – Possible TUG3/Sm_A_Sk functions of a P4s/SX-TUG3_A_Sk compound function

Atomic function	TU-3/TUG-3 number K	TU-2/TUG-2 number L	TU-12 number M
TUG3/S3_A_Sk/K.0.0	A,B	0	0
TUG3/S2_A_Sk/K.L.0	A,B,C	1 to 7 (A,B) 1 to 5 (C)	0
TUG3/S12_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 3
TUG3/S11*_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 3
TUG3/S11_A_Sk/K.L.M	A,B,C	1 to 7 (A,B) 1 to 5 (C)	1 to 4

For specific implementations only a subset of these TUG3/Sm_A_Sk functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 63 TUG3/S12_A_Sk functions). If a flexible TUG3 multiplex structure is supported, several TUG3/Sm_A_Sk functions may have access to the same TU timeslot. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) to be detected and reported. To prevent this an adaptation sink function can be deactivated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG3 multiplex structure.

NOTE 1 – The P4s/TUG3_A_Sk, TUG3_T_Sk and TUG3/Sm_A_Sk (m=3, 2, 12, 11*, 11) defined in the following clauses can only be used in a P4s/SX-TUG3_A_Sk compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG3 is a virtual sublayer only applicable in a P4s/SX-TUG3_A compound function.

11.3.4.1 P4s layer to TUG3 adaptation sink function P4s/TUG3_A_Sk

NOTE 1 – The P4s/TUG3_A_Sk function can only be used in a P4s/SX-TUG3_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

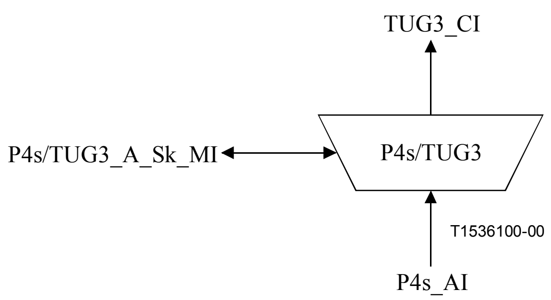


Figure 11-36/G.705 – P4s/TUG3_A_Sk symbol

Interfaces

Table 11-22/G.705 – P4s/TUG3_A_Sk input and output signals

Input(s)	Output(s)
P4s_AI_D P4s_AI_CK P4s_AI_FS P4s_AI_TSF P4s/TUG3_A_Sk_MI_Active	TUG3_CI_D TUG3_CI_CK TUG3_CI_FS TUG3_CI_MFS TUG3_CI_SSF_TUG2 TUG3_CI_SSF_TU3 P4s/TUG3_A_Sk_MI_cPLM P4s/TUG3_A_Sk_MI_cLOM

Processes

The function monitors two payload specific signals (bits 3-5 and bits 6-7) of the P4s POH.

MA[3-5]: The function shall compare the content of the accepted bits 3 to 5 of byte MA with the expected value code "100" (SDH elements mapping II: $2 \times$ TUG-3 and $5 \times$ TUG-2 structure) as a check on consistency between the provisioning operation at each end. The acceptance and mismatch detection processes are described in 6.2.4.2/G.806.

MA[6-7]: The function shall recover the 500 μs (multi)frame start phase performing multi-frame alignment on bits 6 and 7 of byte MA. Out-of-multiframe (OOM) shall be assumed once when an error is detected in the MA bit 6 and 7 sequence. Multiframe alignment shall be assumed to be recovered, and the inmultiframe (IM) state shall be entered, when in four consecutive P4s frames an error free MA bit 6,7 sequence is found.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF_TU3 and CI_SSF_TUG2) and not report its status via the management point.

Defects

The function shall detect for the dPLM defect as specified in 6.2.4.2/G.806.

If the multiframe alignment process is in the OOM state and the MA multiframe is not recovered within X ms, a dLOM defect shall be declared. Once in a dLOM state, this state shall be exited when the multiframe is recovered (multiframe alignment process enter the IM state). X shall be a value in the range 1 to 5 (ms). X is not configurable.

Consequent Actions

aSSF_TU3 ← dPLM

aSSF_TUG2 ← dPLM or dLOM

Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLOM ← dLOM and (not AI_TSF) and (not dPLM)

NOTE 2 – There may be another parallel adaptation function, e.g. P31s/SD_A_Sk that generate also cLOM. The EMF should take care that fLOM is reported only once.

Performance Monitoring: None.

11.3.4.2 TUG3 trail termination sink function TUG3_T_Sk

NOTE – The TUG3_T_Sk function can only be used in a P4s/SX-TUG3_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

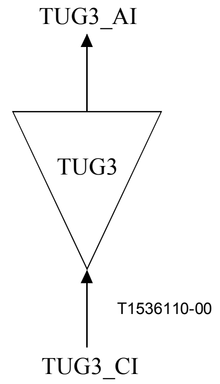


Figure 11-37/G.705 – TUG3_T_Sk symbol

Interfaces

Table 11-23/G.705 – TUG3_T_Sk input and output signals

Input(s)	Output(s)
TUG3_CI_D TUG3_CI_CK TUG3_CI_FS TUG3_CI_SSF_TUG2 TUG3_CI_SSF_TU3	TUG3_AI_D TUG3_AI_CK TUG3_AI_FS TUG3_AI_TSF_TUG2 TUG3_AI_TSF_TU3

Processes: None.

Defects: None.

Consequent Actions

aTSF_TUG2 ← CI_SSF_TUG2

aTSF_TU3 ← CI_SSF_TU3

Defect Correlations: None.

Performance Monitoring: None.

11.3.4.3 TUG3 to VC-3 layer adaptation sink function TUG3/S3_A_Sk/K.0.0

NOTE – The TUG3/S3_A_Sk function can only be used in a P4s/SX-TUG3_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

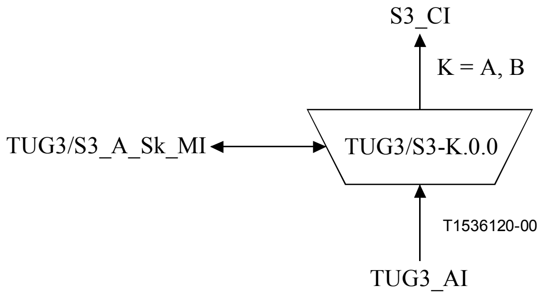


Figure 11-38/G.705 – TUG3/S3_A_Sk symbol

Interfaces

Table 11-24/G.705 – TUG3/S3_A_Sk input and output signals

Input(s)	Output(s)
TUG3_AI_D TUG3_AI_CK TUG3_AI_FS TUG3_AI_TSF_TU3 TUG3/S3_A_Sk_MI_AIS_Reported TUG3/S3_A_Sk_MI_Active	S3_CI_D S3_CI_CK S3_CI_FS S3_CI_SSF TUG3/S3_A_Sk_MI_cLOP TUG3/S3_A_Sk_MI_cAIS

Processes

This function recovers the VC-3 data with frame phase information from a TU-3.

H1, H2 – *TU-3 pointer interpretation*: The function shall perform TU-3 pointer interpretation as specified in Annex A/G.783 to recover the VC-3 frame phase within a TU-3 of a P4s.

TU-3 timeslot: The adaptation source function has access to a specific TU-3 of the TUG3 access point. The TU-3 is defined by the parameter K (K=A,B).

Figure 11-35 shows that more than one adaptation sink function exists in this TUG3 virtual sublayer that can be connected to one TUG3 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) 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 its management point.

Defects

The function shall detect for dAIS and dLOP defects according the algorithm described under the pointer interpreter process in Annex A/G.783 [9].

Consequent Actions

aAIS ← dAIS or dLOP or AI_TSF_TU3

aSSF ← dAIS or dLOP or AI_TSF_TU3

On declaration of aAIS the function shall output an all-ONEs (AIS) signal within 250 µs; on clearing of aAIS the function shall output the recovered data within 250 µs.

Defect Correlations

cAIS ← dAIS and (not AI_TSF_TU3) and AIS_Reported

cLOP ← dLOP and (not AI_TSF_TU3)

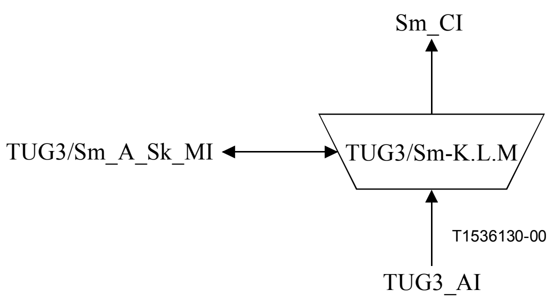
It shall be an option to report AIS as a fault cause. This is controlled by means of the parameter AIS_Reported. The default shall be AIS_Reported = false.

Performance Monitoring: None.

11.3.4.4 TUG3 to VC-m layer adaptation sink function TUG3/Sm_A_Sk/K.L.M

NOTE – The TUG3/Sm_A_Sk (m=2, 12, 11*, 11) function can only be used in a P4s/SX-TUG3_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol



NOTE – The allowed values for K, L, M for each TUG3/Sm_A_Sk function are given in Table 11-21.

Figure 11-39/G.705 – TUG3/Sm_A_Sk symbol

Interfaces

Table 11-25/G.705 – TUG3/Sm_A_Sk input and output signals

Input(s)	Output(s)
TUG3_AI_D TUG3_AI_CK TUG3_AI_FS TUG3_AI_TSF_TUG2 TUG3/Sm_A_Sk_MI_AIS_Reported TUG3/Sm_A_Sk_MI_Active	Sm_CI_D Sm_CI_CK Sm_CI_FS Sm_CI_SSF TUG3/Sm_A_Sk_MI_cLOP TUG3/Sm_A_Sk_MI_cAIS

Processes

This function recovers:

– VC-2 data with frame phase information from a TU-2 (TUG3/S2_A_Sk);

– VC-12 data with frame phase information from a TU-12 (TUG3/S12_A_Sk);

– VC-11 data with frame phase information from a TU-12 (TUG3/S11*_A_Sk);

– VC-11 data with frame phase information from a TU-11 (TUG3/S11_A_Sk).

V1, V2 – *TU-2 pointer interpretation*: The function shall perform TU pointer interpretation as specified in Annex A/G.783 to recover the VC frame phase within a TU of a P4s.

TU timeslot: The adaptation source function has access to a specific TU of the TUG access point. The TU is defined by the parameters K, L and M:

– for TU–2: K=A,B, L=1 to 7, M=0 and K=C, L=1 to 5, M=0;
– for TU-12: K=A to C, L=1 to 7, M=1 to 3;
– for TU-11: K=A to C, L=1 to 7, M=1 to 4.

Figure 11-35 shows that more than one adaptation sink function exists in this TUG3 virtual sublayer that can be connected to one TUG access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) 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 its management point.

Defects

The function shall detect for dAIS and dLOP defect according the algorithm described under the pointer interpreter process in Annex A/G.783.

Consequent Actions

aAIS ← dAIS or dLOP or AI_TSF_TUG2

aSSF ← dAIS or dLOP or AI_TSF_TUG2

On declaration of aAIS the function shall output all-ONEs signal within 1 ms; on clearing of aAIS the function shall output the recovered data within 1 ms.

Defect Correlations

cAIS ← dAIS and (not AI_TSF_TUG2) and AIS_Reported

cLOP ← dLOP and (not AI_TSF_TUG2)

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

Performance Monitoring: None.

11.3.5 P4s layer to VC-2, VC-12, and VC-11 layer compound adaptation source function P4s/SX-TUG2_A_So

Symbol

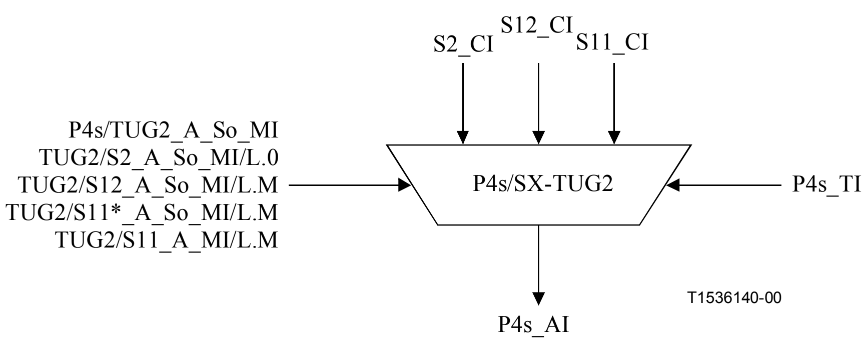


Figure 11-40/G.705 – P4s/SX-TUG2_A_So symbol

Interfaces

Table 11-26/G.705 – P4s/SX-TUG2_A_So input and output signals

Input(s)	Output(s)
P4s/TUG2_A_So_MI P4s_TI maximum 20 inputs: S2_CI TUG/S2_A_So_MI/L.0 maximum 60 inputs: S12_CI TUG/S12_A_So_MI/L.M maximum 60 inputs: S11_CI TUG/S11*_A_So_MI/L.M maximum 80 inputs: S11_CI TUG/S11_A_So_MI/L.M	P4s_AI

Processes

The P4s/SX-TUG2_A_So compound function provides adaptation from the VC-2/12/11 layers to the P4s layer. This process is performed by a combination of several atomic functions as shown in Figure 11-41. The P4s/TUG2_A_So function performs the P4s layer specific signal label and multiframe processing, while the TUG2/S2_A_So, TUG2/S12_A_So, TUG2/S11*_A_So and TUG2/S11_A_So functions perform the lower order VC specific frequency justification and bit rate adaptation. Each of these TUG2/Sm_A_So functions is characterized by the L.M parameters, which define the number of the TU within the P4s the function has access to (TU numbering scheme according to Appendix III). According to the TUG2 multiplex structures supported by the NE, a variety of possible combinations of these TUG2/Sm_A_So functions exists. Table 11-27 lists all possible TUG2/Sm_A_So functions within a P4s/SX-TUG2_A_So compound functions.

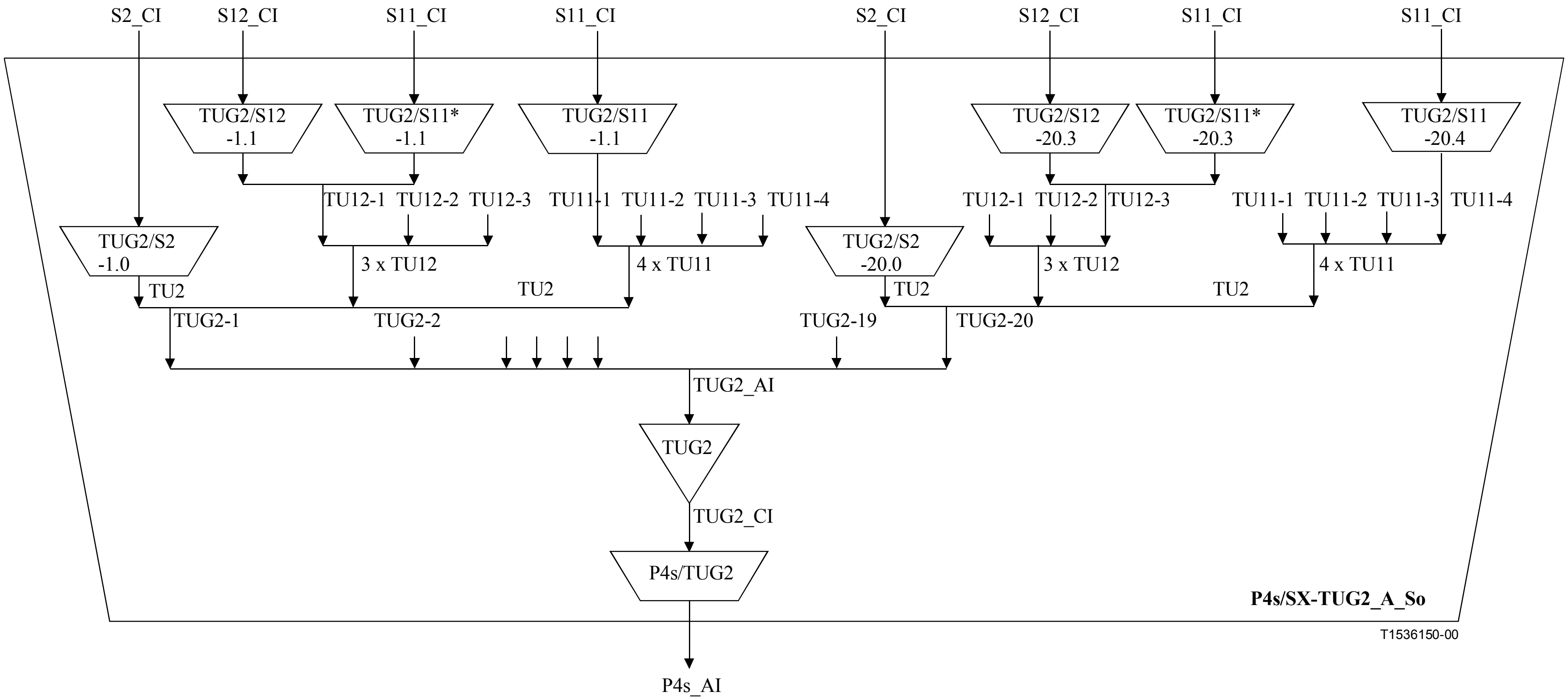


Figure 11-41/G.705 − P4s/SX-TUG2_A_So compound function with set of TUG2/Sm_A_So atomic functions

Table 11-27/G.705 – Possible TUG2/Sm_A_So functions of a P4s/SX-TUG2_A_So compound function

Atomic function	TU-2/TUG-2 number L	TU-12 number M
TUG2/S2_A_So/L.0	1 to 20	–
TUG2/S12_A_So/L.M	1 to 20	1 to 3
TUG2/S11*_A_So/ L.M	1 to 20	1 to 3
TUG2/S11_A_So/ L.M	1 to 20	1 to 4

For specific implementations only a subset of these TUG2/Sm_A_So functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 60 TUG2/S12_A_So functions). If a flexible TUG2 multiplex structure is supported, several TUG2/Sm_A_So functions may have access to the same TU timeslot. For such case, only one of these adaptation source functions is allowed to be activated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG2 multiplex structure.

NOTE 1 – The P4s/TUG2_A_So, TUG2_T_So and TUG2/Sm_A_So (m=2, 12, 11*, 11) defined in the following clauses can only be used in a P4s/SX-TUG2_A_So compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG2 is a virtual sublayer only applicable in a P4s/SX-TUG2_A compound function.

The number of TUG2/Sm_A (m=2,12,11*,11) functions that is active shall completely fill the P4s payload.

11.3.5.1 P4s layer to TUG2 adaptation source function P4s/TUG2_A_So

NOTE – The P4s/TUG2_A_So function can only be used in a P4s/SX-TUG2_A_So compound function. It cannot be used as a stand-alone function.

Symbol

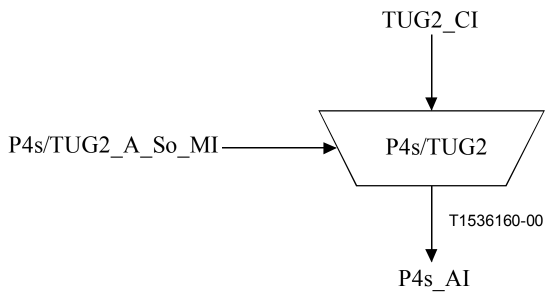


Figure 11-42/G.705 – P4s/TUG2_A_So symbol

Interfaces

Table 11-28/G.705 – P4s/TUG2_A_So input and output signals

Input(s)	Output(s)
TUG2_CI_D TUG2_CI_CK TUG2_CI_FS TUG2_CI_MFS P4s/TUG2_A_So_MI_Active	P4s_AI_D P4s_AI_CK P4s_AI_FS

Processes

The function adds two payload specific signals (bits MA[3-5] and MA[6-7]) to the P4s POH.

MA[3-5]: In this byte the function shall insert code "011" (SDH elements mapping I: 20 × TUG-2 structure) as defined in ITU-T G.832.

MA[6-7]: The value of the multiframe indicator MA[6-7] shall be set as specified by ITU-T G.832, 500 μs TU multiframe sequence, and aligned with TUG2_CI_MFS.

					TU multiframe indicator		
1	2	3	4	5	6	7	8

Figure 11-43/G.705 – TU multiframe indicator bits in byte MA

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.

11.3.5.2 TUG2 trail termination source function TUG2_T_So

NOTE – The TUG2_T_So functions can only be used in a P4s/SX-TUG2_A_So compound function. It cannot be used as a stand-alone function.

Symbol

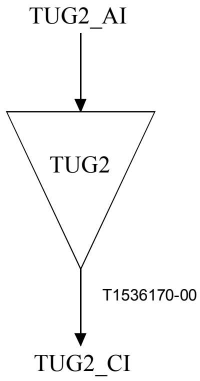


Figure 11-44/G.705 – TUG2_T_So symbol

Interfaces

Table 11-29/G.705 – TUG2_T_So input and output signals

Input(s)	Output(s)
TUG2_AI_D TUG2_AI_CK TUG2_AI_FS TUG2_AI_MFS	TUG2_CI_D TUG2_CI_CK TUG2_CI_FS TUG2_CI_MFS

Processes: None.

Defects: None.

Consequent Actions: None.

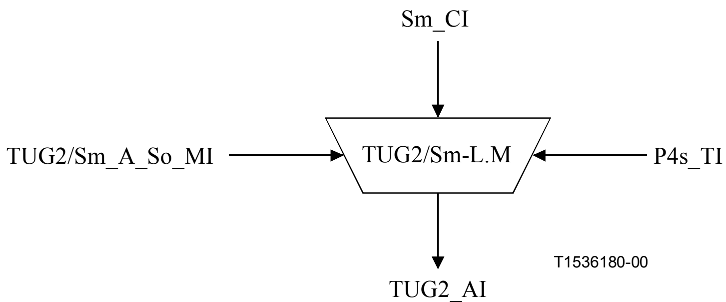
Defect Correlations: None.

Performance Monitoring: None.

11.3.5.3 TUG2 to VC-m layer adaptation source function TUG2/Sm_A_So/L.M

NOTE 1 – The TUG2/Sm_A_So (m=2, 12, 11*, 11) function can only be used in a P4s/SX-TUG2_A_So compound function. It cannot be used as a stand-alone function.

Symbol



NOTE – The allowed values for L and M for each TUG2/Sm_A_So are given in Table 11-27.

Figure 11-45/G.705 – TUG2/Sm_A_So symbol

Interfaces

Table 11-30/G.705 – TUG2/Sm_A_So input and output signals

Input(s)	Output(s)
Sm_CI_D Sm_CI_CK Sm_CI_FS S2_CI_SSF P4s_TI_CK P4s_TI_FS P4s_TI_MFS TUG2/Sm_A_So_MI_Active	TUG2_AI_D TUG2_AI_CK TUG2_AI_FS TUG2_AI_MFS

Processes

This function provides frequency justification and bit rate adaptation for:

– a VC-2 signal (TUG2/S2_A_So), represented by a nominally (428 × 64/4) = 6848 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-2;

– a VC-12 signal (TUG2/S12_A_So), represented by a nominally (140 × 64/4) = 2240 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-12;

– a VC-11 signal (TUG2/S11*_A_So), represented by a nominally (104 × 64/4) = 1664 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal. The VC-11 is transported within a TU-12; 9 bytes of fixed stuff (Figure 11-48) are added per 125 µs to the VC-11 as specified by ITU-T G.707 to map the VC-11 into the TU-12 payload (see Note 2);

– a VC-11 signal (TUG2/S11_A_So), represented by a nominally (104 × 64/4) = 1664 kbit/s information stream with a frequency accuracy within the limits specified in clause 5/G.813 and the related frame phase, to be multiplexed into a P4s signal via a TU-11.

NOTE 2 – Mapping a VC-11 into a TU-12 allows the VC-11 signal to be transported in a VC-12 based network (via S12_C and TUG/S12_A functions) and to non-intrusively monitor this VC-11 by means of a VC-12 non-intrusive monitor (S12m_TT_Sk). The TUG2/S11*_A function will be used at the junction of VC-11 and VC-12 networks.

NOTE 3 – Degraded performance may be observed when equipment having a ± 4.6 ppm network element clock source interworks with equipment having a ± 20 ppm network element clock source.

The (500 µs) frame phase of the VC is coded in the related TU pointer. Frequency justification, if required, is performed by pointer adjustments. The accuracy of this coding process is specified below.

Frequency justification and bit rate adaptation: The function shall provide an elastic store (buffer) process. The data and frame start signals shall be written into the buffer under control of the associated input clock. The data and frame start signals shall be read out of the buffer under control of the P4s clock, frame position, and justification decision.

The justification decisions determine the phase error introduced by the TUG2/Sm_A_So function. The amount of this phase error can be measured at the physical interfaces by monitoring the TU pointer actions.

Each justification decision results in a corresponding negative/positive justification action. Upon a positive justification action, the reading of 8 data bits shall be cancelled once and no data are written at the justification opportunity position V3+1 (see Figures 11-46 to 11-49). Upon a negative justification action, an extra 8 data bits shall be read out once into the justification opportunity position V3.

NOTE 4 – A requirement for maximum introduced phase error cannot be defined until a reference path is defined from which the requirements for network elements can be deduced. Such a requirement would also limit excessive phase error caused by pointer processors under fixed frequency offset conditions.

Buffer size: For further study.

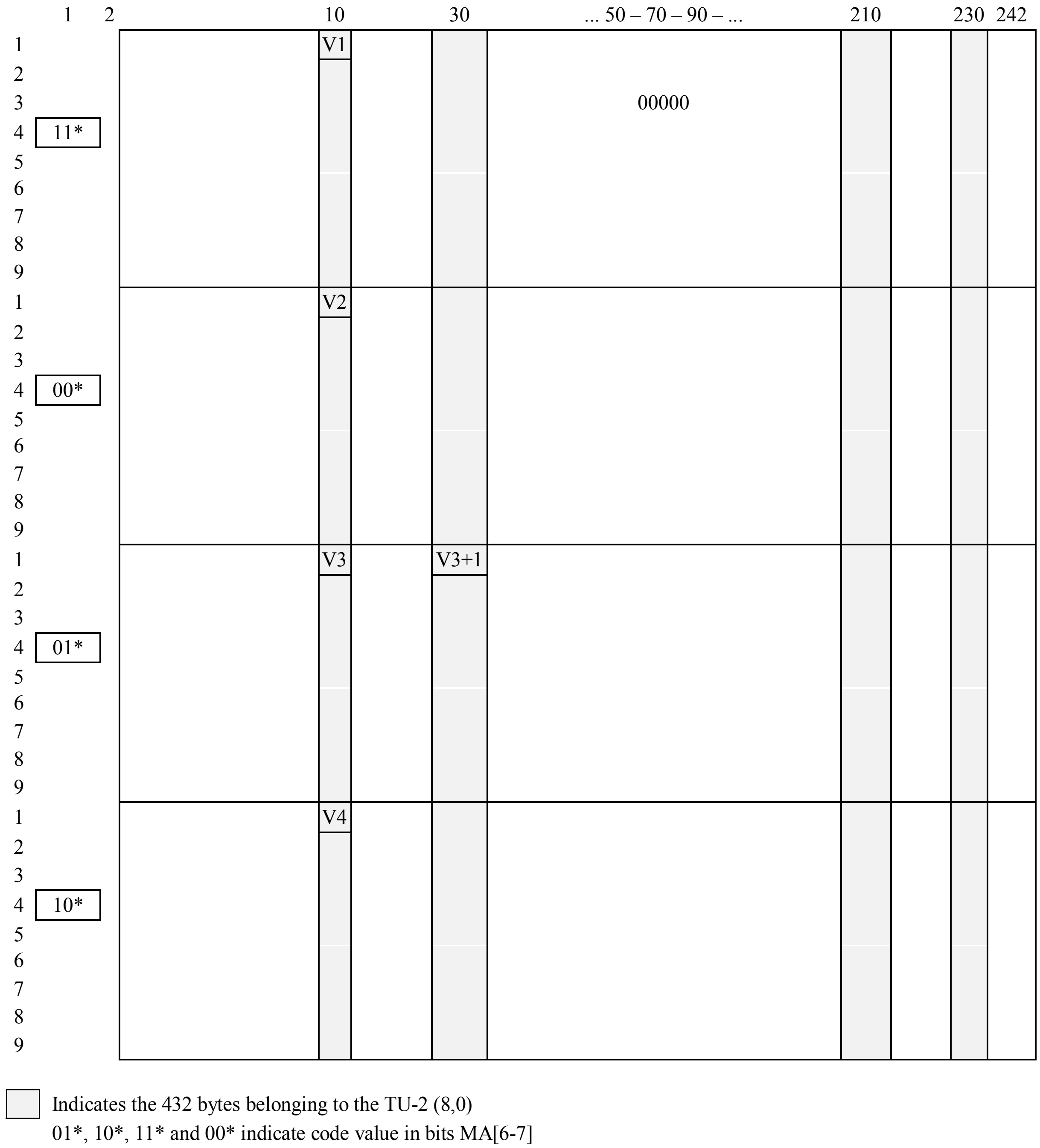
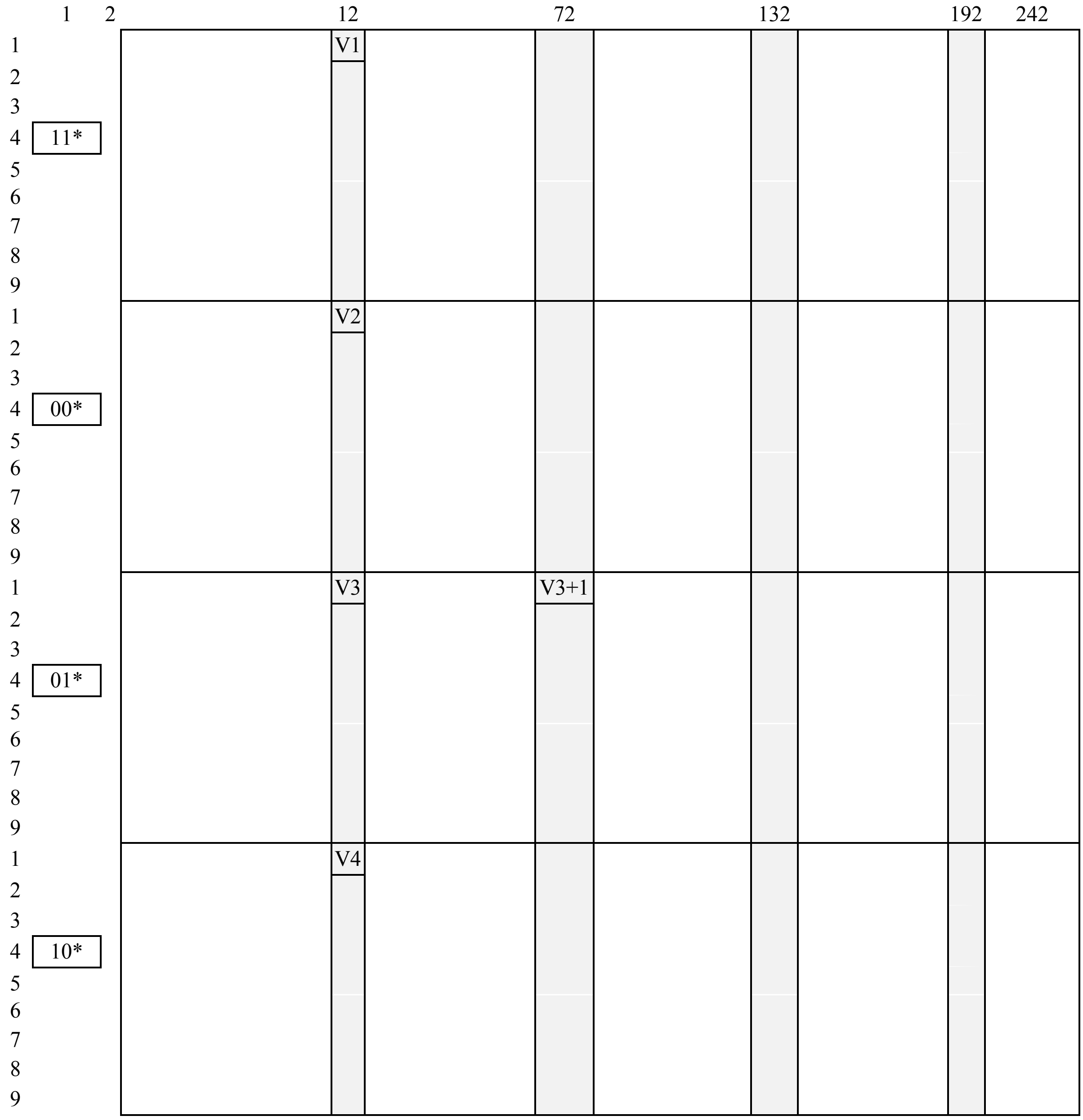


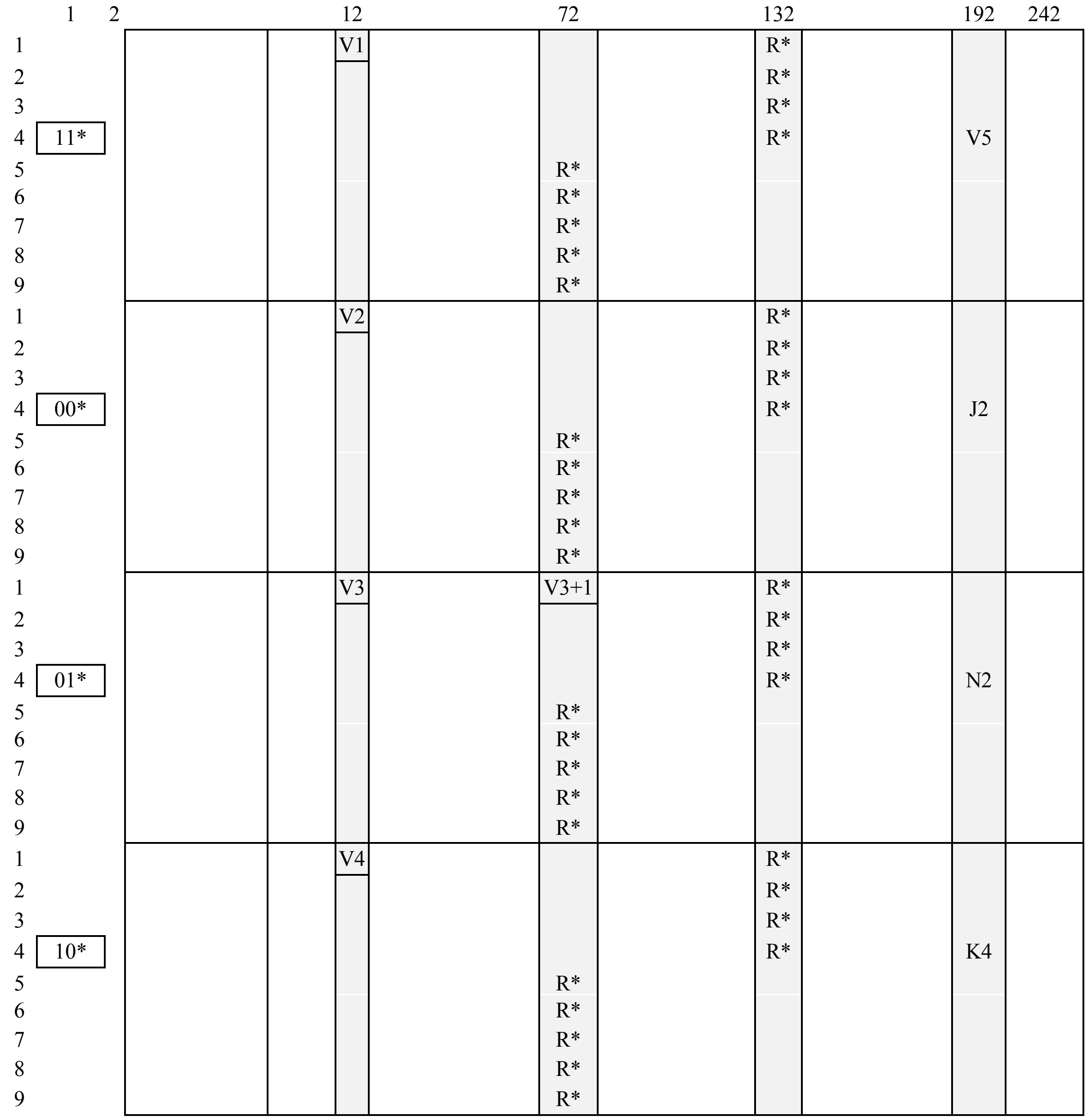
Figure 11-46/G.705 – TUG2_AI_D/8.0 signal for TUG2/S2_A_So



Indicates the 144 bytes belonging to the TU-12 (10,1)

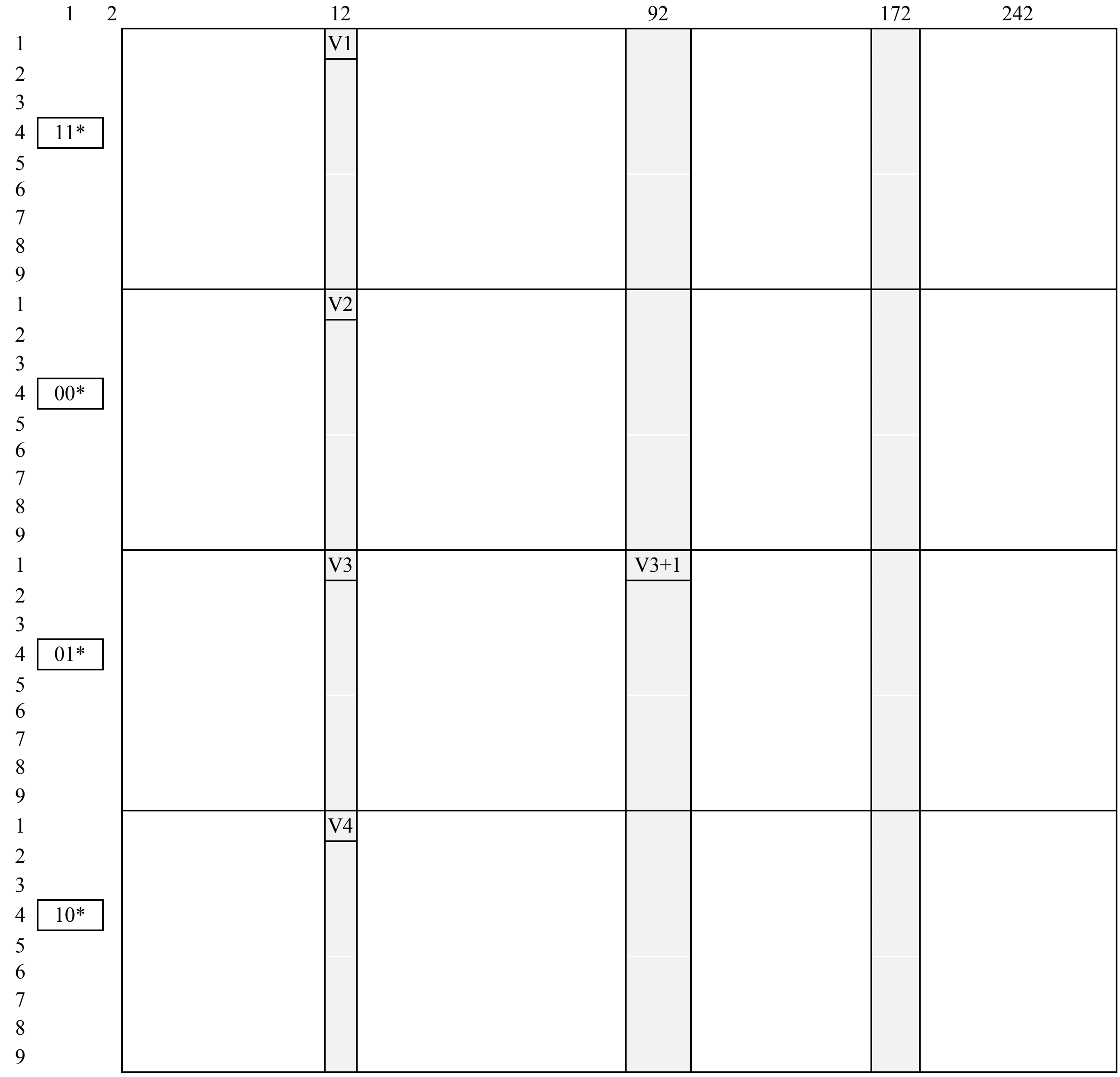
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]

Figure 11-47/G.705 – TUG2_AI_D/10.1 signal for TUG2/S12_A_So



Indicates the 144 bytes belonging to the TU-12 (10,1)
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]
R* indicates fixed stuff with even parity
The positions of the V5, J2, N2, K4 and R* bytes is relative to the position of the VC-11 in the TU-12. The start of the VC-11 (V5 byte) is defined by the TU-12 pointer.

Figure 11-48/G.705 – TUG2_AI_D/10.1 signal for TUG2/S11*_A_So



Indicates the 108 bytes belonging to the TU-11 (10,1)
01*, 10*, 11* and 00* indicate code value in bits MA[6-7]

Figure 11-49/G.705 – TUG2_AI_D/10.1 signal for TUG2/S11_A_So

The TU pointer is carried in bytes V1 and V2 of payload specific OH once per 500 µs multiframe (see Figures 11-46 to 11-49). The TU pointer is aligned in the P4s payload in fixed positions relative to the P4s frame and multiframe. The format of the TU pointer and its location in the frame/multiframe are defined in ITU-T G.832.

V1, V2 – *Pointer generation*: The function shall generate the TU pointer as is described in ITU-T G.707. It shall insert the pointer in the appropriate V1, V2 positions with the SS field set to 00 to indicate TU-2, 10 to indicate TU-12 and 11 to indicate TU-11.

NOTE 5 – The byte V4 is undefined.

TU timeslot: The adaptation source function has access to a specific TU of the TUG access point. The TU is defined by the parameter L and M:

– for TU-2: L=1 to 20, M=0;

– for TU-12: L=1 to 20, M=1 to 3;

– for TU-11: L=1 to 20, M=1 to 4.

Figure 11-41 shows that more than one adaptation source function exists in the TUG2 virtual sublayer that can be connected to one TUG2 access point. For such case, a subset of these adaptation source functions is allowed to be activated together, but only one adaptation source function may have access to a specific TU timeslot. Access to the same TU timeslot by other adaptation source functions shall 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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 6 – If CI_SSF is not connected (when connected to a Sm_TT_So (m=2, 12, 11)), CI_SSF is assumed to be false.

Defect Correlations: None.

Performance Monitoring: None.

11.3.6 P4s layer to VC-2, VC-12, and VC-11 layer compound adaptation sink function P4s/SX-TUG2_A_Sk

Symbol

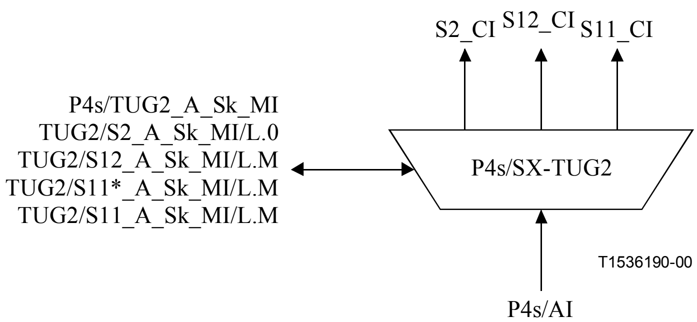


Figure 11-50/G.705 – P4s/SX-TUG2_A_Sk symbol

Interfaces

Table 11-31/G.705 – P4s/SX-TUG2_A_Sk input and output signals

Input(s)	Output(s)
P4s_AI P4s/TUG2_A_Sk_MI maximum 20 inputs: TUG2/S2_A_Sk_MI/L.0 maximum 60 inputs: TUG2/S12_A_Sk_MI/L.M maximum 60 inputs: TUG2/S11*_A_Sk_MI/L.M maximum 80 inputs: TUG2/S11_A_Sk_MI/L.M	P4s/TUG2_A_Sk_MI maximum 20 outputs: S2_CI TUG2/S2_A_Sk_MI/L.0 maximum 60 outputs: S12_CI TUG2/S12_A_Sk_MI/L.M maximum 60 outputs: S11_CI TUG2/S11*_A_Sk_MI/L.M maximum 80 outputs: S11_CI TUG2/S11_A_Sk_MI/L.M

Processes

The P4s/SX-TUG2_A_Sk compound function provides adaptation from the P4s layer to the VC-2/12/11 layers. This process is performed by a combination of several atomic functions as shown in Figure 11-51. The P4s/TUG2_A_Sk function performs the P4s layer specific signal label and multiframe processing, while the TUG2/S2_A_Sk, TUG2/S12_A_Sk, TUG2/S11*_A_Sk and TUG2/S11_A_Sk functions perform the lower order VC specific frequency justification and bit rate adaptation. Each of these TUG2/Sm_A_Sk functions is characterized by the K.L.M parameters, which define the number of the TU within the P4s the function has access to (TU numbering scheme according to Appendix III). According to the TUG multiplex structures supported by the NE, a variety of possible combinations of these TUG2/Sm_A_Sk functions exists. Table 11-32 lists all possible TUG2/Sm_A_Sk functions within a P4s/SX-TUG2_A_Sk compound function.

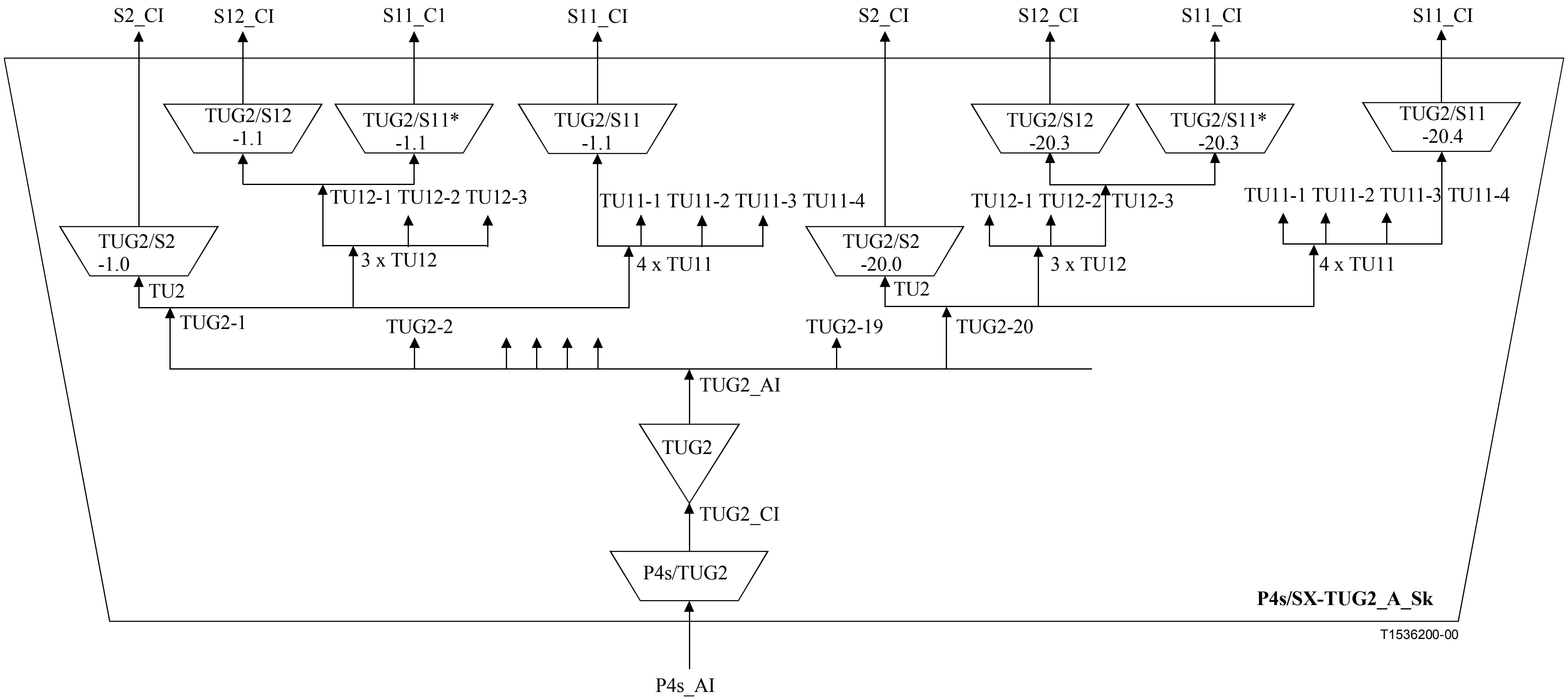


Figure 11-51/G.705 − P4s/SX-TUG2_A_Sk compound function with set of TUG2/Sm_A_Sk atomic functions

Table 11-32/G.705 – Possible TUG2/Sm_A_Sk functions of a P4s/SX-TUG2_A_Sk compound function

Atomic function	TU-2/TUG-2 number L	TU-12 number M
TUG2/S2_A_Sk/L.0	1 to 20	0
TUG2/S12_A_Sk/L.M	1 to 20	1 to 3
TUG2/S11*_A_Sk/L.M	1 to 20	1 to 3
TUG2/S11_A_Sk/L.M	1 to 20	1 to 4

For specific implementations only a subset of these TUG2/Sm_A_Sk functions may be used (e.g. a terminal multiplexer with fixed 2 Mbit/s access has 60 TUG2/S12_A_Sk functions). If a flexible TUG2 multiplex structure is supported, several TUG2/Sm_A_Sk functions may have access to the same TU timeslot. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) to be detected and reported. To prevent this an adaptation sink function can be deactivated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured TUG multiplex structure.

NOTE 1 – The P4s/TUG2_A_Sk, TUG2_T_Sk and TUG2/Sm_A_Sk (m=2, 12, 11*, 11) defined in the following clauses can only be used in a P4s/SX-TUG2_A_Sk compound function. These functions cannot be used as stand-alone functions.

NOTE 2 – The TUG2 is a virtual sublayer only applicable in a P4s/SX-TUG2_A compound function.

11.3.6.1 P4s layer to TUG2 adaptation sink function P4s/TUG2_A_Sk

NOTE 1 – The P4s/TUG2_A_Sk function can only be used in a P4s/SX-TUG2_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

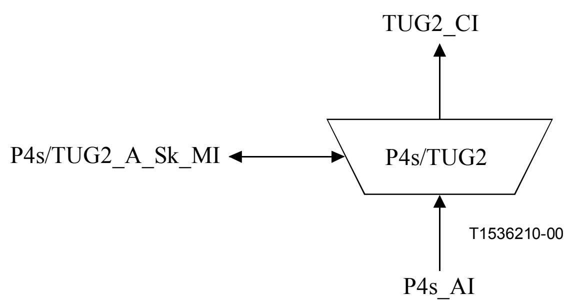


Figure 11-52/G.705 – P4s/TUG2_A_Sk symbol

Interfaces

Table 11-33/G.705 – P4s/TUG2_A_Sk input and output signals

Input(s)	Output(s)
P4s_AI_D P4s_AI_CK P4s_AI_FS P4s_AI_TSF P4s/TUG2_A_Sk_MI_Active	TUG2_CI_D TUG2_CI_CK TUG2_CI_FS TUG2_CI_MFS TUG2_CI_SSF P4s/TUG2_A_Sk_MI_cPLM P4s/TUG2_A_Sk_MI_cLOM

Processes

The function monitors two payload specific signals (bits 3-5 and bits 6-7) of the P4s POH.

MA[3-5]: The function shall compare the content of the accepted bits 3 to 5 of byte MA with the expected value code "011" (SDH elements mapping I: 20 × TUG-2 structure) as a check on consistency between the provisioning operation at each end. The acceptance and mismatch detection processes are described in 6.2.4.2/G.806.

MA[6-7]: The function shall recover the 500 µs (multi)frame start phase performing multi-frame alignment on bits 6 and 7 of byte MA. Out-of-multiframe (OOM) shall be assumed once when an error is detected in the MA bit 6 and 7 sequence. Multiframe alignment shall be assumed to be recovered, and the in-multiframe (IM) state shall be entered, when in four consecutive P4s frames an error free MA bit 6,7 sequence is found.

Activation: The function shall perform the operation specified above when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF_TUG2) and not report its status via the management point.

Defects

The function shall detect for the dPLM defect according 6.2.4.2/G.806.

If the multiframe alignment process is in the OOM state and the MA multiframe is not recovered within X ms, a dLOM defect shall be declared. Once in a dLOM state, this state shall be exited when the multiframe is recovered (multiframe alignment process enter the IM state). X shall be a value in the range 1 to 5 (ms). X is not configurable.

Consequent Actions

aSSF ← dPLM or dLOM

Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLOM ← dLOM and (not AI_TSF) and (not dPLM)

NOTE 2 – There may be another parallel adaptation function, e.g. P4s/SD_A_Sk that generate also cLOM. The EMF should take care that fLOM is reported only once.

Performance Monitoring: None.

11.3.6.2 TUG2 trail termination sink function TUG2_T_Sk

NOTE – The TUG2_T_Sk function can only be used in a P4s/SX-TUG2_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol

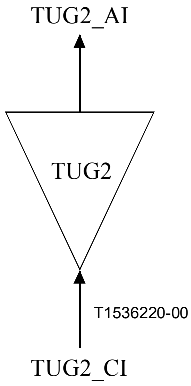


Figure 11-53/G.705 – TUG2_T_Sk symbol

Interfaces

Table 11-34/G.705 – TUG2_T_Sk input and output signals

Input(s)	Output(s)
TUG2_CI_D TUG2_CI_CK TUG2_CI_FS TUG2_CI_SSF	TUG2_AI_D TUG2_AI_CK TUG2_AI_FS TUG2_AI_TSF

Processes: None.

Defects: None.

Consequent Actions

aTSF ← CI_SSF

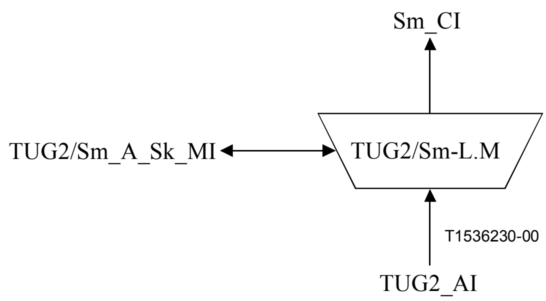
Defect Correlations: None.

Performance Monitoring: None.

11.3.6.3 TUG2 to VC-m layer adaptation sink function TUG2/Sm_A_Sk/L.M

NOTE – The TUG2/Sm_A_Sk (m=2, 12, 11*, 11) function can only be used in a P4s/SX-TUG2_A_Sk compound function. It cannot be used as a stand-alone function.

Symbol



NOTE – The allowed values for L and M for each TUG2/Sm_A_Sk are given in Table 11-32.

Figure 11-54/G.705 – TUG2/Sm_A_Sk symbol

Interfaces

Table 11-35/G.705 – TUG2/Sm_A_Sk input and output signals

Input(s)	Output(s)
TUG2_AI_D TUG2_AI_CK TUG2_AI_FS TUG2_AI_TSF TUG2/Sm_A_Sk_MI_AIS_Reported TUG2/Sm_A_Sk_MI_Active	Sm_CI_D Sm_CI_CK Sm_CI_FS Sm_CI_SSF TUG2/Sm_A_Sk_MI_cLOP TUG2/Sm_A_Sk_MI_cAIS

Processes

This function recovers:

– VC-2 data with frame phase information from a TU-2 (TUG2/S2_A_Sk).

– VC-12 data with frame phase information from a TU-12 (TUG2/S12_A_Sk).

– VC-11 data with frame phase information from a TU-12 (TUG2/S11*_A_Sk).

– VC-11 data with frame phase information from a TU-11 (TUG2/S11_A_Sk).

V1, V2 – *TU pointer interpretation*: The function shall perform TU pointer interpretation as specified in Annex A/G.783 to recover the VC frame phase within a TU of a P4s.

TU timeslot: The adaptation source function has access to a specific TU of the TUG access point. The TU is defined by the parameter L and M:

– for TU-2: L=1 to 20, M=0;

– for TU-12: L=1 to 20, M=1 to 3;

– for TU-11: L=1 to 20, M=1 to 4.

Figure 11-51 shows that more than one adaptation sink function exists in this TUG2 virtual sublayer that can be connected to one TUG2 access point. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause faults (e.g. cLOP) 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 its management point.

Defects

The function shall detect for dAIS and dLOP defect according the algorithm described under the pointer interpreter process in Annex A/G.783.

Consequent Actions

aAIS ← dAIS or dLOP or AI_TSF

aSSF ← dAIS or dLOP or AI_TSF

On declaration of aAIS the function shall output all-ONEs signal within 1 ms; on clearing of aAIS the function shall output the recovered data within 1 ms.

Defect Correlations

cAIS ← dAIS and (not AI_TSF) and AIS_Reported

cLOP ← dLOP and (not AI_TSF)

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

Performance Monitoring: None.

11.3.7 P*q*s layer to P0s layer adaptation source P*q*s/P0s_A_So

Symbol

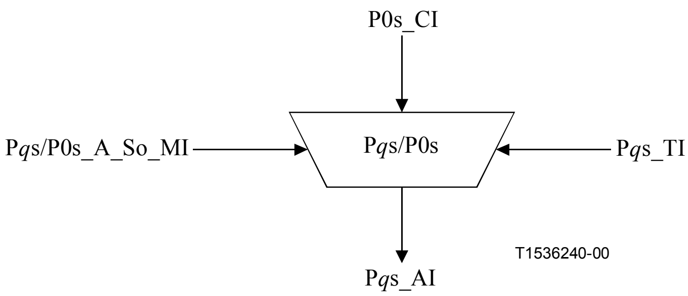


Figure 11-55/G.705 – P*q*s/P0s_A_So symbol

Interfaces

Table 11-36/G.705 – P*q*s/P0s_A_So input and output signals

Input(s)	Output(s)
P0s_CI_D P0s_CI_CK P0s_CI_FS Pqs_TI_CK Pqs_TI_FS Pqs/P0s_A_So_MI_Active	Pqs_AI_D

Processes

This function provides the multiplexing of a 64 kbit/s information stream into the P*q*s_AI using slip buffering. It takes P0s_CI, defined in ITU-T G.703 as an octet structured bit-stream with a synchronous bit rate of 64 kbit/s, present at its input and inserts it into the P*q*s POH byte GC as defined in ITU-T G.832 and depicted in Figures 11-2 and 11-3.

NOTE – Any frequency deviation between the 64 kbit/s signal and the P*q*s signal leads to octet slips.

Frequency justification and bit rate adaptation: The function shall provide for an elastic store (slip buffer) process. The data signal shall be written into the buffer under control of the associated input clock. The data shall be read out of the buffer under control of the P*q*s clock, frame position (P*q*s_TI), and justification decisions.

Each justification decision results in a corresponding negative/positive justification (slip) action. Upon a positive justification (slip) action, the reading of one 64 kbit/s octet (8 bits) shall be cancelled once. Upon a negative justification (slip) action, the same 64 kbit/s octet (8 bits) shall be read out a second time.

Buffer size: The elastic store (slip buffer) shall accommodate at least 18 µs of wander without introducing errors.

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.

11.3.8 P*q*s layer to P0s layer adaptation sink P*q*s/P0s_A_Sk

Symbol

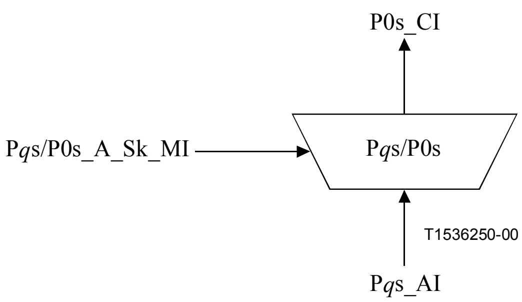


Figure 11-56/G.705 – P*q*s/P0s_A_Sk symbol

Interfaces

Table 11-37/G.705 – P*q*s/P0s_A_Sk input and output signals

Input(s)	Output(s)
Pqs_AI_D Pqs_AI_CK Pqs_AI_FS Pqs_AI_TSF Pqs/P0s_A_Sk_MI_Active	P0s_CI_D P0s_CI_CK P0s_CI_FS

Processes

The function extracts the general communications channel byte GC from the P*q*s layer Characteristic Information. The recovered byte provides a 64 kbit/s channel for the client (user).

Data latching and smoothing process: The function shall provide a data latching and smoothing function. Each 8-bit octet received shall be written and latched into a data store under the control of the P*q*s signal clock. The eight data bits shall then be read out of the store using a nominal 64 kHz clock which may be derived directly from the incoming E*q* signal clock. It should be noted that the divider is not an integer value.

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).

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 signal (a bit rate in range 64 kbit/s ± 100 ppm) – within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

Defect Correlations: None.

Performance Monitoring: None.

11.3.9 P*q*s to V0x adaptation source P*q*s/V0x_A_So

Symbol

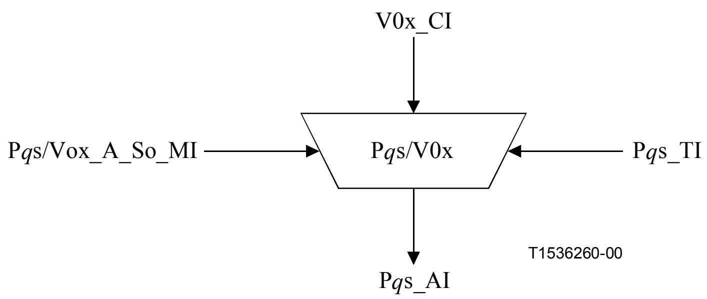


Figure 11-57/G.705 – P*q*s/V0x_A_So symbol

Interfaces

Table 11-38/G.705 – P*q*s/V0x_A_So input and output signals

Input(s)	Output(s)
V0x_CI_D Pqs_TI_CK Pqs_TI_FS Pqs/V0x_A_So_MI_Active	Pqs_AI_D V0x_CI_CK

Processes

This function multiplexes the V0x_CI data (64 kbit/s) into the byte location GC as defined in ITU-T G.832 and depicted in Figures 11-2 and 11-3.

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.

11.3.10 P*q*s to V0x adaptation sink P*q*s/V0x_A_Sk

Symbol

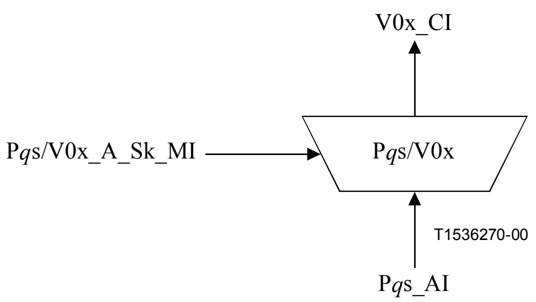


Figure 11-58/G.705 – P*q*s/V0x_A_Sk symbol

Interfaces

Table 11-39/G.705 – P*q*s/V0x_A_Sk input and output signals

Input(s)	Output(s)
Pqs_AI_D Pqs_AI_CK Pqs_AI_FS Pqs_AI_TSF Pqs/V0x_A_Sk_MI_Active	V0x_CI_D V0x_CI_CK V0x_CI_SSF

Processes

This function separates user channel data from P*q*s Overhead (byte GC) as defined in ITU-T G.832 and depicted in Figures 11-2 and 11-3.

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).

Defects: None.

Consequent Actions

aAIS ← AI_TSF

aSSF ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs (AIS) signal – complying to the frequency limits for this signal (a bit rate in range 64 kbit/s ± X ppm) – within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms. X is for further study.

Defect Correlations: None.

Performance Monitoring: None.

11.3.11 P*q*s to DCC adaptation source P*q*s/DCC_A_So

Symbol

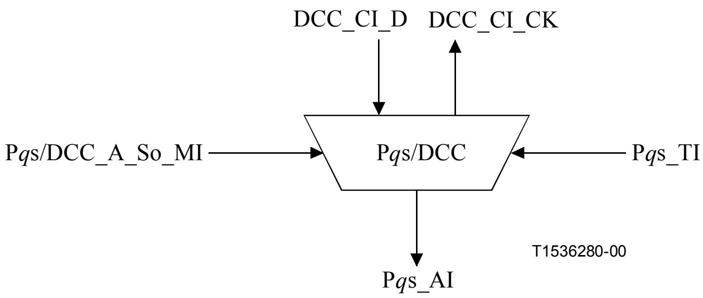


Figure 11-59/G.705 – P*q*s/DCC_A_So symbol

Interfaces

Table 11-40/G.705 – P*q*s/DCC_A_Sk input and output signals

Input(s)	Output(s)
DCC_CI_D Pqs_TI_CK Pqs_TI_FS Pqs/DCC_A_So_MI_Active	Pqs_AI_D DCC_CI_CK

Processes

The function multiplexes the DCC CI data (64 kbit/s) into the byte location GC as defined in ITU-T G.832 and depicted in Figures 11-2 and 11-3.

NOTE – DCC transmission can be "disabled" when the matrix connection in the connected DCC_C function is removed.

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.

11.3.12 P*q*s to DCC adaptation sink P*q*s/DCC_A_Sk

Symbol

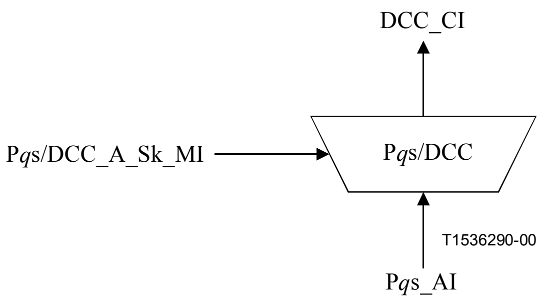


Figure 11-60/G.705 – P*q*s/DCC_A_Sk symbol

Interfaces

Table 11-41/G.705 – P*q*s/DCC_A_Sk input and output signals

Input(s)	Output(s)
Pqs_AI_D Pqs_AI_CK Pqs_AI_FS Pqs_AI_TSF Pqs/DCC_A_Sk_MI_Active	DCC_CI_D DCC_CI_CK DCC_CI_SSF

Processes

The function separates DCC data from P*q*s Overhead (byte GC) as defined in ITU-T G.832 and depicted in Figures 11-2 and 11-3.

NOTE – DCC processing can be "disabled" when the matrix connection in the connected DCC_C function is removed.

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).

Defects: None.

Consequent Actions

aSSF ← AI_TSF

Defect Correlations: None.

Performance Monitoring: None.

11.3.13 P*q*s to SD adaptation source P*q*s/SD_A_So

Refer to ITU-T G.781 [8].

11.3.14 P*q*s to SD adaptation sink P*q*s/SD_A_Sk

Refer to ITU-T G.781.

11.3.15 P*q*s to ATM VP compound adaptation source P*q*s/Avp_A_So

Refer to ITU-T I.732.

11.3.16 P*q*s to ATM VP compound adaptation sink P*q*s/Avp_A_Sk

Refer to ITU-T I.732.

11.3.17 P*q*s Layer Clock adaptation source P*q*s-LC_A_So

Refer to ITU-T G.781.

11.4 P*q*s layer trail protection functions

For further study.

11.5 P*q*s tandem connection sublayer functions

11.5.1 P*q*s tandem connection trail termination functions P*q*sD_TT and P*q*sDm_TT

11.5.1.1 P*q*s tandem connection trail termination source function (P*q*sD_TT_So)

Symbol

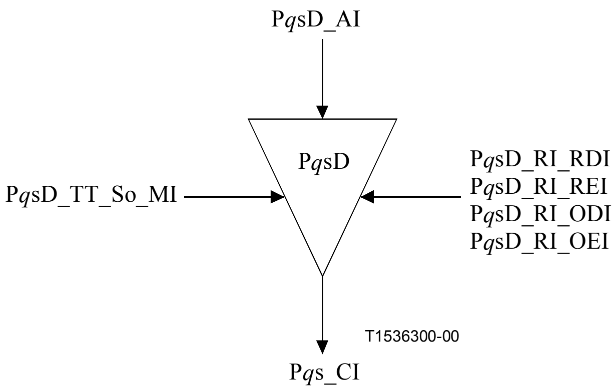


Figure 11-61/G.705 – P*q*sD_TT_So symbol

Interfaces

Table 11-42/G.705 – P*q*sD_TT_So input and output signals

Input(s)	Output(s)
PqsD_AI_D PqsD_AI_CK PqsD_AI_FS PqsD_AI_SF PqsD_RI_RDI PqsD_RI_REI PqsD_RI_ODI PqsD_RI_OEI PqsD_TT_So_MI_TxTI	Pqs_CI_D Pqs_CI_CK Pqs_CI_FS

Processes

NR[8][73] (see Note 1): The function shall insert the TC RDI code within 1 multiframe (9.5 ms) after the RDI request generation (RI_RDI) in the tandem connection trail termination sink function. It ceases TC RDI code insertion within 1 multiframe (9.5 ms) after the TC RDI request has cleared.

NOTE 1 – NR[x][y] refers to bit x (x = 7,8) of byte NR in frame y (y=1 to 76) of the 76 frame multiframe.

NR[5]: The function shall insert the RI_REI value in the REI bit in the following frame.

NR[7][74]: The function shall insert the ODI code within 1 multiframe (9,5 ms) after the ODI request generation (aODI) in the tandem connection trail termination sink function. It ceases ODI code insertion at the first opportunity after the ODI request has cleared.

NR[6]: The function shall insert the RI_OEI value in the OEI bit in following frame.

NR[7-8]: The function shall insert in the multiframed NR[7-8] channel:

– the Frame Alignment Signal (FAS) "1111 1111 1111 1110" in FAS bits in frames 1 to 8;
– the TC trace identifier, received via MI_TxTI, in the TC-TI bits in frames 9 to 72;
– the TC RDI (NR[8][73]) and ODI (NR[7][74]) signals; and
– "0" in the six reserved bits in frames 73 to 76.

NR[1-4]: Even BIP-8 shall be computed for each bit n of every byte of the preceding incoming P*q*s frame (P*q*s_AI) including EM byte and compared with byte EM recovered from the current frame. A difference between the computed and recovered BIP-8 values shall be taken as evidence of one or more errors in the computation block, and shall be inserted in bits 1 to 4 of byte NR (Figure 11-62, Table 11-43). If AI_SF is true, code "1110" shall be inserted in bits 1 to 4 of byte NR instead of the number of incoming BIP-8 violations.

NOTE 2 – Zero BIP-8 violations detected in the tandem connection incoming signal is coded with a non-all-ZEROs IEC code. This allows this IEC field to be used at the TC tail end as differentiator between TC incoming unequipped VC and unequipped TC.

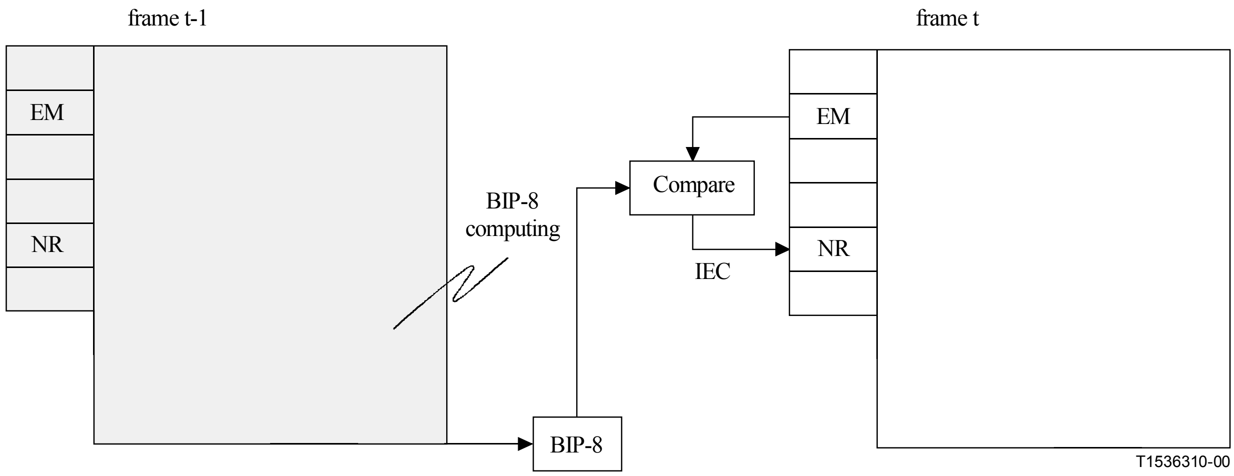


Figure 11-62/G.705 – TC IEC computing and insertion

Table 11-43/G.705 – IEC code generation

Number of BIP-8 violations	NR[1]	NR[2]	NR[3]	NR[4]
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
0	1	0	0	1

EM: The function shall compensate the P*q*s BIP 8 (in EM) according the following rule:

Since the BIP-8 parity check is taken over the P*q*s (including NR), writing into NR at the P*q*sD_TT_So will affect the P*q*s path parity calculation. Unless this is compensated for, a device which monitors P*q*s path parity within the Tandem Connection (e.g. a non-intrusive monitor) may incorrectly count errors. The BIP-8 parity bits should always be consistent with the current state of the P*q*s. Therefore, whenever NR is written, BIP-8 shall be modified to compensate for the change in the NR value. Since the BIP-8 value in a given frame reflects a parity check over the previous frame (including the BIP-8 bits in that frame), the changes made to the BIP-8 bits in the previous frame shall also be considered in the compensation of BIP-8 for the current frame. Therefore, the following equation shall be used for BIP-8 compensation (Figure 11-63):

$$EM[i]'(t) = EM[i](t-1) \oplus EM[i]'(t-1) \oplus NR[i](t-1) \oplus NR[i]'(t-1) \oplus EM[i](t)$$

Where:

– EM[i] = the existing EM[i] value in the incoming signal;

– EM[i]' = the new (compensated) EM[i] value;

– NR[i] = the existing NR[i] value in the incoming signal;

– NR[i]' = the new value written into the NR[i] bit ;

– ⊕ = exclusive OR operator;

– t = the time of the current frame;

– t-1 = the time of the previous frame.

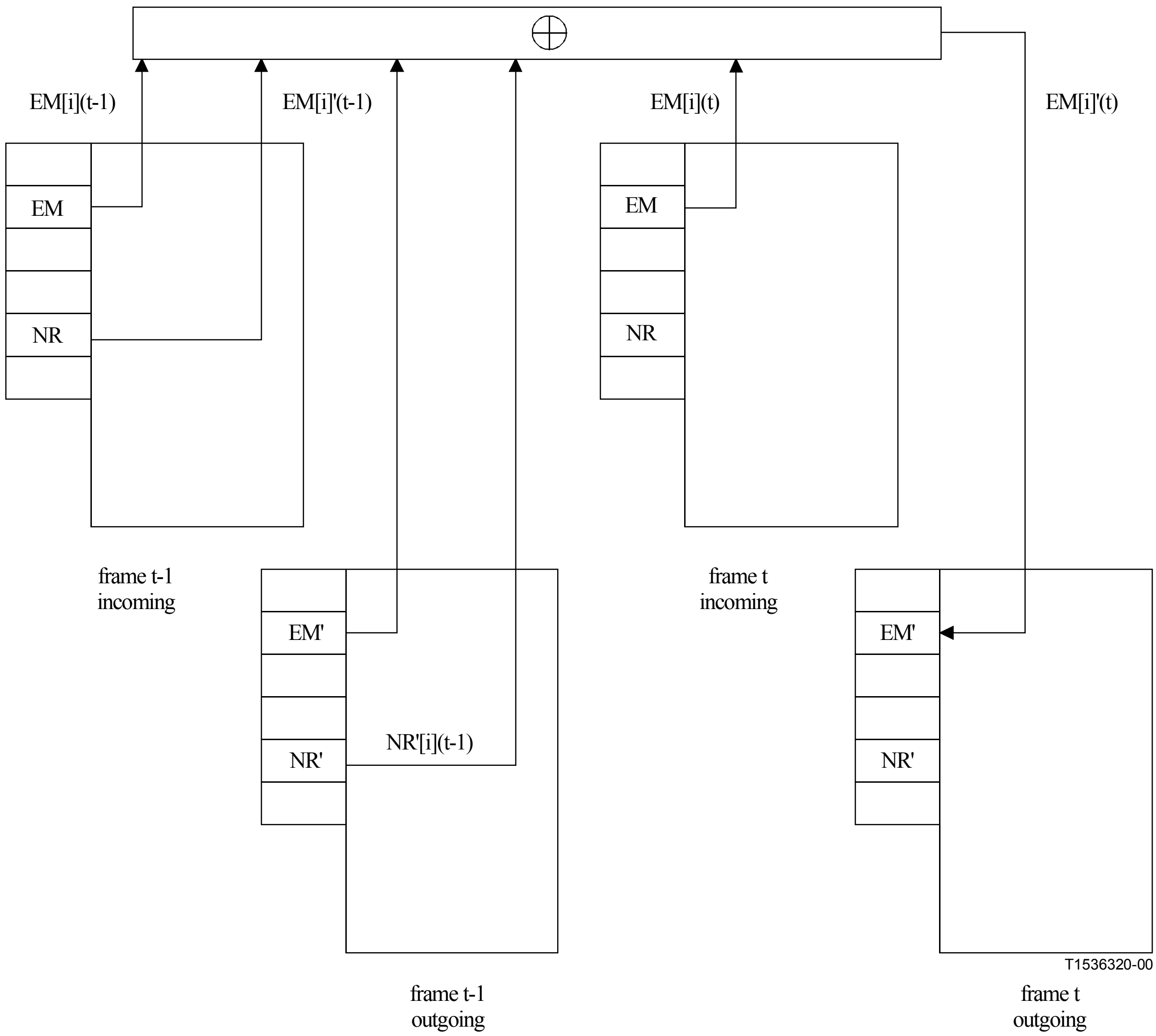


Figure 11-63/G.705 – EM[i], i=1 to 8 compensating process

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

11.5.1.2 P*q*s tandem connection trail termination sink function (P*q*sD_TT_Sk)

Symbol

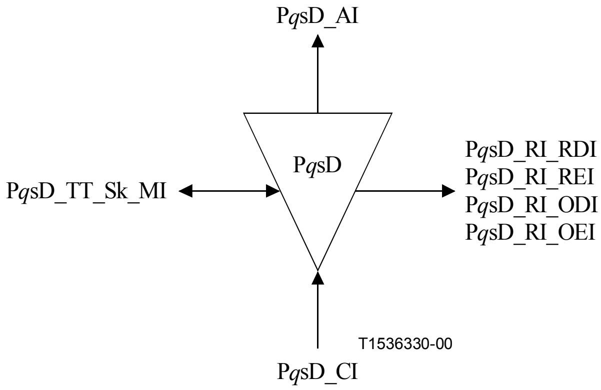


Figure 11-64/G.705 – P*q*sD_TT_Sk symbol

Interfaces

Table 11-44/G.705 – P*q*sD_TT_Sk input and output signals

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF PqsD_TT_Sk_MI_ExTI PqsD_TT_Sk_MI_AIS_Reported PqsD_TT_Sk_MI_SSF_Reported PqsD_TT_Sk_MI_RDI_Reported PqsD_TT_Sk_MI_ODI_Reported PqsD_TT_Sk_MI_TIMdis PqsD_TT_Sk_MI_DEGM PqsD_TT_Sk_MI_DEGTHR PqsD_TT_Sk_MI_1second PqsD_TT_Sk_MI_TPmode	PqsD_AI_D PqsD_AI_CK PqsD_AI_FS PqsD_AI_TSF PqsD_AI_TSD PqsD_AI_OSF PqsD_TT_Sk_MI_cLTC PqsD_TT_Sk_MI_cTIM PqsD_TT_Sk_MI_cUNEQ PqsD_TT_Sk_MI_cDEG PqsD_TT_Sk_MI_cRDI PqsD_TT_Sk_MI_cSSF PqsD_TT_Sk_MI_cODI PqsD_TT_Sk_MI_cIncAIS PqsD_TT_Sk_MI_AcTI PqsD_RI_RDI PqsD_RI_REI PqsD_RI_ODI PqsD_RI_OEI PqsD_TT_Sk_MI_pN_EBC PqsD_TT_Sk_MI_pF_EBC PqsD_TT_Sk_MI_pN_DS PqsD_TT_Sk_MI_pF_DS PqsD_TT_Sk_MI_pON_EBC PqsD_TT_Sk_MI_pOF_EBC PqsD_TT_Sk_MI_pON_DS PqsD_TT_Sk_MI_pOF_DS

Processes

TC EDC violations: Even bit parity shall be computed for each bit n of every byte of the preceding P*q*s and compared with bit n of EM recovered from the current frame (n=1 to 8 inclusive). A difference between the computed and recovered EM values shall be taken as evidence of one or more errors in the computation block (nON_B). The magnitude (absolute value) of the difference between this calculated number of errors and the number of errors written into the IEC (see Table 11-45) at the trail termination source shall be used to determine the error performance of the tandem connection for each transmitted P*q*s (Figure 11-65). If this magnitude of the difference is one or more, an errored TC block is detected (nN_B). If one or more errors were detected in the computation block, an errored P*q*s block (nON_B) shall be declared.

NOTE 1 – The EM data and the IEC read in the current frame both apply to the previous frame.

Table 11-45/G.705 – IEC code interpretation

NR[1]	NR[2]	NR[3]	NR[4]	IEC code interpretation
0	0	0	0	0 errors
0	0	0	1	1 error
0	0	1	0	2 errors
0	0	1	1	3 errors
0	1	0	0	4 errors
0	1	0	1	5 errors
0	1	1	0	6 errors
0	1	1	1	7 errors
1	0	0	0	8 errors
1	0	0	1	0 errors
1	0	1	0	0 errors
1	0	1	1	0 errors
1	1	0	0	0 errors
1	1	0	1	0 errors
1	1	1	0	0 errors
1	1	1	1	0 errors

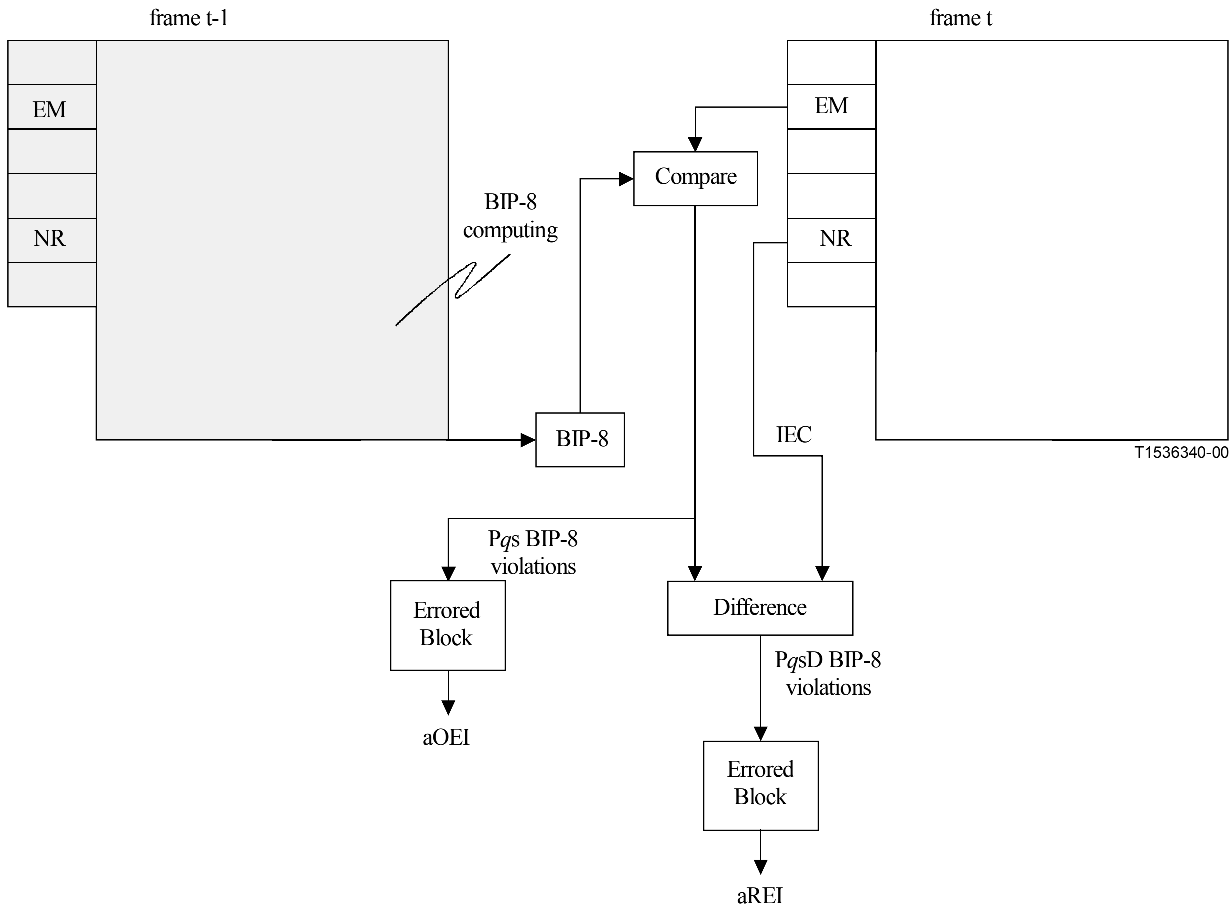


Figure 11-65/G.705 – P*q*sD and P*q*s BIP-8 computing and comparison

NR[1-4]: The function shall extract the Incoming Error Code (IEC). It shall accept the received code without further processing.

NR[7-8][9-72]: The Received Trail Trace Identifier RxTI shall be recovered from the tandem connection trail trace identifier overhead and shall be made available as AcTI for network management purposes. The acceptance process shall be performed as specified in 6.2.2.2/G.806. The mismatch detection process shall be as specified below.

NR[1-4]: The function shall extract the Incoming AIS code.

NR[5], NR[8][73]: The information carried in the REI, RDI bits in byte NR shall be extracted to enable single ended maintenance of a bi-directional tandem connection Trail. The REI (nF_B) shall be used to monitor the error performance of the other direction of transmission, and the RDI shall be used to provide information as to the status of the remote receiver. A "1" indicates a Remote Defect Indication state, while a "0" indicates the normal, working state.

NR[6], NR[7][74]: The information carried in the OEI, ODI bits in byte NR shall be extracted to enable single ended (intermediate) maintenance of a the P*q*s egressing the tandem connection Trail. The OEI (nOF_B) shall be used to monitor the error performance of the other direction of transmission, and the ODI shall be used to provide information as to the status of the remote receiver. A "1" indicates a Outgoing Defect Indication state, while a "0" indicates the normal, working state.

NR[7-8] – *Multiframe alignment*: The function shall perform a multiframe alignment on bits 7 and 8 of byte NR to recover the TTI, RDI, and ODI signals transported within the multiframed bits. The multiframe alignment shall be found by searching for the pattern "1111 1111 1111 1110" within the bits 7 and 8 of byte NR. The signal shall be continuously checked with the presumed multiframe start position for the alignment.

Frame alignment is deemed to have been lost (entering Out Of Multiframe (OOM) state) when two consecutive FASs are detected in error (i.e. ≥ 1 error in each FAS).

Frame alignment is deemed to have been recovered (entering In Multiframe (IM) state) when one non-errored FAS is found.

NR: The function shall terminate NR channel by inserting an all-ZEROs pattern.

EM: The function shall compensate the P*q*s BIP-8 in byte EM according the algorithm defined in P*q*sD_TT_So.

Defects

TC Unequipped (dUNEQ):

The function shall detect for an unequipped Tandem Connection (UNEQ) condition by monitoring byte NR for code "00000000". The unequipped defect (dUNEQ) shall be detected if five consecutive P*q*s frames contain the "0000 0000" pattern in byte NR. The dUNEQ defect shall be cleared if in five consecutive NR frames any pattern other than the "0000 0000" is detected in byte NR.

TC Loss of Tandem Connection (dLTC):

The function shall detect for the presence/absence of the tandem connection overhead in the byte NR by evaluating the multiframe alignment signal in bits 7 and 8 of byte NR. The loss of tandem connection defect (dLTC) shall be detected if the multiframe alignment process is in the OOM state. The dLTC shall be cleared if the multiframe alignment process is in the IM state.

TC Connectivity (Trace Identifier) (dTIM):

The function shall detect for a TC mis-connection condition by monitoring the TC trace identifier. The Trace Identifier Mismatch defect (dTIM) shall be detected and cleared within a maximum period of 1 s in the absence of bit errors.

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

The defect shall be suppressed during the receipt of SSF.

It shall be possible to disable the trace identifier mismatch defect detection (TIMdis).

TC Signal Degrade (dDEG):

The function shall detect for a TC signal degrade defect condition by monitoring for TC BIP-8 violations. The algorithm shall be according 6.2.3/G.806.

TC Remote Defect (dRDI):

The function shall detect for a TC remote defect indication defect condition by monitoring the TC RDI signal. The algorithm shall be according 6.2.6.3/G.806.

TC Remote Outgoing Pqs Defect (dODI):

The function shall detect for a TC remote outgoing P*q*s defect indication defect condition by monitoring the TC ODI signal. The algorithm shall be according 6.2.6.3/G.806.

Incoming AIS (dIncAIS):

The function shall detect for a tandem connection incoming AIS condition by monitoring the IEC bits in byte NR for code "1110". If 5 consecutive frames contain the "1110" pattern in the IEC bits a dIncAIS defect shall be detected. dIncAIS shall be cleared if in 5 consecutive frames any pattern other than the "1110" is detected in the IEC bits.

NOTE 2 – Bits 1 to 4 of byte NR support two applications: conveying the incoming error information (Table 11-45) and conveying the incoming AIS information to the TC tail end. Codes 0000 to 1101, 1111 represent IncAIS is false, code 1110 represents IncAIS is true.

Consequent Actions

The function shall perform the following consequent actions (refer to 6.3/G.806):

aAIS ← dUNEQ or dTIM or dLTC

aTSF ← CI_SSF or dUNEQ or dTIM or dLTC

aTSD ← dDEG

aRDI ← CI_SSF or dUNEQ or dTIM or dLTC

aREI ← nN_B

aODI ← CI_SSF or dUNEQ or dTIM or dIncAIS or dLTC

aOEI ← nON_B

aOSF ← CI_SSF or dUNEQ or dTIM or dLTC or dIncAIS

The function shall insert the all-ONEs (AIS) signal within 250 μs after AIS request generation (aAIS), and cease the insertion within 250 μs after the AIS request has cleared.

Defect Correlations

The function shall perform the following defect correlations (refer to 6.4/G.806):

cUNEQ ← MON and dUNEQ

cLTC ← MON and (not dUNEQ) and dLTC

cTIM ← MON and (not dUNEQ) and (not dLTC) and dTIM

cDEG ← MON and (not dTIM) and (not dLTC) and dDEG

cSSF ← MON and CI_SSF and SSF_reported

cRDI ← MON and (not dUNEQ) and (not dTIM) and (not dLTC) and dRDI and RDI_Reported

cODI ← MON and (not dUNEQ) and (not dTIM) and (not dLTC) and dODI and ODI_Reported

cIncAIS ← MON and dIncAIS and (not CI_SSF) and (not dLTC) and (not dTIM) and AIS_reported

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

It shall be an option to report RDI as a fault cause. This is controlled by means of the parameter RDI_Reported. The default shall be RDI_Reported = false.

It shall be an option to report ODI as a fault cause. This is controlled by means of the parameter ODI_Reported. The default shall be ODI_Reported = false.

Performance Monitoring

The following TC error performance parameters shall be counted for each 1-second period (refer to 6.5/G.806):

pN_DS ← aTSF or dEQ

pF_DS ← dRDI

pN_EBC ← ΣnN_B

pF_EBC ← ΣnF_B

pON_DS ← aODI or dEQ

pOF_DS ← dODI

pON_EBC ← ΣnON_B

pOF_EBC ← ΣnOF_B

pN_EBC and pN_DS do not represent the actual performance monitoring support within an equipment. For that, these pN_DS/pN_EBC signals shall be connected to performance monitoring functions within the element management function. Similar for the far-end signals pF_EBC and pF_DS and for pON_EBC/pON_DS, pOF_EBC/pOF_DS.

11.5.1.3 P*q*s tandem connection non-intrusive trail termination sink function (P*q*sDm_TT_Sk)

Symbol

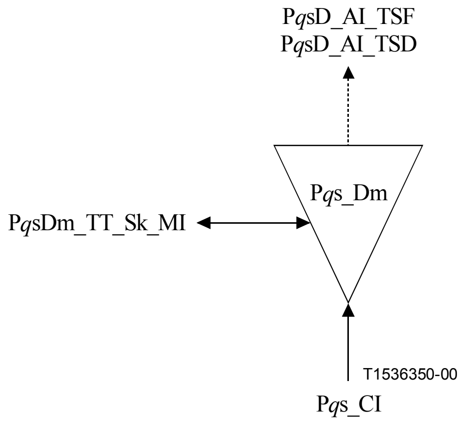


Figure 11-66/G.705 – P*q*sDm_TT_Sk symbol

Interfaces

Table 11-46/G.705 – P*q*sDm_TT_Sk input and output signals

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF PqsDm_TT_Sk_MI_ExTI PqsDm_TT_Sk_MI_SSF_Reported PqsDm_TT_Sk_MI_RDI_Reported PqsDm_TT_Sk_MI_ODI_Reported PqsDm_TT_Sk_MI_TIMdis PqsDm_TT_Sk_MI_DEGM PqsDm_TT_Sk_MI_DEGTHR PqsDm_TT_Sk_MI_1second PqsD_TT_Sk_MI_TPmode	PqsD_AI_TSF PqsD_AI_TSD PqsDm_TT_Sk_MI_cLTC PqsDm_TT_Sk_MI_cTIM PqsDm_TT_Sk_MI_cUNEQ PqsDm_TT_Sk_MI_cDEG PqsDm_TT_Sk_MI_cRDI PqsDm_TT_Sk_MI_cSSF PqsDm_TT_Sk_MI_cODI PqsDm_TT_Sk_MI_AcTI PqsDm_TT_Sk_MI_pN_EBC PqsDm_TT_Sk_MI_pF_EBC PqsDm_TT_Sk_MI_pN_DS PqsDm_TT_Sk_MI_pF_DS PqsDm_TT_Sk_MI_pOF_EBC PqsDm_TT_Sk_MI_pOF_DS

Processes

This function can be used to perform the following:

1) single ended maintenance of the TC by monitoring at an intermediate node, using remote information (RDI, REI);
2) aid in fault localization within TC trail by monitoring near-end defects;
3) monitoring of P*q*s performance at TC egressing point (except for connectivity defects before the TC) using remote outgoing information (ODI, OEI).

TC EDC violations: Even bit parity shall be computed for each bit n of every byte of the preceding P*q*s and compared with bit n of EM recovered from the current frame (n=1 to 8 inclusive). A difference between the computed and recovered EM values shall be taken as evidence of one or more errors in the computation block (nON_B). The magnitude (absolute value) of the difference between this calculated number of errors and the number of errors written into the IEC (see Table 11-45) at the trail termination source shall be used to determine the error performance of the tandem connection for each transmitted P*q*s (Figure 11-65). If this magnitude of the difference is one or more, an errored TC block is detected (nN_B). Refer to P*q*sD_TT_Sk. If one or more errors were detected in the computation block, an errored P*q*s block (nON_B) shall be declared.

NR[1-4]: The function shall extract the Incoming Error Code (IEC). It shall accept the received code without further processing.

NR[7-8][9-72]: The Received Trail Trace Identifier RxTI shall be recovered from the tandem connection trail trace identifier overhead and shall be made available as AcTI for network management purposes. The acceptance process and mismatch detection process shall be performed as specified in 6.2.1.4/G.806.

NR[1-4]: The function shall extract the Incoming AIS code.

NR[5], NR[8][73]: The information carried in the REI, RDI bits in byte NR shall be extracted to enable single ended maintenance of a bi-directional tandem connection Trail. The REI (nF_B) shall be used to monitor the error performance of the other direction of transmission, and the RDI shall be used to provide information as to the status of the remote receiver. A "1" indicates a Remote Defect Indication state, while a "0" indicates the normal, working state.

NR[6], NR[7][74]: The information carried in the OEI, ODI bits in byte NR shall be extracted to enable single ended (intermediate) maintenance of the P*q*s egressing the tandem connection Trail. The OEI (nOF_B) shall be used to monitor the error performance of the other direction of transmission, and the ODI shall be used to provide information as to the status of the remote receiver. A "1" indicates a Outgoing Defect Indication state, while a "0" indicates the normal, working state.

NR[7-8] – *Multiframe alignment*: The function shall perform a multiframe alignment on bits 7 and 8 of byte NR to recover the TTI, RDI, and ODI signals transported within the multiframed bits. The multiframe alignment shall be found by searching for the pattern "1111 1111 1111 1110" within the bits 7 and 8 of byte NR. The signal shall be continuously checked with the presumed multiframe start position for the alignment.

Frame alignment is deemed to have been lost (entering Out Of Multiframe (OOM) state) when two consecutive FAS are detected in error (i.e. ≥ 1 error in each FAS).

Frame alignment is deemed to have been recovered (entering In Multiframe (IM) state) when one non-errored FAS is found.

Defects

TC Unequipped (dUNEQ):

The function shall detect for an unequipped Tandem Connection (UNEQ) condition by monitoring byte NR for code "00000000". The unequipped defect (dUNEQ) shall be detected if five consecutive P*q*s frames contain the "0000 0000" pattern in byte NR. The dUNEQ defect shall be cleared if in five consecutive NR frames any pattern other than the "0000 0000" is detected in byte NR.

TC Loss of Tandem Connection (dLTC):

The function shall detect for the presence/absence of the tandem connection overhead in the byte NR by evaluating the multiframe alignment signal in bits 7 and 8 of byte NR. The loss of tandem connection defect (dLTC) shall be detected if the multiframe alignment process is in the OOM state. The dLTC shall be cleared if the multiframe alignment process is in the IM state.

TC Connectivity (Trace Identifier) (dTIM):

The function shall detect for a TC mis-connection condition by monitoring the TC trace identifier. The Trace Identifier Mismatch defect (dTIM) shall be detected and cleared within a maximum period of 1 s in the absence of bit errors.

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

The defect shall be suppressed during the receipt of SSF.

It shall be possible to disable the trace identifier mismatch defect detection (TIMdis).

TC Signal Degrade (dDEG):

The function shall detect for a TC signal degrade defect condition by monitoring for TC BIP-8 violations. The algorithm shall be according 6.2.3/G.806.

TC Remote Defect (dRDI):

The function shall detect for a TC remote defect indication defect condition by monitoring the TC RDI signal. The algorithm shall be according 6.2.6.3/G.806.

TC Remote Outgoing Pqs Defect (dODI):

The function shall detect for a TC remote outgoing P*q*s defect indication defect condition by monitoring the TC ODI signal. The algorithm shall be according 6.2.6.3/G.806.

Consequent Actions

aTSF ← CI_SSF or dUNEQ or dTIM or dLTC

aTSD ← dDEG

Defect Correlations

The function shall perform the following defect correlations (refer to 6.4/G.806):

cUNEQ ← MON and dUNEQ

cLTC ← MON and (not dUNEQ) and dLTC

cTIM ← MON and (not dUNEQ) and (not dLTC) and dTIM

cDEG ← MON and (not dTIM) and (not dLTC) and dDEG

cSSF ← MON and CI_SSF and SSF_reported

cRDI ← MON and (not dUNEQ) and (not dTIM) and (not dLTC) and dRDI and RDI_reported

cODI ← MON and (not dUNEQ) and (not dTIM) and (not dLTC) and dODI and ODI_Reported

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

It shall be an option to report RDI as a fault cause. This is controlled by means of the parameter

RDI_Reported. The default shall be RDI_Reported = false.

It shall be an option to report ODI as a fault cause. This is controlled by means of the parameter ODI_Reported. The default shall be ODI_Reported = false.

Performance Monitoring

The following TC error performance parameters shall be counted for each 1-second period (refer to 6.5/G.806):

pN_DS	←	aTSF or dEQ
pF_DS	←	dRDI
pN_EBC	←	ΣnN_B
pF_EBC	←	ΣnF_B
pOF_DS	←	dODI
pOF_EBC	←	ΣnOF_B

11.5.2 P*q*s tandem connection adaptation functions

11.5.2.1 P*q*s tandem connection to P*q*s adaptation source function (P*q*sD/P*q*s_A_So)

Symbol

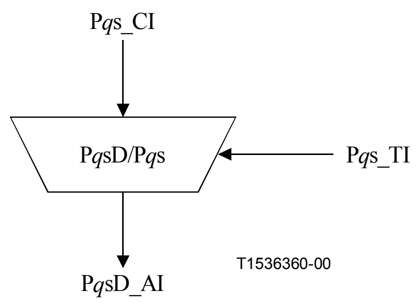


Figure 11-67/G.705 – P*q*sD/P*q*s_A_So symbol

Interfaces

Table 11-47/G.705 – P*q*sD/P*q*s_A_So input and output signals

Input(s)	Output(s)
Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF Pqs_TI_CK	PqsD_AI_D PqsD_AI_CK PqsD_AI_FS PqsD_AI_SF

Processes

NOTE 1 – The function has no means to verify the existence of a tandem connection within the incoming signal. Nested tandem connections are not supported.

The function shall replace the incoming P*q*s signal (P*q*s_CI) by a local generated P*q*s frame with valid FA1 and FA2 bytes and all ONEs for all other bytes (i.e. enter "holdover") if an all-ONEs (AIS) P*q*s is received (i.e. if CI_SSF is TRUE).

NOTE 2 – The local frame start is generated with the P*q*s_TI timing.

Defects: None.

Consequent Actions

AI_SF ← CI_SSF

Defect Correlations: None.

Performance Monitoring: None.

11.5.2.2 P*q*s tandem connection to P*q*s adaptation sink function (P*q*sD/P*q*s_A_Sk)

Symbol

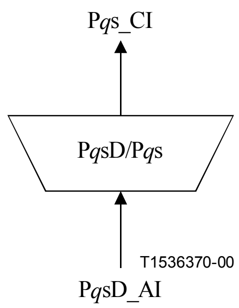


Figure 11-68/G.705 – P*q*sD/P*q*s_A_Sk symbol

Interfaces

Table 11-48/G.705 – P*q*sD/P*q*s_A_Sk input and output signals

Input(s)	Output(s)
PqsD_AI_D PqsD_AI_CK PqsD_AI_FS PqsD_AI_OSF	Pqs_CI_D Pqs_CI_CK Pqs_CI_FS Pqs_CI_SSF

Processes

The function shall restore the invalid frame start condition (i.e. output aSSF = true) if that existed at the ingress of the tandem connection.

NOTE – In addition, the invalid frame start condition is activated on a tandem connection connectivity defect condition that causes all-ONEs (AIS) insertion in the P*q*sD_TT_Sk.

Defects: None.

Consequent Actions

aAIS ← AI_OSF

aSSF ← AI_OSF

The function shall insert the all-ONEs (AIS) signal within 250 µs after AIS request generation (aAIS), and cease the insertion within 250 µs after the AIS request has cleared.

Defect Correlations: None.

Performance Monitoring: None.

12 P12s path layer functions

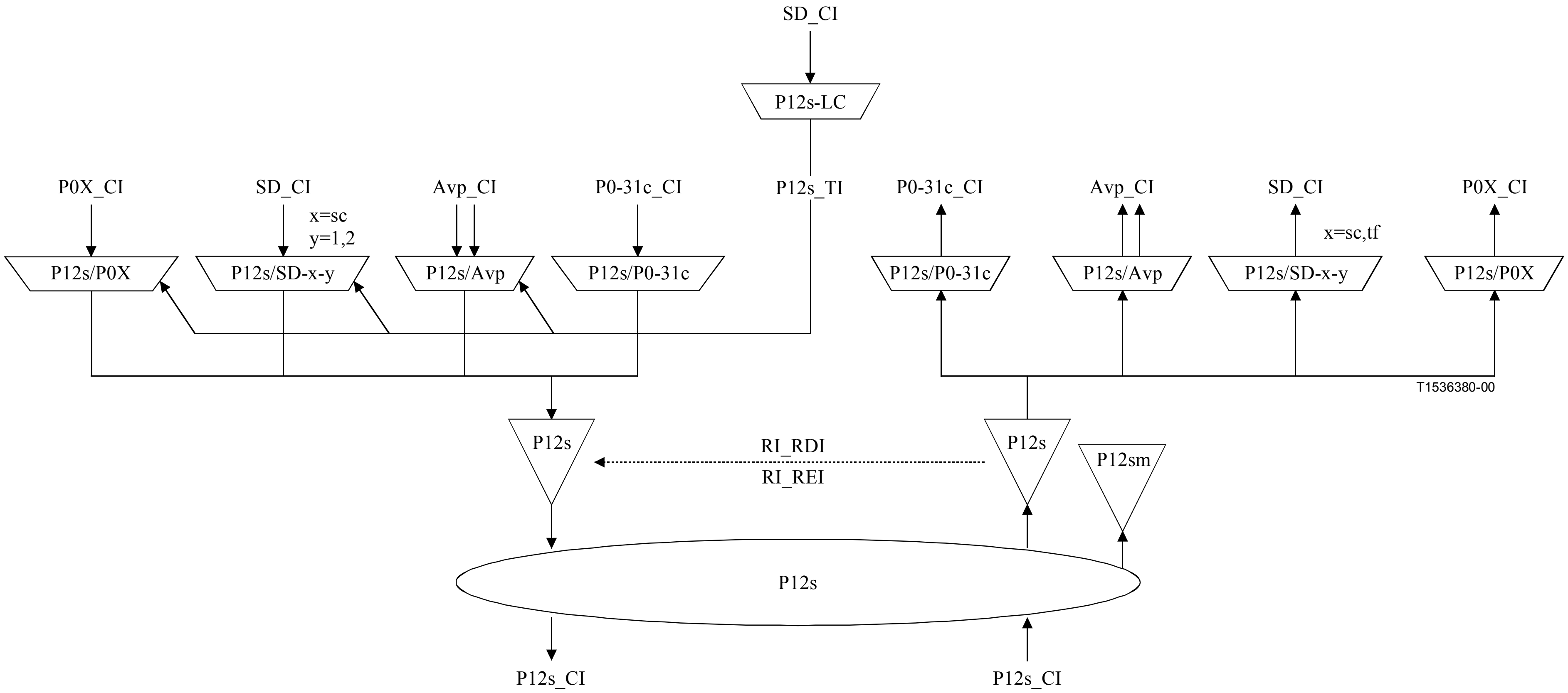


Figure 12-1/G.705 – P12s atomic functions

P12s layer CP

The CI at this point is a synchronous 2 048 kbit/s byte structured signal as specified in ITU-T G.704 with co-directional bit timing and the frame start information FS. The CI is structured:

– either as a 2 × 256 bit long (basic) frame with 2 × 8 bit frame overhead containing a FAS, RDI (A bit), and User Characteristic Information (S_i and S_a bits);

– or as a 16 × 256 bit long (multi) frame with 16 × 8 bit frame overhead containing a FAS, CRC-4 MFAS, CRC-4 code, RDI (A bit), REI (E bits), User Characteristic Information (S_a bits), and (optionally) a Synchronization Status Message channel.

Figures 12-2, 12-4 and 12-5 below depict the basic frame, multiframe and overhead structure.

P12s layer AP

The signal transported by a P12s will be determined by the client layer application. Typical signals include:

– a 1 984 kbit/s signal P0-31c_CI with unspecified content (to be passed through transparently);

– an ATM 1 920 kbit/s cell stream signal as specified in ITU-T G.804.

NOTE 1 – Many more compositions exist which are not addressed in this version of this Recommendation.

In addition, the AI may contain:

– a 4 bit Synchronization Status Message (SSM), located in one of the five S_a bits. This interface is used to pass timing synchronization information;

– a P0X_CI signal.

Figure 12-1 shows that more than one adaptation function exists in this P12s layer that can be connected to one P12s access point. For the case of the adaptation source functions, only one of these adaptation source functions is allowed to be activated. For this activated source, access to the access point by other adaptation source functions must be denied. 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.

NOTE 2 – If one adaptation function only is connected to the AP, it will be activated. If one or more other functions are connected to the same AP, one out of the set of functions will be active.

	1	2	3	4	5	6	7	8
TS0	Si	FAS						
TS1 : TS31	2 048 kbit/s payload (31 bytes)							
TS0	Si	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
TS1 : TS31	2 048 kbit/s payload (31 bytes)							

Figure 12-2/G.705 – Basic frame overhead structure of the P12s_CI_D signal

	1	2	3	4	5	6	7	8
TS0								
TS1 : TS31	2 048 kbit/s payload (31 bytes)							
TS0				Sa4	Sa5	Sa6	Sa7	Sa8
TS1 : TS31	2 048 kbit/s payload (31 bytes)							

Figure 12-3/G.705 – Basic frame overhead structure of the P12s_AI_D signal

Frame		1	2	3	4	5	6	7	8
Frame 0	TS0	C1	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 1	TS0	MFAS	1	A	Sa41	Sa51	Sa61	Sa71	Sa81
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 2	TS0	C2	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 3	TS0	MFAS	1	A	Sa42	Sa52	Sa62	Sa72	Sa82
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 4	TS0	C3	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 5	TS0	MFAS	1	A	Sa43	Sa53	Sa63	Sa73	Sa83
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 6	TS0	C4	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 7	TS0	MFAS	1	A	Sa44	Sa54	Sa64	Sa74	Sa84
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							

Frame		1	2	3	4	5	6	7	8
Frame 8	TS0	C1	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 9	TS0	MFAS	1	A	Sa41	Sa51	Sa61	Sa71	Sa81
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 10	TS0	C2	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 11	TS0	MFAS	1	A	Sa42	Sa52	Sa62	Sa72	Sa82
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 12	TS0	C3	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 13	TS0	E	1	A	Sa43	Sa53	Sa63	Sa73	Sa83
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 14	TS0	C4	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 15	TS0	E	1	A	Sa44	Sa54	Sa64	Sa74	Sa84
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							

Figure 12-4/G.705 – CRC-4 multiframe structure of the P12s_CI_D signal (with 4 bit code Sa structure)

Frame	TS	1	2	3	4	5	6	7	8
Frame 0	TS0	C1	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 1	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 2	TS0	C2	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 3	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 4	TS0	C3	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 5	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 6	TS0	C4	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 7	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							

Frame	TS	1	2	3	4	5	6	7	8
Frame 8	TS0	C1	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 9	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 10	TS0	C2	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 11	TS0	MFAS	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 12	TS0	C3	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 13	TS0	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 14	TS0	C4	FAS						
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							
Frame 15	TS0	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	TS1 … TS31	2 048 kbit/s payload (31 bytes)							

Figure 12-5/G.705 – CRC-4 multiframe structure of the P12s_CI_D signal (without 4 bit code Sa structure)

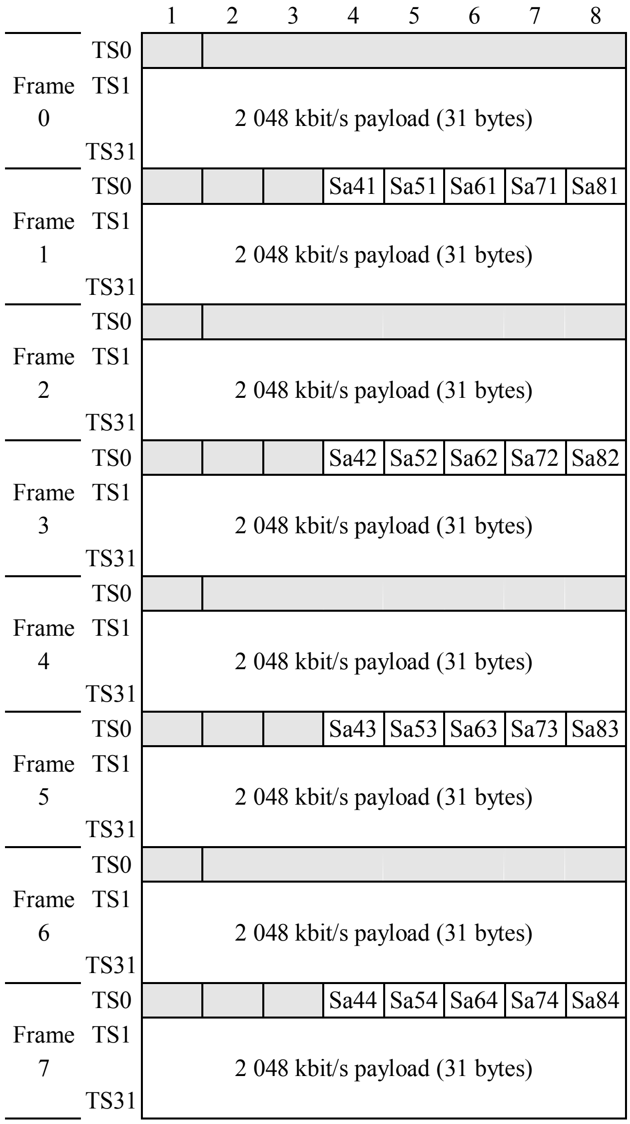


Figure 12-6/G.705 – 4 bit S_{ax} structure in "CRC-4 sub-multiframe" of the P12s_AI_D signal

12.1 P12s connection functions

Generic description of the connection function is described in 5.6.1/G.806.

12.2 P12s trail termination functions

12.2.1 P12s trail termination source P12s_TT_So

Symbol

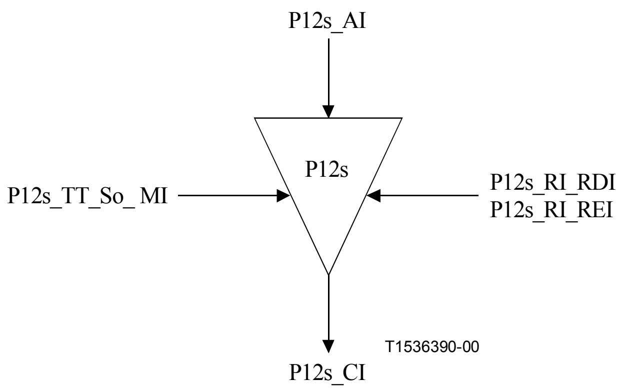


Figure 12-7/G.705 – P12s_TT_So symbol

Interfaces

Table 12-1/G.705 – P12s_TT_So input and output signals

Input(s)	Output(s)
P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_MFS P12s_AI_AISinsert P12s_RI_RDI P12s_RI_REI P12s_TT_So_MI_CRC4mode	P12s_CI_D P12s_CI_CK P12s_CI_FS

Processes

This function adds to P12s_AI the RDI information, the frame alignment signal, the CRC-4 multiframe alignment signal, the CRC-4 code, and REI information into the frame overhead. The frame overhead is defined in ITU-T G.704 [3].

A: This bit represents the defect status of the associated P12s_TT_Sk. The RDI indication shall be set to "1" on activation of P12s_RI_RDI within 5 ms, determined by the associated P12s_TT_Sk function, and set to "0" within 5 ms on the P12s_RI_RDI removal.

NOTE 1 – Components in "old" and "new" equipment designed prior to this Recommendation may meet 100 ms or less, instead of 5 ms. For some applications where this delay is not critical, a maximum value of 100 ms may be acceptable.

FAS – *Frame Alignment Signal (FAS)*: The function shall insert the 2048 kbit/s frame alignment signal "0011011" in bits 2 to 8 of TS0 in even frames, and "1" in bit 2 of TS0 in odd frames as defined in ITU-T G.704.

S_i – *TimeSlot 0, bit 1*: If CRC4mode is OFF, the function shall insert "1" into bit 1 of TimeSlot 0. If CRC4mode is ON or AUTO, the function shall generate the CRC-4 multiframe and perform the MFAS, E bit and $C_1C_2C_3C_4$ processes as defined below.

NOTE 2 – P12s_TT_So_MI_CRC4mode signal shall be the same signal as the one used in the associated adaptation sink function (<server>/P12s_A_Sk) to comply with ITU-T G.704.

S_i – MFAS – *CRC-4 Multiframe Alignment Signal*: The function shall insert the CRC-4 multiframe alignment signal "001011" in bit 1 of TS0 in frames 1,3,5,7,9,11 of the 16 frame CRC-4 multiframe as defined in ITU-T G.704.

S_i – E: Two E-bits are generated for each CRC-4 multiframe. Any E bit shall be set to "1", unless RI_REI (from the associated P12s_TT_Sk function) is true. For each RI_REI value which is TRUE, one of the E-bits shall be set to "0" within 1 second after RI_REI reception.

S_i – $C_1C_2C_3C_4$: The function shall compute the CRC-4 code value of the 2 Mbit/s signal as specified in 2.3.3.5/G.704. The computed value shall be inserted in the C_1 to C_4 bits of the following sub-multiframe.

Defects: None.

Consequent Actions

aAIS $\leftarrow$ AI_AISinsert

On activation of aAIS the function shall output an all-ONEs (AIS) signal, within the frequency range of 2048 kbit/s ± 50 ppm, within 250 µs; on deactivation of aAIS the function shall output normal data within 250 µs.

NOTE 3 – If AI_AISinsert is not connected, AI_AISinsert is assumed to be inactive, and all-ONEs (AIS) will not be output.

NOTE 4 – A 2 Mbit/s E12 interface may be used to pass timing synchronization information. If the signal does not support the Synchronization Status Message (SSM) it should be shutdown (i.e. all-ONEs (AIS) insertion) when the synchronization timing source has a quality level less or equal than a minimum provisioned level. The function P12s/SD_A_So is used to control AIS injection via the AI_AISinsert signal if required. The full specification is contained in ITU-T G.781.

Defect Correlations: None.

Performance Monitoring: None.

12.2.2 P12s trail termination sink P12s_TT_Sk

Symbol

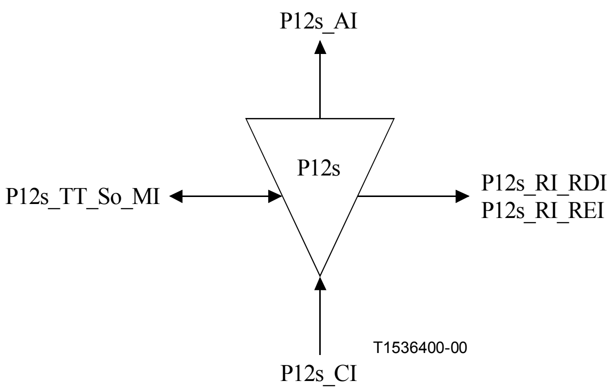


Figure 12-8/G.705 – P12s_TT_Sk symbol

Interfaces

Table 12-2/G.705 – P12s_TT_Sk input and output signals

Input(s)	Output(s)
P12s_CI_D P12s_CI_CK P12s_CI_FS P12s_CI_MFS P12s_CI_SSF P12s_CI_MFP P12s_TT_Sk_MI_TPmode P12s_TT_Sk_MI_SSF_Reported P12s_TT_Sk_MI_RDI_Reported P12s_TT_Sk_MI_DEGM P12s_TT_Sk_MI_DEGTHR P12s_TT_Sk_MI_1second P12s_TT_Sk_MI_CRC4mode	P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_MFS P12s_AI_TSF P12s_AI_TSD P12s_AI_MFP P12s_RI_RDI P12s_RI_REI P12s_TT_Sk_MI_cSSF P12s_TT_Sk_MI_cDEG P12s_TT_Sk_MI_cRDI P12s_TT_Sk_MI_RNCI P12s_TT_Sk_MI_MFP P12s_TT_Sk_MI_pN_EBC P12s_TT_Sk_MI_pN_DS P12s_TT_Sk_MI_pF_EBC P12s_TT_Sk_MI_pF_DS

Processes

This function monitors a P12s for errors, and recovers the trail termination status. It extracts the payload independent overhead bits ($C_1C_2C_3C_4$, A, E) from the P12s layer CI and outputs the P12s_AI.

FAS: The FAS bits of each received double frame are compared to their expected value "0011011". If CI_MFP is FALSE, a difference is taken as evidence of one or more errors (nN_B) in the block.

$C_1C_2C_3C_4$: If CI_MFP is TRUE, CRC-4 is computed for each bit of the preceding P12s sub-multiframe and compared with bits $C_1C_2C_3C_4$ recovered from the current sub-multiframe. A difference between the computed and recovered $C_1C_2C_3C_4$ values is taken as evidence of one or more errors (nN_B) in the computation block.

A, E: The information carried in the A and E bits (RDI, REI) is extracted to enable single ended maintenance of a bidirectional Trail (Path). The REI is used to monitor the error performance of the other direction of transmission, and the RDI provides information as to the status of the remote receiver. An A-bit set to "1" indicates an RDI state, while a "0" indicates the normal, working state. If CI_MFP is FALSE, nF_B is set to 0. If CI_MFP is true, each E-bit set to "0" is an indication for nF_B. The application process is described in Appendix II/G.806 [10].

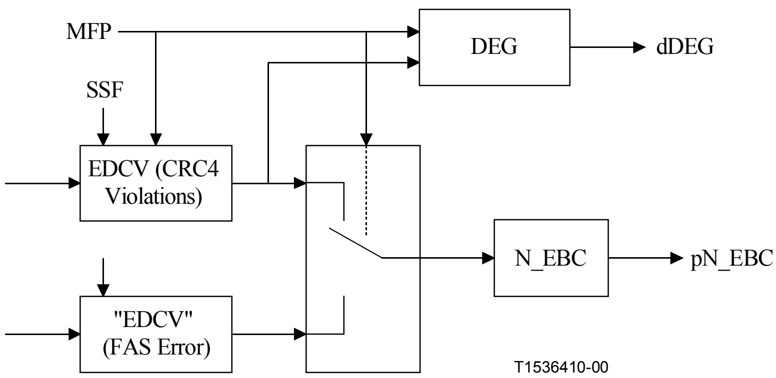


Figure 12-9/G.705 – dDEG and pN_EBC processing related to CI_MFP

Defects

The function shall detect for dRDI defect according to the specification in 6.2.6.3/G.806.

The function shall detect for dDEG defect as specified in 6.2.3/G.806 for a bursty error distribution with the following extensions (Figure 12-9): the Error Detection Code Violation (EDCV) process shall assume "zero" EDCVs in the incoming signal if CI_MFP is FALSE, and dDEG shall be cleared when CI_MFP is FALSE.

NOTE 1 – The precise behaviour of the N_EBC counting during the second of the switch over in which MFP changes its value, is not defined in this Recommendation.

The function shall detect a CRC-4 multiframe generator/detector status (MI_RNCI) if (pF_EBC > 990 and pF_DS = false) for five consecutive seconds. The MI_RNCI status shall be cleared if (pF_EBC < 990 or pF_DS = true) for five consecutive seconds.

NOTE 2 – This defect is defined only when the frame alignment process in the associated <server>/P12s_A_Sk function operates in the automatic CRC4 interworking mode (CRC4mode is AUTO).

NOTE 3 – P12s_TT_Sk_MI_CRC4mode signal shall be the same signal as the one used in the associated adaptation sink function (<server>/P12s_A_Sk).

Consequent Actions

aTSF ← CI_SSF

aRDI ← CI_SSF

aTSD ← dDEG

aREI ← nN_B or (not CI_MFP)

NOTE 4 – Per CRC-4 multiframe, two RI_REI values are to be conveyed to the associated P12s_TT_So function.

AI_MFP ← CI_MFP

MI_MFP ← CI_MFP

Defect Correlations

cDEG ← dDEG and MON

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance Monitoring

The performance monitoring process shall be performed as specified in 6.5/G.806.

NOTE 5 – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

The function shall support performance monitoring on CRC-4 violations (CRC4V) and on frame alignment signal errors (FASE). This shall be controlled via the CI_MFP signal. For the case CI_MFP is TRUE CRC4V will be applied. Otherwise (CI_MFP is FALSE) FASE will be applied (Figure 12-9).

NOTE 6 – The precise behaviour of the N_EBC counting during the second of the switch over in which MFP changes its value, is not defined in this Recommendation.

pN_DS ← aTSF or dEQ

pF_DS ← dRDI

pN_EBC ← ΣnN_B

pF_EBC ← ΣnF_B

12.3 P12s adaptation functions

12.3.1 P12s to P0-31c adaptation source P12s/P0-31c_A_So

Symbol

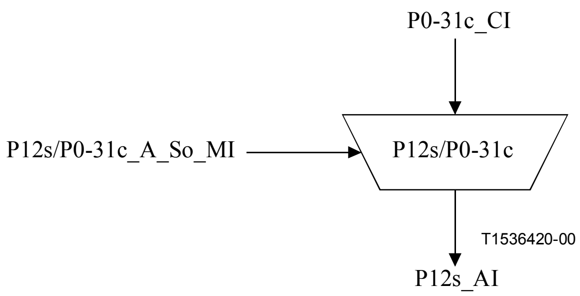


Figure 12-10/G.705 – P12s/P0-31c_A_So symbol

Interfaces

Table 12-3/G.705 – P12s/P0-31c_A_So input and output signals

Input(s)	Output(s)
P0-31c_CI_D P0-31c_CI_CK P0-31c_CI_FS P0-31c_CI_TSF P12s/P0-31c_A_So_MI_Active	P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_MFS

Processes

This function passes a 1 984 kbit/s signal without further processing into the appropriate 31 timeslots (TS1 to TS31) of a P12s signal.

The function shall convert the P0-31c frame start signal (P0-31c_CI_FS) identifying TS1 position into a P12s multiframe start signal (P12s_AI_MFS) identifying TS0 byte positions in a 16 frame multiframe structure.

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

NOTE 1 – This function should not be activated when P12s/SD_A_So function is also active. The timing information (CK, MFS, FS) might be different.

NOTE 2 – Further specifications are for further study.

Defects: None.

Consequent Actions: None.

Defect Correlations: None.

Performance Monitoring: None.

12.3.2 P12s to P0-31c adaptation sink P12s/P0-31c_A_Sk

Symbol

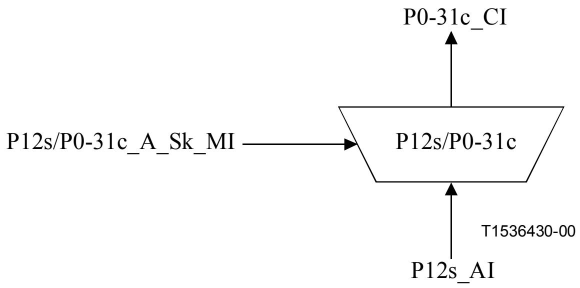


Figure 12-11/G.705 – P12s/P0-31c_A_Sk symbol

Interfaces

Table 12-4/G.705 – P12s/P0-31c_A_Sk input and output signals

Input(s)	Output(s)
P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_TSF P12s/P0-31c_A_Sk_MI_Active	P0-31c_CI_D P0-31c_CI_CK P0-31c_CI_FS P0-31c_CI_SSF

Processes

The function extracts the 1984 kbit/s synchronous signal from the TS1 through TS31 of the P12s_AI (Figures 12-3 and 12-6).

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

aSSF $\leftarrow$ AI_TSF

aAIS $\leftarrow$ AI_TSF

On declaration of the aAIS the function shall output an all-ONEs (AIS) signal in the P0-31c_CI_D within 250 µs; on clearing of aAIS the function shall output normal data within 250 µs. The P0-31c_CI_CK during the all-ONEs signal shall be within 1984 kHz ± 4.6 ppm.

Defect Correlations: None.

Performance Monitoring: None.

12.3.3 P12s to SD adaptation source P12s/SD_A_So

Refer to ITU-T G.781 [8].

12.3.4 P12s to SD adaptation sink P12s/SD_A_Sk

Refer to ITU-T G.781.

12.3.5 P12s to ATM VP compound adaptation source P12s/Avp_A_So

For further study.

12.3.6 P12s to ATM VP compound adaptation sink P12s/Avp_A_Sk

For further study.

12.3.7 P12s Layer Clock adaptation source P12s-LC_A_So

Refer to ITU-T G.781.

12.3.8 P12s Layer to P0 layer compound adaptation source function P12s/P0X_A_So

Symbol

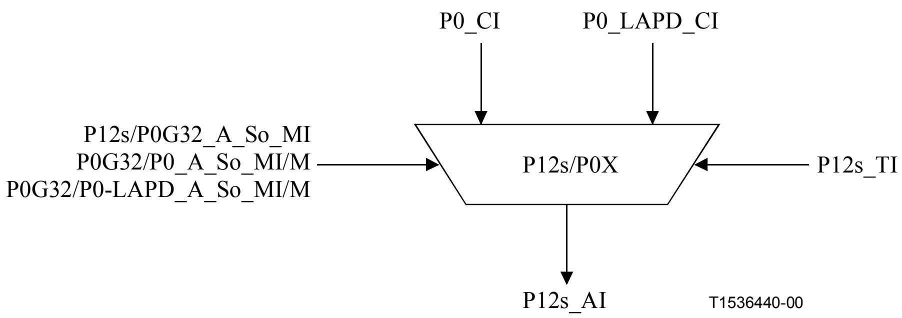


Figure 12-12/G.705 – P12s/P0X_A_So symbol

Interfaces

Table 12-5/G.705 – P12s/P0X_A_So input and output signals

Input(s)	Output(s)
P12s/P0G32_A_So_MI P12s_TI maximum 31 inputs: P0_CI P0G32/P0_A_So_MI/M maximum 31 inputs: P0-LAPD_CI P0G32/P0-LAPD_A_So_MI/M	P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_MFS

Processes

The P12s/P0X_A_So compound function provides adaptation from the P0 layers to the P12s layer. This process is performed by a combination of several atomic functions as shown in Figure 12-13. The P12s/P0G32_A_So function performs the P12s layer specific processing, while the P0G32/P0_A_So and P0G32/P0-LAPD_A_So functions perform the client specific adaptation. Each of these P0G32/P0X_A_So functions is characterized by the parameter M, which define the number of the P0 within the P12s the function has access to (P0 numbering scheme as specified in 5.1.1.2/G.704, i.e. 0 to 31). According to the P0G32 multiplex structures supported by the NE, a variety of possible combinations of these P0G32/P0X_A_So functions exist. Table 12-6 lists all possible P0G32/P0X_A_So functions within a P12s/P0X_A_So compound functions.

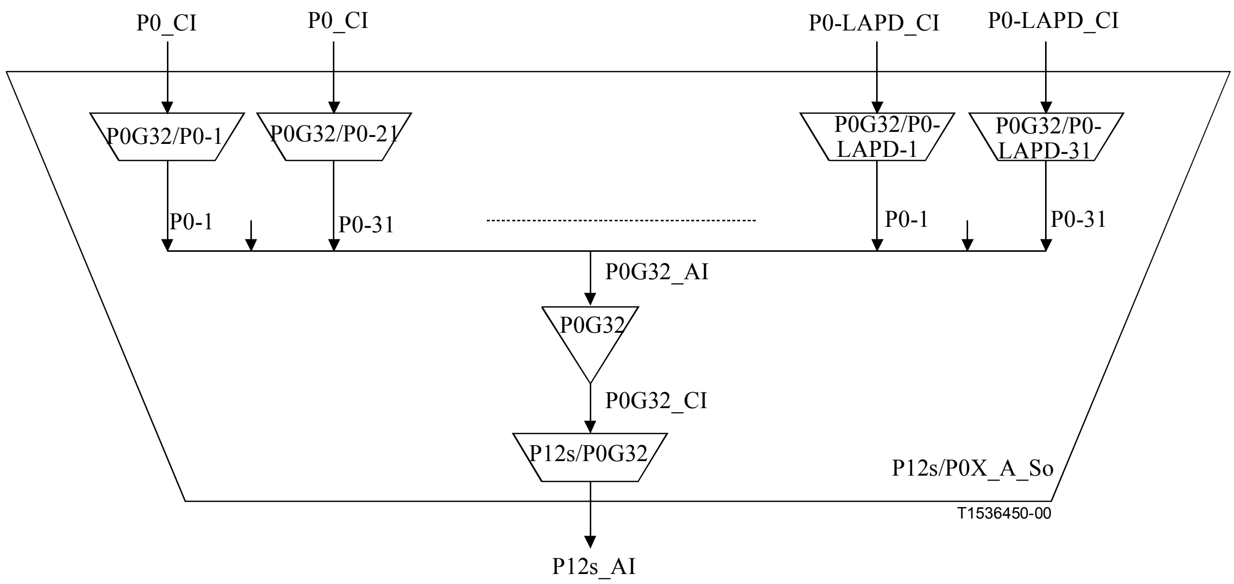


Figure 12-13/G.705 – P12s/P0X_A_So symbol

Table 12-6/G.705 – Possible P0G32/P0X_A_So functions of a P12s/P0X_A_So compound function

Atomic function	P0 number M
P0G32/P0_A_So/M	1 to 31
P0G32/P0-LAPD_A_So/M	1 to 31

For specific implementations only a subset of these P0G32/P0X_A_So functions may be used (e.g. Channel bank). If a flexible P0G32 multiplex structure is supported, several P0G32/P0X_A_So functions may have access to the same P0 timeslot. For such case, only one of these adaptation source functions is allowed to be activated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured P0G32 multiplex structure.

NOTE 1 – The P12s/P0G32_A_So, P0G32_T_So and P0G32/P0X_A_So defined in the following clauses can only be used in a P12s/P0X_A_So compound function. These functions cannot be used as standalone functions.

NOTE 2 – The P0G32 is a virtual sublayer only applicable in a P12s/P0X_A compound function.

NOTE 3 – The number of P0G32/P0X_A functions that is active shall completely fill the P12s payload.

12.3.8.1 P12s to P0G32 adaptation source P12s/P0G32_A_So

Symbol

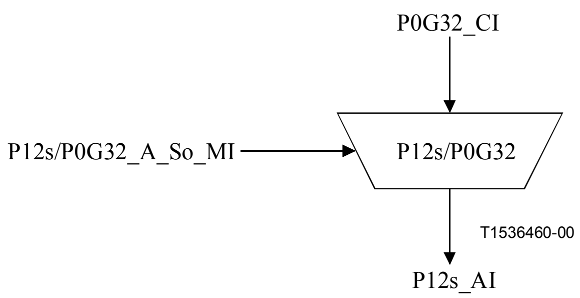


Figure 12-14/G.705 – P12s/P0G32_A_So symbol

Interfaces

Table 12-7/G.705 – P12s/P0G32_A_So input and output signals

Input(s)	Output(s)
P0G32_CI_D P0G32_CI_CK P0G32_CI_FS P0G32_CI_TSF P12s/P0G32_A_So_MI_Active	P12s_AI_D P12s_AI_CK P12s_AI_FS

Processes

This function passes a group of 31 P0 signal without further processing into the appropriate 31 timeslots (TS1 to TS31) of a P12s signal.

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

NOTE 1 – The P12s/P0G32_A_So functions can only be used in a P12s/PX_A_So compound function. It cannot be used as a standalone function.

NOTE 2 – This function could be activated when also P12s/SD_A_So function is active. The timing information (CK, MFS, FS) is identical.

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

12.3.8.2 P0G32 termination source function P0G32_T_So

NOTE – The P0G32_T_So function can only be used in a P12s/P0_A_So compound function. It cannot be used as a standalone function.

Symbol

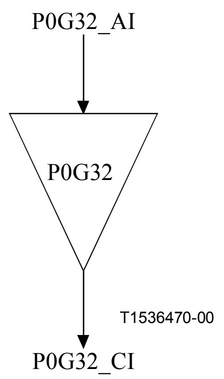


Figure 12-15/G.705 – P0G32_T_So symbol

Interfaces

Table 12-8/G.705 – P0G32_T_So input and output signals

Input(s)	Output(s)
P0G32_AI_D P0G32_AI_CK P0G32_AI_FS P0G32_AI_MSF	P0G32_CI_D P0G32_CI_CK P0G32_CI_FS P0G32_CI_MFS

Processes: None.

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

12.3.8.3 P0G32 to P0 layer adaptation source function P0G32/P0_A_So/M

NOTE 1 – The P0G32/P0_A_So function can only be used in a P12s/P0_A_So compound function. It cannot be used as a standalone function.

Symbol

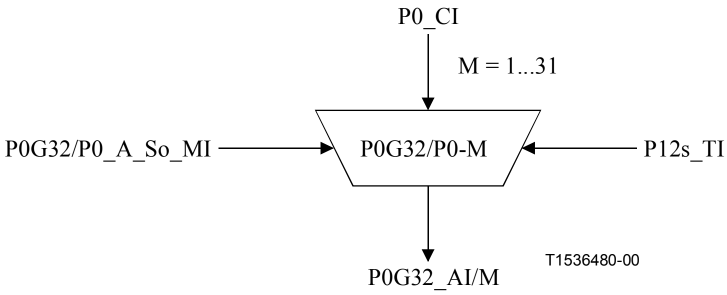


Figure 12-16/G.705 – P0G32/P0_A_So symbol

Interfaces

Table 12-9/G.705 – P0G32/P0_A_So input and output signals

Input(s)	Output(s)
P0_CI_D P0_CI_CK P0_CI_FS P0_CI_SSF P12s_TI_CK P12s_TI_FS P12s_TI_MFS P0G32/P0_A_So_MI_Active	P0G32_AI_D P0G32_AI_CK P0G32_AI_FS

Processes

This function multiplexes a P0_CI into time a slot M (M = 1..31) of the P0G32_AI/M.

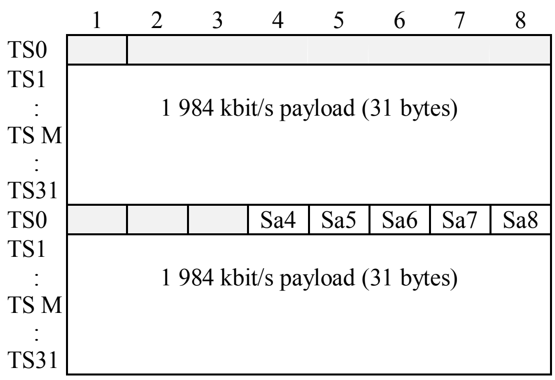


Figure 12-17/G.705 – P0G32_AI_D/M signal for P0G32/P0_A_So

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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 2 – If CI_SSF is not connected (when connected to a P0_TT_So), CI_SSF is assumed to be false.

Defect correlations: None.

Performance monitoring: None.

12.3.8.4 P0G32 to P0-LAPD layer adaptation source function P0G32/P0-LAPD_A_So/M

NOTE 1 – The P0G32/P0-LAPD_A_So function can only be used in a P12s/P0X_A_So compound function. It cannot be used as a standalone function.

Symbol

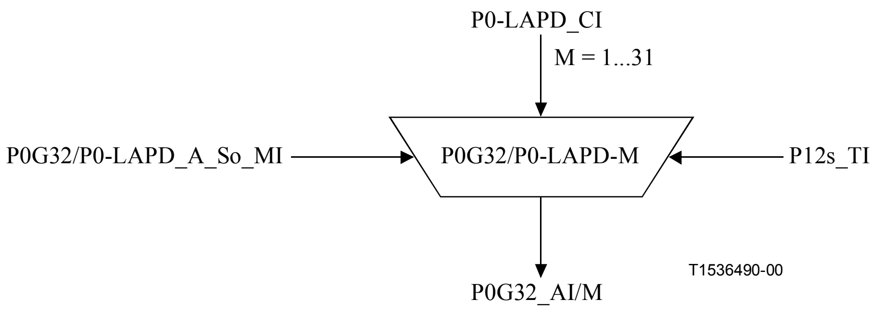


Figure 12-18/G.705 – P0G32/P0-LAPD_A_So symbol

Interfaces

Table 12-10/G.705 – P0G32/P0-LAPD_A_So input and output signals

Input(s)	Output(s)
P0-LAPD_CI_D P0-LAPD _CI_CK P0-LAPD _CI_FS P0-LAPD _CI_SSF P12s_TI_CK P12s_TI_FS P12s_TI_MFS P0G32/P0-LAPD _A_So_MI_Active	P0G32_AI_D P0G32_AI_CK P0G32_AI_FS

Processes

This function multiplexes a P0-LAPD_CI according to ITU-T Q.921 into a timeslot M (M = 1..31) of the P0G32_AI/M.

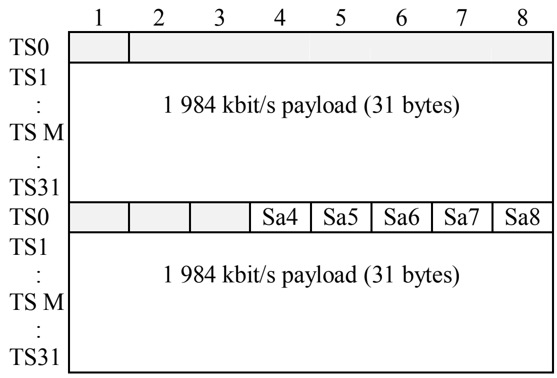


Figure 12-19/G.705 – P0G32_AI_D/M signal for P0G32/P0-LAPD_A_So

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

aAIS ← CI_SSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 2 – If CI_SSF is not connected (when connected to a P0_TT_So), CI_SSF is assumed to be false.

Defect correlations: None.

Performance monitoring: None.

12.3.9 P12s layer to P0X layer compound adaptation sink function P12s/P0X_A_Sk

Symbol

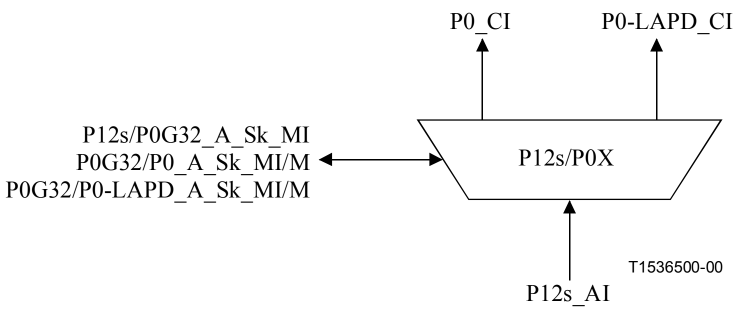


Figure 12-20/G.705 – P12s/P0X_A_Sk symbol

Interfaces

Table 12-11/G.705 – P12s/P0G32_A_Sk input and output signals

Input(s)	Output(s)
P12s_AI P12s/P0G32_A_Sk_MI maximum 31 inputs: P0G32/P0_A_Sk_MI/M maximum 31 inputs: P0G32/P0-LAPD_A_Sk_MI/M	P12s/P0G32_A_Sk_MI maximum 31 outputs: P0_CI P0G32/P0_A_Sk_MI/M maximum 31 outputs: P0-LAPD_CI P0G32/P0-LAPD_A_Sk_MI/M

Processes

The P12s/P0X_A_Sk compound function provides adaptation from the P12s layer to the P0X layers. This process is performed by a combination of several atomic functions as shown in Figure 12-21. The P12s/P0G32_A_Sk function performs the P12s layer specific slip buffer processing, while the P0G32/P0X_A_Sk functions perform the lower order P0 specific adaptation. Each of these P0G32/P0X_A_Sk functions is characterized by the parameter M, which define the timeslot number of the P0 within the P12s the function has access to (P0 numbering scheme as specified in 5.1.1.2/G.704, i.e. 0 to 31). According to the P0G32 multiplex structures supported by the NE, a variety of possible combinations of these P0G32/P0X_A_Sk functions exist. Table 11-12 lists all possible P0G32/P0X_A_Sk functions within a P12s/P0X_A_Sk compound function.

NOTE 1 – Sub-rates below 64 kbit/s rate are for further study.

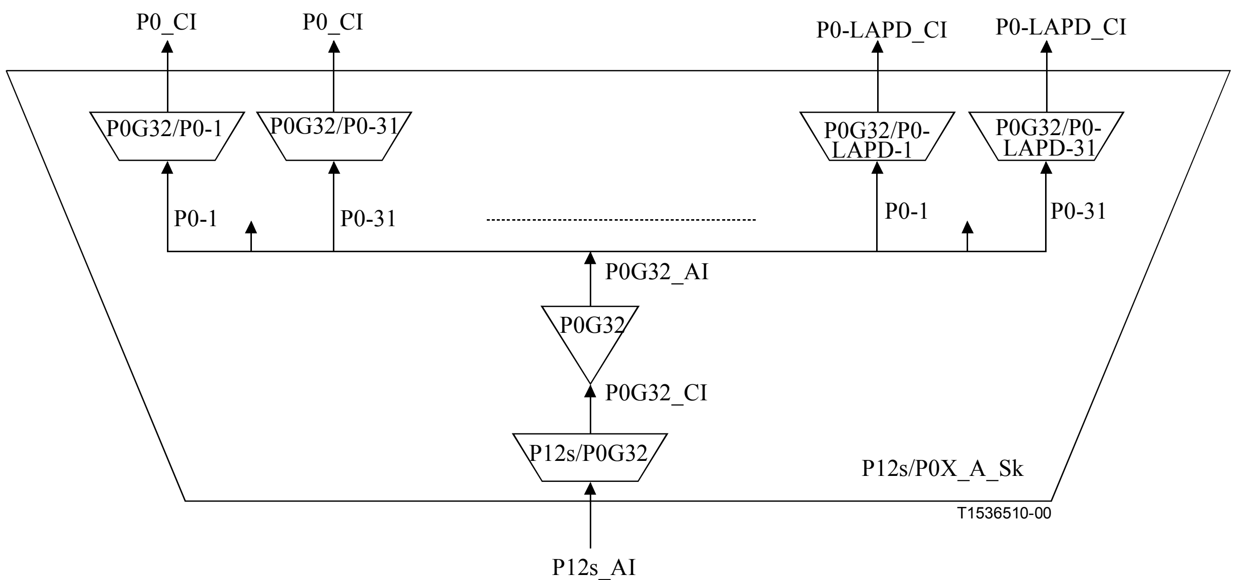


Figure 12-21/G.705 – P12s/P0X_A_Sk compound function with set of P12s/P0_A_Sk atomic functions

Table 12-12/G.705 – Possible P0G32/P0X_A_Sk functions of a P12s/P0X_A_Sk compound function

Atomic function	P0 number M
P0G32/P0_A_Sk/M	1 to 31
P0G32/P0-LAPD_A_Sk/M	1 to 31

For specific implementations only a subset of these P0G32/P0X_A_Sk functions may be used (e.g. PCM channel bank). If a flexible P0G32 multiplex structure is supported, several P0G32/P0X_A_Sk functions may have access to the same P0 timeslot. In contradiction with the source direction, adaptation sink functions may be activated all together. This will presumably cause events (e.g. pN_CS) to be detected and reported. To prevent this an adaptation sink function can be deactivated. This is controlled by the equipment management function by activating/deactivating the functions according to the configured P0G32 multiplex structure.

NOTE 2 – The P12s/P0G32_A_Sk, P0GG24_T_Sk and P0G32/P0_A_Sk defined in the following clauses can only be used in a P12s/X_A_Sk compound function. These functions cannot be used as standalone functions.

NOTE 3 – The P0G32 is a virtual sublayer only applicable in a P12s/P0X_A compound function.

12.3.9.1 P12s layer to P0G32 adaptation sink function P12s/P0G32_A_Sk

NOTE 1 – The P12s/P0G32_A_Sk function can only be used in a P12s/P0X_A_Sk compound function. It cannot be used as a standalone function.

Symbol

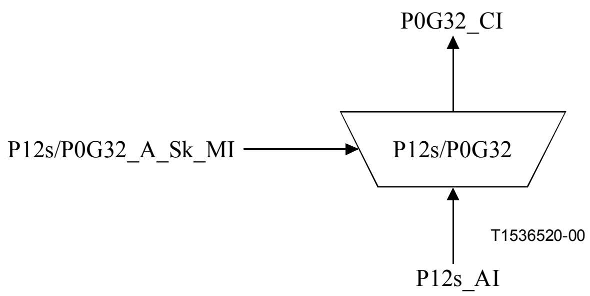


Figure 12-22/G.705 – P12s/P0G32_A_Sk symbol

Interfaces

Table 12-13/G.705 – P12s/P0G32_A_Sk input and output signals

Input(s)	Output(s)
P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_TSF P0G32_CI_CK P0G32_CI_FS P12s/P0G32_A _Sk_MI_1second P12s/P0G32_A_Sk_MI_Active	P0G32_CI_D P0G32_CI_SSF P0G32_MI_pN_CS

Processes

The function performs rate adaptation between the P12s and the P0G32 by means of frame slip. The function shall tolerate jitter and wander according to ITU-T G.823 without any impairment. Wander outside the limits and frequency deviations shall result in controlled 125 µs frame slips.

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

aSSF ← AI_TSF

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 2 – If AI_TSF is not connected (when connected to a P0_TT_So), AI_TSF is assumed to be false.

Defect correlations: None.

Performance monitoring

The performance monitoring process shall be performed as specified in 5.2.2/M.2100 and Annex B/M.2100.

NOTE – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

The function shall support performance monitoring on controlled frame slips.

pN_CS ← Number of controlled frame slips

12.3.9.2 P0G32 termination sink function TUG_T_Sk

NOTE – The P0G32_T_Sk function can only be used in a P12s/P0X_A_Sk compound function. It cannot be used as a standalone function.

Symbol

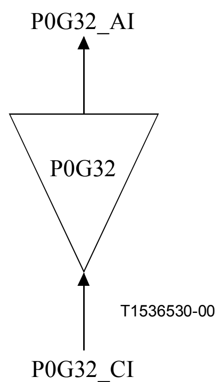


Figure 12-23/G.705 – P0G32_T_Sk symbol

Interfaces

Table 12-14/G.705 – P0G32_T_Sk input and output signals

Input(s)	Output(s)
P0G32_CI_D P0G32_CI_CK P0G32_CI_FS P0G32_CI_TSF P12s/P0G32_A_So_MI_Active	P12s_AI_D P12s_AI_CK P12s_AI_FS

Processes: None.

Defects: None.

Consequent actions

aTSF ← CI_SSF

Defect correlations: None.

Performance monitoring: None.

12.3.9.3 P0G32 to P0 layer adaptation sink function P0G32/P0_A_Sk/M

NOTE 1 – The P0G32/P0_A_Sk function can only be used in a P12s/P0X_A_Sk compound function. It cannot be used as a standalone function

Symbol

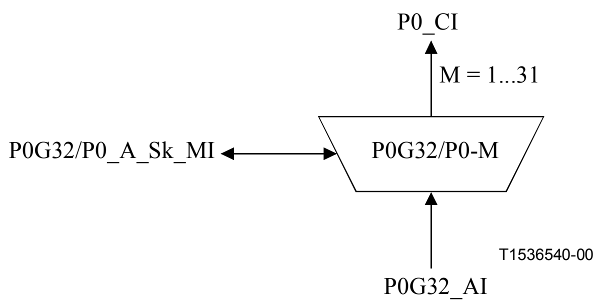


Figure 12-24/G.705 – P0G32/P0_A_Sk symbol

Interfaces

Table 12-15/G.705 – P0G32/P0_A_Sk input and output signals

Input(s)	Output(s)
P0G32_AI_D P0G32_AI_CK P0G32_AI_FS P0G32_AI_TSF P0G32/P0_A_Sk_MI_Active	P0_CI_D P0_CI_CK P0_CI_FS P0_CI_SSF

Processes

This function demultiplexes a P0_CI from timeslot M (M = 1..31) in the P0G32_AI/M.

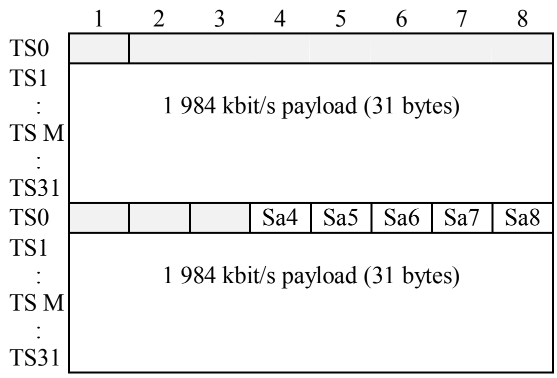


Figure 12-25/G.705 – P0G32_AI_D/M signal for P0G32/P0_A_So

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

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 2 – If AI_TSF is not connected (when connected to a P0_TT_So), AI_TSF is assumed to be false.

Defect correlations: None.

Performance monitoring: None.

12.3.9.4 P0G32 to P0-LAPD layer adaptation sink function P0G32/P0-LAPD_A_Sk/M

NOTE 1 – The P0G32/P0-LAPD_A_Sk function can only be used in a P12s/P0X_A_Sk compound function. It cannot be used as a standalone function.

Symbol

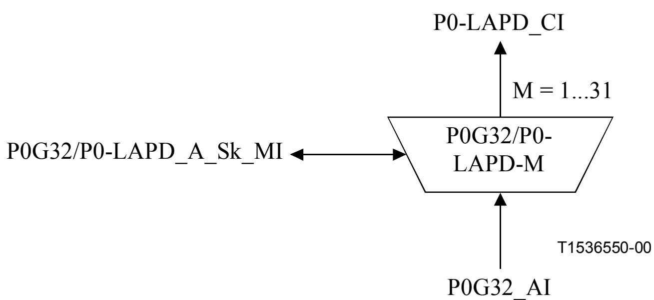


Figure 12-26/G.705 – P0G32/P0-LAPD_A_Sk symbol

Interfaces

Table 12-16/G.705 – P0G32/P0-LAPD_A_Sk input and output signals

Input(s)	Output(s)
P0G32_AI_D P0G32_AI_CK P0G32_AI_FS P0G32_AI_TSF P0G32/P0-LAPD_A_Sk_MI_AIS_ Reported P0G32/P0-LAPD_A_Sk_MI_Active	P0-LAPD_CI_D P0-LAPD_CI_CK P0-LAPD_CI_FS P0-LAPD_CI_SSF

Processes

This function demultiplexes a P0-LAPD_CI according to ITU-T Q.921 from timeslot M (M = 1..31) in the P0G32_AI/M.

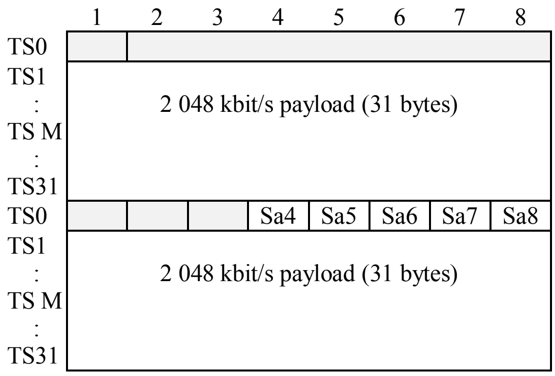


Figure 12-27/G.705 – P0G32_AI_D/M signal for P0G32/P0-LAPD_A_So

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

aAIS ← AI_TSF

On declaration of aAIS the function shall output an all-ONEs signal within 1 ms; on clearing of aAIS the function shall output normal data within 1 ms.

NOTE 2 – If AI_TSF is not connected (when connected to a P0-LAPD_TT_So), AI_TSF is assumed to be false.

Defect correlations: None.

Performance monitoring: None.

12.3.10 P12s layer to V3-SM layer adaptation source function P12s/P0X_A_So

Inserts the Sa5 bits and Sa6 nibbles for the purpose of the V3 Section maintenance. For further study.

12.3.11 P12s layer to V3-SM layer adaptation source function P12s/P0X_A_Sk

Evaluates the A, Sa5 bits and Sa6 nibbles for the purpose of the V3 Section maintenance. For further study.

12.4 P12s layer monitoring functions

12.4.1 P12s layer non-intrusive monitoring function P12sm_TT_Sk

Symbol

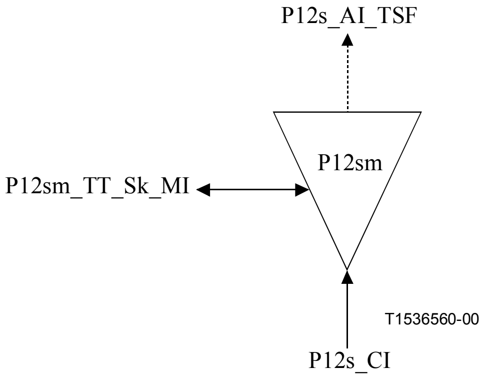


Figure 12-28/G.705 – P12sm_TT_Sk symbol

Interfaces

Table 12-17/G.705 – P12sm_TT_Sk input and output signals

Input(s)	Output(s)
P12s_CI_D P12s_CI_CK P12s_CI_FS P12s_CI_MFS P12s_CI_SSF P12s_CI_MFP P12sm_TT_Sk_MI_TPmode P12sm_TT_Sk_MI_SSF_Reported P12sm_TT_Sk_MI_RDI_Reported P12sm_TT_Sk_MI_DEGM P12sm_TT_Sk_MI_DEGTHR P12sm_TT_Sk_MI_1second P12sm_TT_Sk_MI_CRC4mode	P12s_AI_TSF P12s_AI_TSD P12sm_TT_Sk_MI_cSSF P12sm_TT_Sk_MI_cDEG P12sm_TT_Sk_MI_cRDI P12sm_TT_Sk_MI_RNCI P12sm_TT_Sk_MI_MFP P12sm_TT_Sk_MI_pN_EBC P12sm_TT_Sk_MI_pN_DS P12sm_TT_Sk_MI_pF_EBC P12sm_TT_Sk_MI_pF_DS

Processes

This function monitors a P12s for errors, and recovers the trail termination status. It extracts the payload independent overhead bits ($C_1C_2C_3C_4$, A, E) from the P12s layer characteristic.

FAS: If CI_MFP is FALSE, the FAS bits of each received double frame are compared to their expected value "0011011". A difference is taken as evidence of one or more errors (nN_B) in the block.

$C_1C_2C_3C_4$: If CI_MFP is TRUE, CRC-4 is computed for each bit of the preceding P12s sub-multiframe and compared with bits $C_1C_2C_3C_4$ recovered from the current sub-multiframe. A difference between the computed and recovered $C_1C_2C_3C_4$ values is taken as evidence of one or more errors (nN_B) in the computation block.

A, E: The information carried in the A and E bits (RDI, REI) is extracted to enable single ended maintenance of a bidirectional Trail (Path). The REI (nF_B) is used to monitor the error performance of the other direction of transmission, and the RDI provides information as to the status of the remote receiver. A "1" indicates a Remote Defect Indication state, while a "0" indicates the normal, working state. The application process is described in Appendix II/G.806.

Defects

The function shall detect for dRDI defect according the specification in 6.2.6.3/G.806.

The function shall detect for dDEG defect as specified in 6.2.3/G.806 for bursty error distribution with the following extensions (see Figure 12-9): the Error Detection Code Violation (EDCV) process shall assume "zero" EDCVs in the incoming signal if CI_MFP is FALSE, and dDEG shall be cleared when CI_MFP is FALSE.

NOTE 1 – The precise behaviour of the N_EBC counting during the second of the switch over in which MFP changes its value, is not defined in this Recommendation.

The function shall detect a CRC-4 multiframe generator/detector status (MI_RNCI) if (pF_EBC > 990 and pF_DS = false) for five consecutive seconds. The MI_RNCI status shall be cleared if (pF_EBC < 990 or pF_DS = true) for five consecutive seconds.

NOTE 2 – This defect is defined only when the frame alignment process in the associated <server>/P12s_A_Sk function operates in the automatic CRC-4 interworking mode (*CRC4mode* is AUTO).

NOTE 3 – P12sm_TT_Sk_MI_CRC4mode signal shall be the same signal as the one used in the associated adaptation sink function (<server>/P12s_A_Sk).

Consequent Actions

aTSF ← CI_SSF

aTSD ← dDEG

MI_MFP ← CI_MFP

Defect Correlations

cDEG ← dDEG and MON

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance Monitoring

The performance monitoring process shall be performed as specified in 6.5/G.806.

NOTE 4 – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

The function shall support performance monitoring on (CRC-4 violations CRC4V) and on frame alignment signal errors (FASE). This shall be controlled via the CI_MFP signal. For the case CI_MFP is TRUE CRC4V will be applied. Otherwise (CI_MFP is FALSE) FASE will be applied (Figure 12-9).

pN_DS ← aTSF or dEQ

pF_DS ← dRDI

pN_EBC ← ΣnN_B

pF_EBC ← ΣnF_B

13 P4a path layer functions

For further study.

14 P32e path layer functions

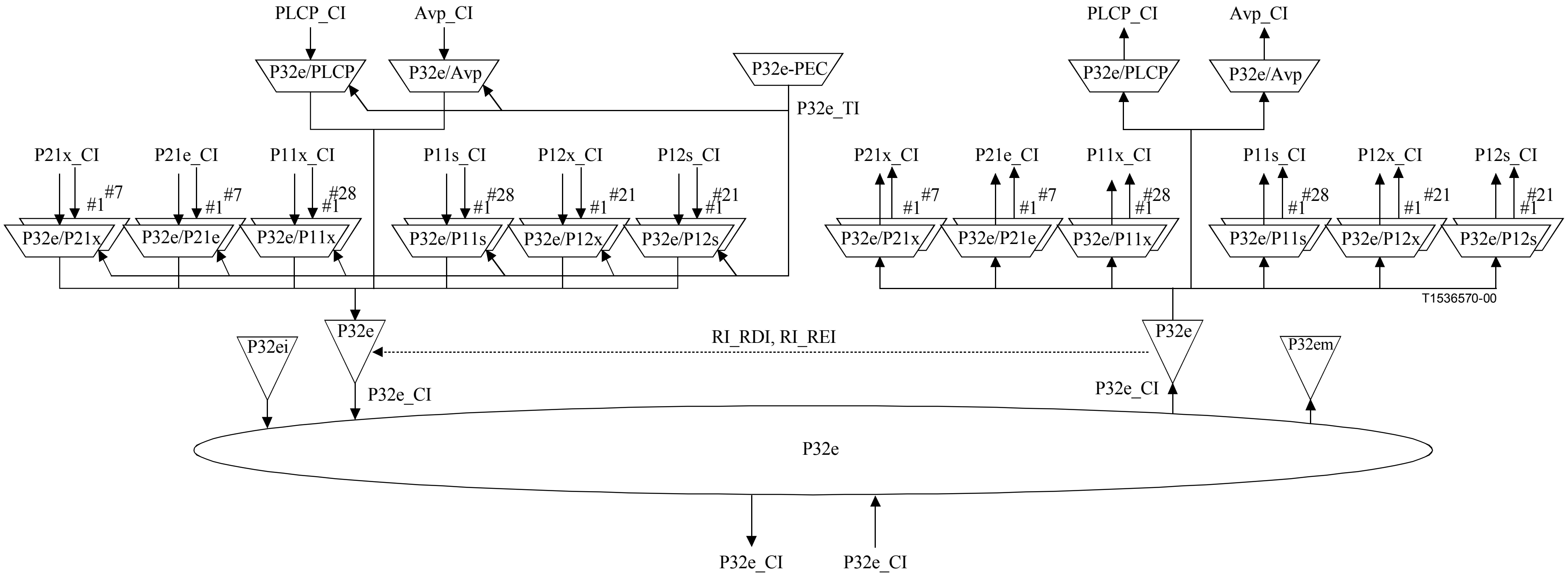


Figure 14-1/G.705 − P32e path layer atomic functions

P32e layer CP

The CI at this point is 44 736 kbit/s bit structured signal as specified in ITU-T G.704 [3] or ITU-T G.752 [6] with co-directional bit timing and the frame start information FS. The CI is structured to form a 4 760 bit long multiframe. The multiframes are divided into seven M-subframes each with 680 bits; each M-subframe is further divided into eight blocks of 85 bits: 1 bit for overhead and 84 bits for payload. Thus, there are 56 overhead bits per multiframe. The overhead contains a multiframe alignment signal (M-bits), M-subframe alignment signal (F-bits), Parity (P-bits), RDI (X-bits), and C-bits used as defined for the C-bit Parity multiplex application specified in ITU-T G.704 or used for justification as specified in ITU-T G.752. Alternatively, it may be an idle signal as specified in 2.5.3.6.2/G.704.

NOTE 1 – The signal specified by ITU-T G.752 is included for interworking with older G.752 equipment. It should only be supported when interworking with older G.752 equipment as it does not support far-end maintenance.

P32e layer AP

The signal transported by a P32e will be determined by the client layer application. Typical signals include:

– a multiplexed signal containing twenty-eight 1544 kbit/s tributary signals (P11x_CI) without an assumed structure. Overhead C-bits are used as specified in ITU-T G.704;
– a multiplexed signal containing twenty-eight 1544 kbit/s tributary signals (P11s_CI) with a frame structure as specified in ITU-T G.704. Overhead C-bits are used as specified in ITU-T G.704;
– a multiplexed signal containing twenty-one 2048 kbit/s tributary signals (P12x_CI) without an assumed structure. Overhead C-bits are used as specified in ITU-T G.704;
– a multiplexed signal containing twenty-one 2048 kbit/s tributary signals (P12s_CI) with a frame structure as specified in ITU-T G.704. Overhead C-bits are used as specified in ITU-T G.704;
– a Physical Layer Convergence Protocol (PLCP_CI)-based mapping of ATM cells (PLCP_CI) as defined in ITU-T G.804;
– a HEC-based mapping of ATM cells (Avp_CI) as defined in ITU-T G.804;
– a multiplexed signal containing seven 6312 kbit/s tributary signals (P21x_CI) without an assumed structure. Overhead C-bits are used for justification as specified in ITU-T G.752 [6];
– a multiplexed signal containing seven 6312 kbit/s tributary signals (P21e_CI) with a frame structure as specified in ITU-T G.743 [5] or a frame structure as specified in ITU-T G.747. Overhead C-bits are used for justification as specified in ITU-T G.752.

NOTE 2 – Other payload types are recognized and are for further study.

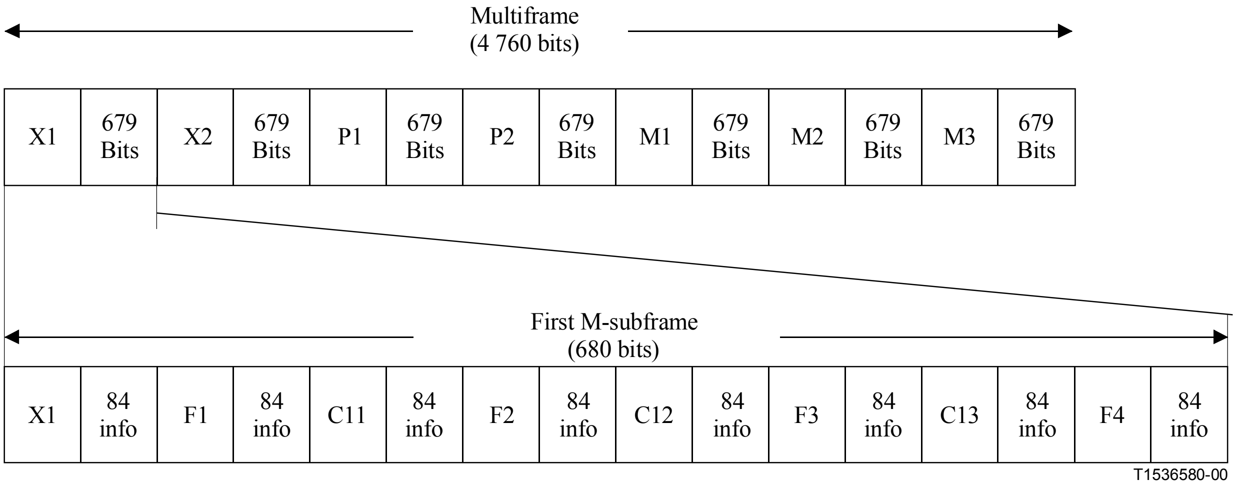
NOTE 3 – The signal specified by ITU-T G.752 is included for interworking with older G.752 equipment. It should only be supported when interworking with older G.752 equipment as it does not support far-end maintenance.

P32ei layer CP

The CI at this point is 44 736 kbit/s bit structured idle signal as specified in 2.5.3.6.2/G.704. The overhead contains a multiframe alignment signal (M-bits) and M-subframe alignment signal (F-bits). The information bits are set to a 1100… sequence, starting with a binary one (1) after each M-bit, F-bit, X-bit, and C-bit. The C-bits are set to binary zero (C1=0, C2=0, C3=0), in the third M-subframe (C31, C32, C33); the remaining C-bits (three C-bits in M-subframes 1, 2, 4, 5, 6, and 7) may be individually set to one or zero, and may vary with time. The X-bits are set to binary one (X1=1, X2=1).

Figure 14-1 shows that more than one adaptation function exists in this P32e layer that can be connected to one P32e access point. For the case of the adaptation source functions, only one of these adaptation source functions is allowed to be activated. For this activated source, access to the access point by other adaptation source functions must be denied. 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.

NOTE 4 – If one adaptation function only is connected to the AP, it will be activated. If one or more other functions are connected to the same AP, one out of the set of functions will be active.



The 56 overhead bits sequential positions as follows:							
X1	F1	C11	F2	C12	F3	X13	F4
X2	F1	C21	F2	C22	F3	X23	F4
P1	F1	C31	F2	C32	F3	C33	F4
P2	F1	C41	F2	C42	F3	C43	F4
M1	F1	C51	F2	C52	F3	C53	F4
M2	F1	C61	F2	C62	F3	C63	F4
M3	F1	C71	F2	C72	F3	C72	F4

Figure 14-2/G.705 – P32e_CI_D signal

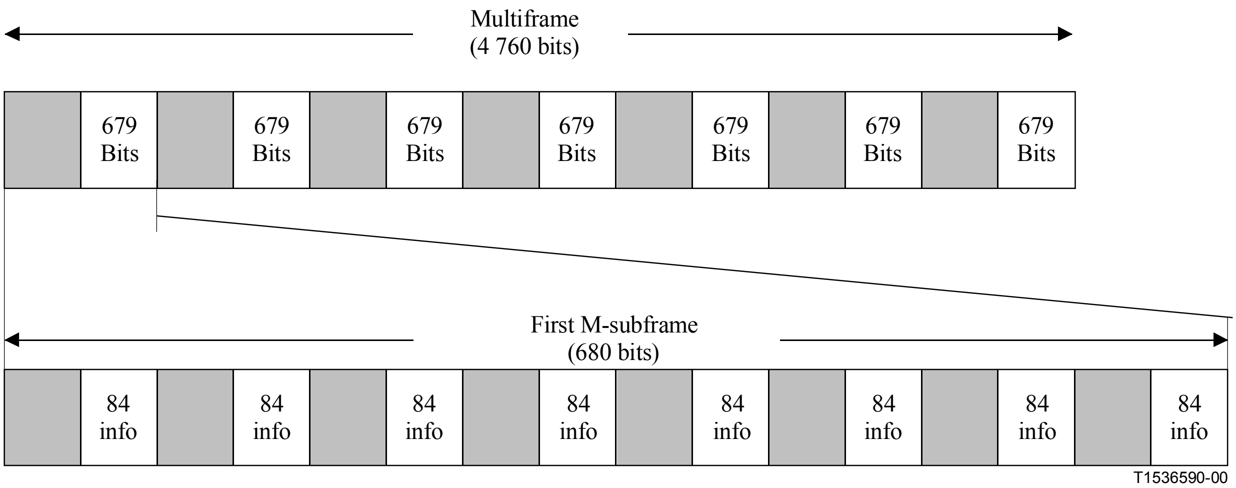


Figure 14-3/G.705 – P32e_AI_D signal

14.1 P32e path layer connection function (P32e_C)

P32e_C is the function which assigns P32e signals at its input ports to the P32e signal at its output port. The P32e_C connection process is a unidirectional function as shown in Figure 14-1.

An idle signal (P32ei) shall be applied at the outgoing P32 if it is not connected to an incoming P32.

Processes

Figure 14-1 presents a set of the atomic functions that can be connected to this P32e_C function: P32e trail termination functions or a P32e non-intrusive monitor trail termination sink function.

Idle signal generation

The function shall generate an idle signal (P32ei), as specified in 2.5.3.6.2/G.704.

14.2 P32e trail termination functions P32e_TT and P32em_TT

14.2.1 P32e trail termination source P32e_TT_So

Symbol

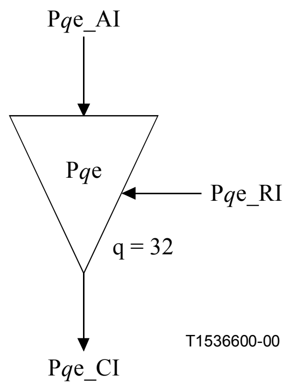


Figure 14-4/G.705 – P*q*e_TT_So symbol

Interfaces

Table 14-1/G.705 – P*q*e_TT_So input and output signals

Input(s)	Output(s)
Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_RI_RDI Pqe_RI_REI	Pqe_CI_D Pqe_CI_CK Pqe_CI_FS

Processes

This function adds the X1, X2, P and C (for a signal as specified in ITU-T G.704) information bits (Figure 14-3) and the frame alignment signal (F and M bits) into the frame overhead. The frame overhead is specified in ITU-T G.704 and G.752.

Frame Alignment Signal (FAS): The function shall insert the 44 736 kbit/s frame alignment signal as specified in ITU-T G.704 or ITU-T G.752 into the frame overhead.

NOTE – The signal specified by ITU-T G.752 is included for interworking with older G.752 equipment. It should only be supported when interworking with older G.752 equipment as it does not support far-end maintenance.

RDI (X1 and X2): These bits represent the defect status of the associated P*q*e_TT_Sk. Both X-bits set to "0" indicates a far-end SEF/AIS state, while both set to "1" indicates the normal, working state.

P-bits: Parity is calculated over the 4704 information bits following the first X bit (X1) in an M-frame. If the digital sum of all information bits is one (1), then P1=P2=1. If the digital sum of all information bits is zero (0), then P1=P2=0.

Far-end Alarm Channel: The third C-bit in M-subframe 1 provides a Far-end Alarm and Control (FEAC) signal as specified in ITU-T G.704. The Far-end Alarm channel represents the failure status of the associated P*q*e_TT_Sk. Specific code words for alarm and control messages as specified in 2.5.3.5.1/G.704 should be supported. The following alarm reports shall be supported: equipment failure (DS3 service affecting), LOS failure, LOF failure, AIS received. When no code words are being sent, the FEAC bits shall be set to "1".

C-bit Parity Application Identification: The first C-bit in M-subframe 1 shall be set to 1 to identify the format as C-bit Parity.

C-bit Parity bits: The three C-bits in M-subframe 3 (CP-bits) shall be set to the same value as the two P-bits.

REI: The three C-bits in M-subframe 4 shall be set to any combination of 1s and 0s except "111" to indicate the occurrence of a framing error or CP-bit parity error. The three bits are set to "111" to indicate that no M-bit or F-bit or CP-bit parity error event occurred.

Defects: None.

Consequent Actions: None.

Defect Correlation: None.

Performance Monitoring: None.

14.2.2 P32e trail termination sink P32e_TT_Sk

Symbol

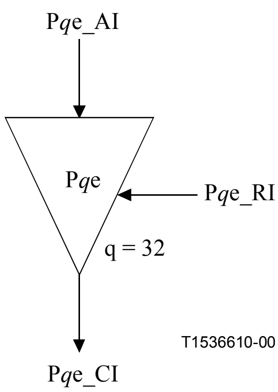


Figure 14-5/G.705 – P*q*e_TT_Sk symbol

Interfaces

Table 14-2/G.705 – P*q*e_TT_Sk input and output signals

Input(s)	Output(s)
Pqe_CI_D Pqe_CI_CK Pqe_CI_FS Pqe_CI_SSF Pqe_TT_Sk_MI_TPmode Pqe_TT_Sk_MI_SSF_Reported Pqe_TT_Sk_MI_RDI_Reported Pqe_TT_Sk_MI_1second	Pqe_AI_D Pqe_AI_CK Pqe_AI_FS Pqe_AI_TSF Pqe_RI_RDI Pqe_TT_Sk_MI_cRDI Pqe_TT_Sk_MI_cSSF Pqe_TT_Sk_MI_pN_DS Pqe_TT_Sk_MI_pP-P_N_EBC Pqe_TT_Sk_MI_pCP-P_N_EBC Pqe_TT_Sk_MI_pF_EBC Pqe_TT_Sk_MI_pF_DS Pqe_TT_Sk_MI_AIC Pqe_TT_Sk_MI_Idle Pqe_TT_Sk_MI_fRAI

Processes

This function recovers the P Parity bits (P-P), C-bit Parity bits (CP-P), RDI bits (X1 and X2), REI bits (three C-bits in M-subframe 4), C-bit Parity Application Identification Channel (AIC), and Far-end Alarm and Control Channel (FEAC) as specified in 2.5.3.1/G.704 and shown in Figure 14-2.

P-bits: The P-bits of each received frame are compared to their expected value i.e. the calculated value of the received preceding frame. A difference is taken as evidence of one or more errors (P-P_nN_B) in the block. P-bits applicable for either the C-bit Parity signal or a G.752 signal.

NOTE 1 – The P-bits do not necessarily provide end-to-end performance information if PDH transport is used as some national PDH facility equipment may modify the P-bits at each section of the facility.

CP-bit: If a majority vote of the CP-bits contained in the following M-frame does not agree with the calculated parity of the current M-frame, a block error is declared (CP-P_nN_B). CP-bits only applicable for the C-bit Parity application.

RDI: The information carried in the RDI bits (X1, X2) shall be extracted to enable single ended maintenance of a bidirectional Trail (Path). The RDI provides information as to the status of the remote receiver. Both set to "0" indicates an RDI state, while a "1" indicates the normal, working state.

REI: The information carried in the REI bits shall be extracted to enable single ended performance of a bidirectional Trail (Path). The REI provides information as to the status of the remote receiver. REI bits are only applicable for the C-bit Parity application. An occurrence of a "not all 1's" pattern in the three REI bits results in a far-end block error (CP-P_F_B) declared.

AIC: The Application Identification Channel (AIC) as specified in 2.5.3.5.1/G.704 provides an indication of the application (C-bit Parity or G.752). A network element shall identify the application; the process should not exceed 10 seconds in duration. If implemented, the application identification shall be retrievable (P32_TT_Sk_MI_AIC).

Idle: The idle signal is specified in 2.5.3.6.2/G.704. A network element should identify the idle signal condition, and the processing should not exceed 10 seconds in duration. If implemented, the idle signal shall be retrievable (P32_TT_Sk_MI_Idle).

Far-end Alarm Channel: For the C-Bit Parity application, the following code words as specified in 2.5.3.5.1/G.704 shall be detected: equipment failure (DS3 service affecting), LOS failure, LOF failure, AIS failure. A Remote Alarm Indication (RAI) failure shall be declared as soon as the presence of any one is detected. A RAI failure shall be cleared as soon as the absence of all of the failures is detected.

Defects

The function shall detect an RDI defect (dRDI) according the specification in ITU-T G.775.

Far-end Failure

The function shall detect a RAI failure (fRAI).

Consequent actions

aTSF ← CI_SSF

aRDI ← CI_SSF

Defect correlation

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance monitoring

The performance monitoring process shall be performed according to 6.5/G.806.

NOTE 2 – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

pP-P_N_EBC	←	Σ P-P_nN_B
pCP-P_N_EBC	←	Σ CP-P_nN_B
pN_DS	←	aTSF or dEQ
pF_EBC	←	Σ nF_B
pF_DS	←	dRDI

14.2.3 P32e trail non-intrusive monitoring function P32em_TT_Sk

Symbol

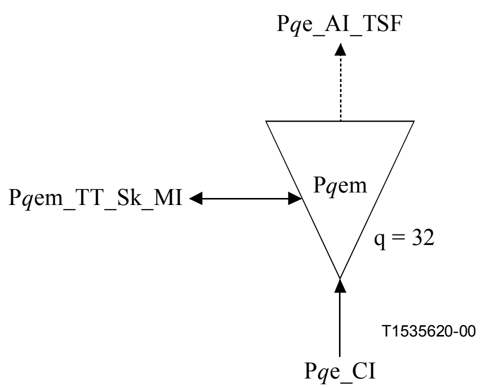


Figure 14-6/G.705 – P*q*em_TT_Sk symbol

Interfaces

Table 14-3/G.705 – P*q*em_TT_Sk input and output signals

Input(s)	Output(s)
Pqe_CI_D Pqe_CI_CK Pqe_CI_FS Pqe_CI_SSF Pqem_TT_Sk_MI_TPmode Pqem_TT_Sk_MI_SSF_Reported Pqem_TT_Sk_MI_RDI_Reported Pqem_TT_Sk_MI_1second	Pqe_AI_TSF Pqem_TT_Sk_MI_cRDI Pqem_TT_Sk_MI_cSSF Pqem_TT_Sk_MI_pN_DS Pqem_TT_Sk_MI_pP-P_N_EBC Pqem_TT_Sk_MI_CP-P_N_EBC Pqem_TT_Sk_MI_pF_EBC Pqem_TT_Sk_MI_pF_DS Pqe_TT_Sk_MI_AIC Pqe_TT_Sk_MI_Idle Pqe_TT_Sk_MI_fRAI

Processes

This function recovers the P Parity bits (P-P), C-bit Parity bits (CP-P), RDI bits (X1 and X2), REI bits (three C-bits in M-subframe 4), C-bit Parity Application Identification Channel (AIC), and Far-end Alarm and Control Channel (FEAC) as specified in 2.5.3.1/G.704 and shown in Figure 14-2.

P-bits: The P-bits of each received frame are compared to their expected value i.e. the calculated value of the received preceding frame. A difference is taken as evidence of one or more errors (P-P_nN_B) in the block. P-bits applicable for either the C-bit Parity signal or a G.752 signal.

NOTE 1 – The P-bits do not necessarily provide end-to-end performance information if PDH transport is used as some national PDH facility equipment may modify the P-bits at each section of the facility.

CP-bit: If a majority vote of the CP-bits contained in the following M-frame does not agree with the calculated parity of the current M-frame, a block error is declared (CP-P_nN_B). CP-bits only applicable for the C-bit Parity application.

RDI: The information carried in the RDI bits (X1, X2) shall be extracted to enable single ended maintenance of a bidirectional Trail (Path). The RDI provides information as to the status of the remote receiver. Both set to "0" indicates an RDI state, while a "1" indicates the normal, working state.

REI: The information carried in the REI bits shall be extracted to enable single ended performance of a bidirectional Trail (Path). The REI provides information as to the status of the remote receiver. REI bits are only applicable for the C-bit Parity application. An occurrence of a "not all 1's" pattern in the three REI bits results in a far-end block error (CP-P_F_B) declared.

AIC: The Application Identification Channel (AIC) as specified in 2.5.3.5.1/G.704 provides an indication of the application (C-bit Parity or G.752). A network element shall identify the application; the process should not exceed 10 seconds in duration. If implemented, the application identification shall be retrievable (P32_TT_Sk_MI_AIC).

Idle: The idle signal is specified in 2.5.3.6.2/G.704. A network element should identify the idle signal condition, and the processing should not exceed 10 seconds in duration. If implemented, the idle signal shall be retrievable (P32_TT_Sk_MI_Idle).

Far-end Alarm Channel: For the C-Bit Parity application, the following code words as specified in 2.5.3.5.1/G.704 shall be detected: equipment failure (DS3 service affecting), LOS failure, LOF failure, AIS failure. A Remote Alarm Indication (RAI) failure shall be declared as soon as the presence of any one is detected. A RAI failure shall be cleared as soon as the absence of all of the failures is detected.

Defects

The function shall detect an RDI defect (dRDI) according the specification in ITU-T G.775.

Far-end Failure

The function shall detect a RAI failure (fRAI).

Consequent actions

aTSF ← CI_SSF

aRDI ← CI_SSF

Defect correlation

cRDI ← dRDI and MON and RDI_Reported

cSSF ← CI_SSF and MON and SSF_Reported

Performance monitoring

The performance monitoring process shall be performed according to 6.5/G.806.

NOTE 2 – Whether or not performance monitoring is actually supported by a network element is determined by the presence of the element management performance monitoring functions.

pP-P_N_EBC	←	Σ P-P_nN_B
pCP-P_N_EBC	←	Σ CP-P_nN_B
pN_DS	←	aTSF or dEQ
pF_EBC	←	Σ nF_B
pF_DS	←	dRDI

14.2.4 P32e path layer adaptation functions

For further study.

15 P21e Path Layer Functions

For further study.

16 P11s path layer functions

For further study.

17 P0 path layer functions

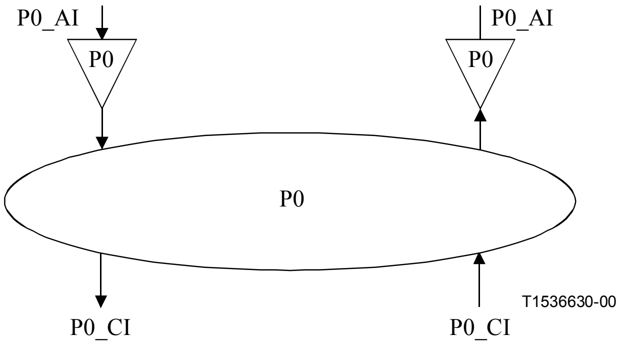


Figure 17-1/G.705 – P0 Atomic Functions

P0 layer CP

The CI at this point is a synchronous 64 kbit/s byte structured signal with co-directional bit timing and the frame start information FS. The CI is structured as 8 bit numbered 1 to 8. Figure 17-2 below depicts the structure.

1	2	3	4	5	6	7	8

Figure 17-2/G.705 – Structure of the P0_CI_D signal

P0 layer AP

The signal transported by a P0 will be determined by the client layer application. Typical signals include:

– an ITU-T G.711 A-law coded speech

– an ITU-T G.711 µ-law coded speech

– a 64 kbit/s data channel

– a 56 kbit/s data channel

NOTE 1 – Many more compositions exist which are not addressed in this version of this Recommendation.

Figure 17-3 shows that more than one adaptation function exists in this P0 layer that can be connected to one P0 access point. For the case of the adaptation source functions, only one of these adaptation source functions is allowed to be activated. For this activated source, access to the access point by other adaptation source functions must be denied. In contradiction with the source direction, adaptation sink functions may be activated all together. This may cause faults to be detected and reported. To prevent this an adaptation sink function can be deactivated.

NOTE 2 – If one adaptation function only is connected to the AP, it will be activated. If one or more other functions are connected to the same AP, one out of the set of functions will be active

1	2	3	4	5	6	7	8

Figure 17-3/G.705 – Structure of the P0_AI_D signal

17.1 P0 connection functions

17.1.1 P0 Trail Connection Function (P0_C)

P0_C is the function which assigns P0 at its input ports P0 at its output ports.

The P0_C connection process is an unidirectional function as illustrated in Figure 17-4. The signal formats at the input and output ports of the function are similar, differing only in the coding of the P0. As the process does not affect the nature of the characteristic information of the signal, the reference point on either side of the P0_C function is the same, as illustrated in Figure 17-4. The P0_C function is not timing transparent.

Incoming P0 at the P0_CP are assigned to available outgoing P0 capacity at the P0_CP.

An idle A-law or μ-law code shall be applied at any outgoing P0 which is not connected to an incoming P0_CP.

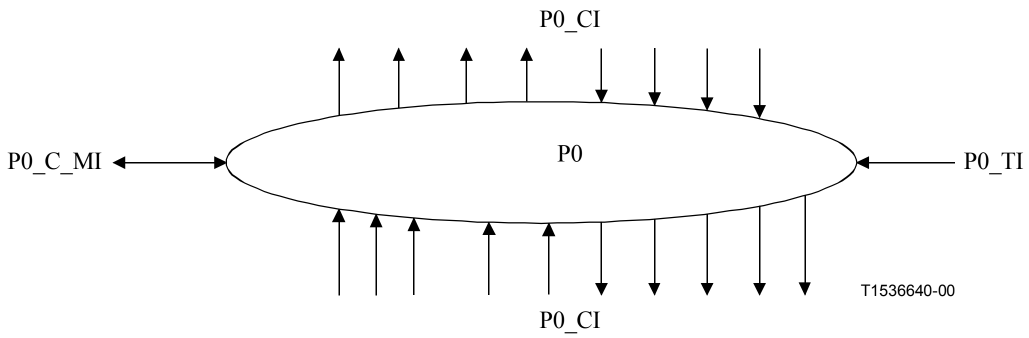


Figure 17-4/G.705 – P0_C symbol

Interfaces

Table 17-1/G.705 – P0_C input and output signals

Input(s)	Output(s)
Per P0_CP, *n* × for the function: P0_CI_Data P0_CI_Clock P0_CI_FrameStart P0_CI_SSF 1 *x* per function: T0_TI_Clock T0_TI_FrameStart Per input and output connection point: P0_C_MI_ConnectionPortIds Per matrix connection: P0_C_MI_ConnectionType P0_C_MI_Directionality	Per P0_CP, *m* × per function: P0_CI_Data P0_CI_Clock P0_CI_FrameStart P0_CI_SSF

Processes

In the P0_C function P0 Layer Characteristic Information is routed between input (termination) connection points [(T)CPs] and output (T)CPs by means of matrix connections. (T)CPs may be allocated within a protection group.

NOTE 1 – Neither the number of input/output signals to the connection function, nor the connectivity is specified in this Recommendation. That is a property of individual network elements.

Figure 17-1 presents a subset of the atomic functions that can be connected to this P0 connection function: P0 trail termination functions and adaptation functions. In addition, adaptation functions in the P0 server (e.g P12s or P11s) layers will be connected to this P0 connection function.

Routing: The function shall be able to connect a specific input with a specific output by means of establishing a matrix connection between the specified input and output. It shall be able to remove an established matrix connection.

Each (matrix) connection in the P0_C function shall be characterized by the:

Traffic direction	unidirectional, bidirectional
Input and output connection points	set of connection point identifiers

NOTE 2 – Broadcast connections are handled as separate connections to the same input CP.

The addition and removal of connections to/from a broadcast shall be possible without disturbing the CI passing the connection:

Idle pattern generation: The function shall generate an idle A-law or μ-law coded P0 signal, as specified in 2.12/Q.522.

Defects: None.

Consequent Actions

If an output of this function is not connected to one of its inputs, the function shall connect the idle P0 (with valid frame start (FS) and SSF = false) to the output.

Defect Correlations: None.

Performance Monitoring: None.

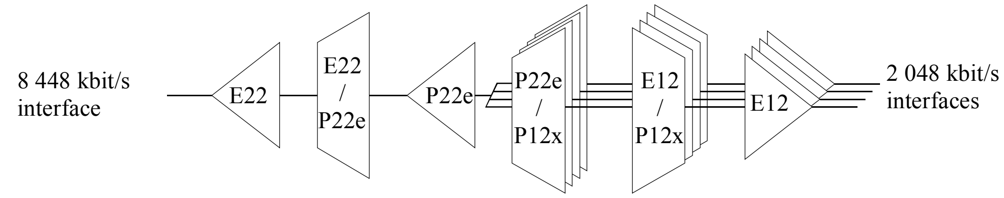
17.2 P0 trail termination functions

For further study.

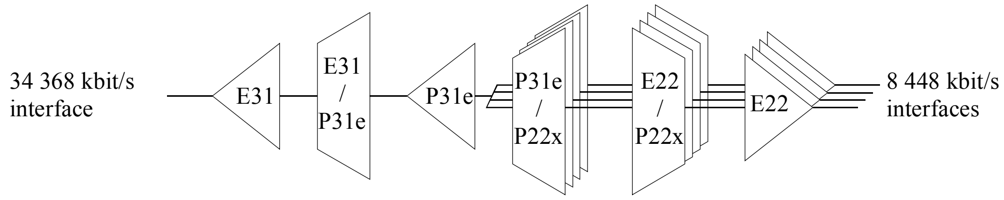
APPENDIX I

Example of representations of PDH multiplexer equipment

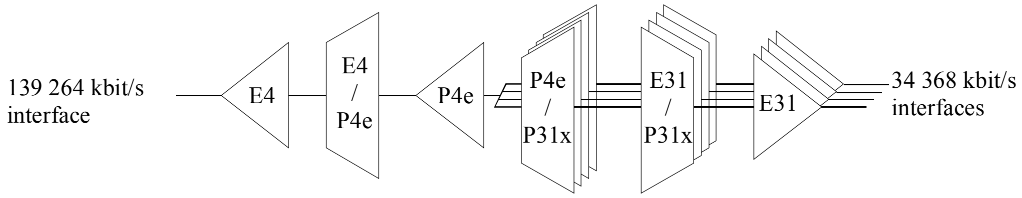
This appendix provides for information the equivalent representations with atomic functions described in this Recommendation of PDH multiplexer equipment defined in ITU-T G.742 [18] and G.751 [19] (see Figure I.1).



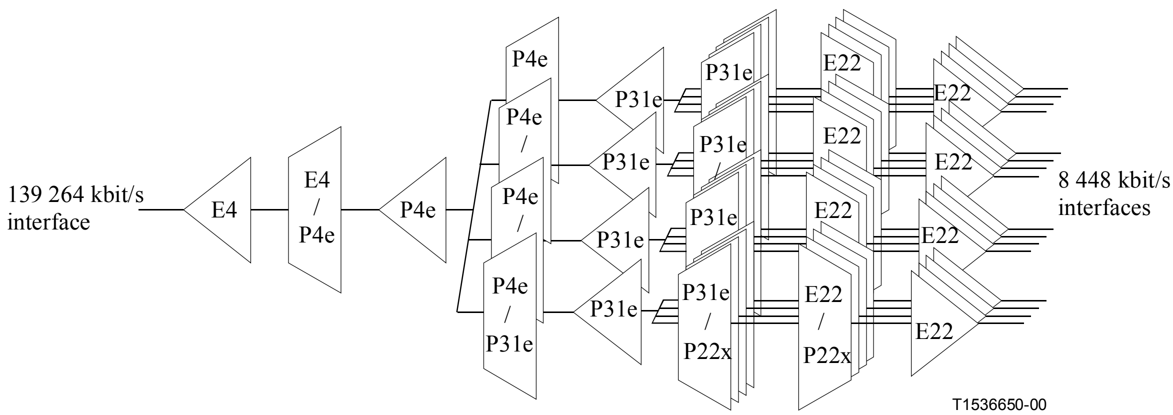
a) Multiplexer equipment operating at the second order bit rate (multiplexing of 4 × 2 048 kbit/s signals into one 8 448 kbit/s signal)



b) Multiplexer equipment operating at the third order bit rate (multiplexing of 4 × 8 448 kbit/s signals into one 34 368 kbit/s signal)



c) Multiplexer equipment operating at the fourth order bit rate (method 1: multiplexing of 4 × 34 368 kbit/s signals into one 139 264 kbit/s signal)



d) Multiplexer equipment operating at the fourth order bit rate (method 2: multiplexing of 16 × 8 448 kbit/s signals into one 139 264 kbit/s signal)

Figure I.1/G.705 – Representation of G.742 and G.751 PDH multiplexer equipment with atomic functions

Compared to the description given in ITU-T G.742 and G.751, the resulting differences are listed below:

- Requirements defined in ITU-T G.742/G.751 and not supported in ITU-T G.705:
  - Loss of power supply and its consequent actions.
  - Timing signal: the following additional note is present in ITU-T G.742/G.751: "if economically feasible, it may be desirable to be able to derive the multiplexer timing signal from an external source as well as an internal source".
  - Bits for national use: set to 1 on a digital path crossing the border (refer to bit 12 of 8 Mbit/s frame in clause 9/G.742, bit 12 of 34 Mbit/s frame in clause 9/G.751, bits 14 to 16 of 140 Mbit/s frame in 1.5.5/G.751).
  - Tributary Loss (multiplexer input): the following additional note is present in ITU-T G.742/G.751: "where separate circuits are used for the digital and the timing signal then loss of either or both should constitute loss of the incoming signal".
- Requirements defined in ITU-T G.705 and not supported in ITU-T G.742/G.751:
  - Support of MI_PortMode/MI_TPMode by trail termination sink functions.
  - Defect detection criteria: in both ITU-T G.742 and G.751, no dAIS, dLOS and dRDI defect detection and clearance criteria is defined. These criteria were defined later in ITU-T G.775. ITU-T G.705 refers to ITU-T G.775 for these defect detection criteria.
  - Support of MI_AIS_Reported by Eq/P*q*e_A_Sk & P*q*e/Pye_A_Sk functions.
  - Support of MI_RDI_Reported by P*q*e_TT_Sk functions.
  - Support of MI_Active by adaptation functions.
  - Report of cSSF by P*q*e_TT_Sk to the management function.
  - Support of MI_SSF_Reported by P*q*e_TT_Sk functions.
  - Report of the performance parameters pN_DS, pN_EBC & MI_pF_DS by P*q*e_TT_Sk (performance monitoring is described in a separate ITU-T M.2100).
  - Defect correlation process.
- Differences between the requirements of ITU-T G.705 and requirements of ITU-T G.742/G.751:
  - Time requirements: see Table I.1.
  - LOS detection at the demultiplexer input: The following additional note is present in ITU-T G.742/G.751: "the detection of this fault condition is required only when it does not result in an indication of loss of frame alignment". In ITU-T G.705, the defect correlation process is different: if LOS is detected then LOF is not reported to the management function (refer to Eq/P*q*e_A_Sk functions).

Table I.1/G.705 – Time requirements for consequent actions

Mux type (refer to Figure I.1)	Consequent actions	G.742/G.751 (see Notes 1 and 2)	G.705 (see Notes 2 and 3)
Mux a (4 × 2 M->8M)	AIS insertion on failure of power supply	1 ms	Not covered
	AIS insertion on LOS for 2 Mbit/s signal	1 ms	250 µs (E12/P12x_A_Sk)
	AIS insertion on LOS for 8 Mbit/s signal	1 ms	600 µs (E22/P22e_A_Sk)
	AIS insertion on LOF for 8 Mbit/s signal	1 ms	600 µs (E22/P22e_A_Sk)
	RDI insertion on LOS for 8 Mbit/s signal	1 ms	No value (P22e_TT_Sk)
	RDI insertion on LOF for 8 Mbit/s signal	1 ms	No value (P22e_TT_Sk)
Mux b (4 × 8M->34M)	AIS insertion on failure of power supply	1 ms	Not covered
	AIS insertion on LOS for 8 Mbit/s signal	1 ms	250 µs (E22/P22x_A_Sk)
	AIS insertion on LOS for 34 Mbit/s signal	1 ms	800 µs (E31/P31e_A_Sk)
	AIS insertion on LOF for 34 Mbit/s signal	1 ms	800 µs (E31/P31e_A_Sk)
	RDI insertion on LOS for 34 Mbit/s signal	1 ms	No value (P31e_TT_Sk)
	RDI insertion on LOF for 34 Mbit/s signal	1 ms	No value (P31e_TT_Sk)
Mux c (4 × 34M->140M)	AIS insertion on failure of power supply	1 ms	Not covered
	AIS insertion on LOS for 34 Mbit/s signal	1 ms	250 µs (E31/P31x_A_Sk)
	AIS insertion on LOS for 140 Mbit/s signal	1 ms	900 µs (E4/P4e_A_Sk)
	AIS insertion on LOF for 140 Mbit/s signal	1 ms	900 µs (E4/P4e_A_Sk)
	RDI insertion on LOS for 140 Mbit/s signal	1 ms	No value (P4e_TT_Sk)
	RDI insertion on LOF for 140 Mbit/s signal	1 ms	No value (P4e_TT_Sk)

Table I.1/G.705 – Time requirements for consequent actions

Mux type (refer to Figure I.1)	Consequent actions	G.742/G.751 (see Notes 1 and 2)	G.705 (see Notes 2 and 3)
Mux d (16 × 8M->140M)	AIS insertion on failure of power supply	1 ms	Not covered
	AIS insertion on LOS for 8 Mbit/s signal	1 ms	250 µs (E22/P22x_A_Sk)
	AIS insertion on LOS for 140 Mbit/s signal	1 ms	900 µs (E4/P4e_A_Sk)
	AIS insertion on LOF for 140 Mbit/s signal	1 ms	900 µs (E4/P4e_A_Sk)
	AIS insertion on LOF for 34 Mbit/s signal	1 ms	900 µs (P4e/P31e_A_sk)
	RDI insertion on LOS for 140 Mbit/s signal	1 ms	No value (P4e_TT_Sk)
	RDI insertion on LOF for 140 Mbit/s signal	1 ms	No value (P4e_TT_Sk)
	RDI insertion on LOF for 34 Mbit/s signal	1 ms	No value (P31e_TT_Sk)

NOTE 1 – The reaction time in ITU-T G.742/G.751 includes defect detection time.

NOTE 2 – The reaction times in ITU-T G.742/G.751 are specified at the physical interface (composite or tributary). In this Recommendation, the reaction times are specified at the outputs of the atomic functions.

NOTE 3 – Contrary to ITU-T G.742/G.751, the reaction time in ITU-T G.705 does not include defect detection time. The different time requirements (in ITU-T G.742/G.751 on the one hand and ITU-T G.705 on the other hand) can be considered globally equivalent.

APPENDIX II

Relationship between TU-3/2/12/11 address, and location of columns within a P4s TUG-3 structured payload

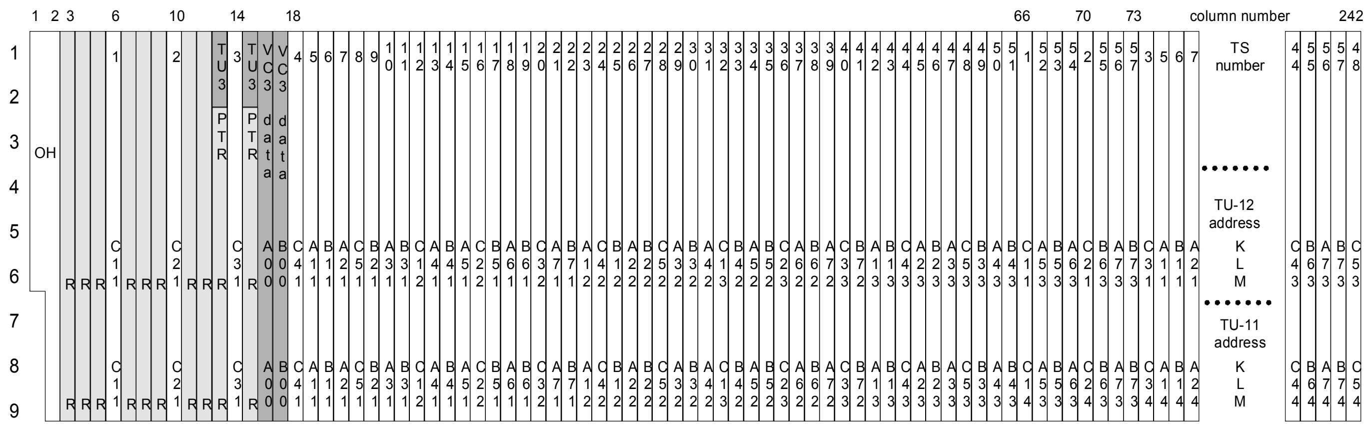


Figure II.1/G.705 – P4s TUG-3 payload (TUGs and fixed stuff "R" bytes)

Table II.1/G.705 – Relationship between TU-3 address and location of columns within a P4s TUG-3 structured payload

TU-3 address			Location of columns in a P4s TUG3 occupied by TU-3 (K, L, M)											
K	L	M												
A	0	0	13	16	19	21	24	27	29	32	35	37	40	43
			45	48	51	53	56	59	61	64	67	69	72	75
			77	80	83	85	88	91	93	96	99	101	104	107
			109	112	115	117	120	123	125	128	131	133	136	139
			141	144	147	149	152	155	157	160	163	165	168	171
			173	176	179	181	184	187	189	192	195	197	200	203
			205	208	211	213	216	219	221	224	227	229	232	235
			237	240										
B	0	0	15	17	20	23	25	28	31	33	36	39	41	44
			47	49	52	55	57	60	63	65	68	71	73	76
			79	81	84	87	89	92	95	97	100	103	105	108
			111	113	116	119	121	124	127	129	132	135	137	140
			143	145	148	151	153	156	159	161	164	167	169	172
			175	177	180	183	185	188	191	193	196	199	201	204
			207	209	212	215	217	220	223	225	228	231	233	236
			239	241										

Table II.2/G.705 – Relationship between TU-2 address and location of columns within a P4s TUG-3 structured payload

TU-2 address			Location of columns in a P4s TUG3 occupied by TU-2 (K, L, M)											
K	L	M	1	2	3	4	5	6	7	8	9	10	11	12
A	1	0	19	37	56	75	93	112	131	149	168	187	205	224
A	2	0	21	40	59	77	96	115	133	152	171	189	208	227
A	3	0	24	43	61	80	99	117	136	155	173	192	211	229
A	4	0	27	45	64	83	101	120	139	157	176	195	213	232
A	5	0	29	48	67	85	104	123	141	160	179	197	216	235
A	6	0	32	51	69	88	107	125	144	163	181	200	219	237
A	7	0	35	53	72	91	109	128	147	165	184	203	221	240
B	1	0	20	39	57	76	95	113	132	151	169	188	207	225
B	2	0	23	41	60	79	97	116	135	153	172	191	210	228
B	3	0	25	44	63	81	100	119	137	156	175	193	212	231
B	4	0	28	47	65	84	103	121	140	159	177	196	215	233
B	5	0	31	49	68	87	105	124	143	161	180	199	218	236
B	6	0	33	52	71	89	108	127	145	164	183	201	220	239
B	7	0	36	55	73	92	111	129	148	167	185	204	223	241
C	1	0	6	26	46	66	86	106	126	146	166	186	206	226
C	2	0	10	30	50	70	90	110	130	150	170	190	210	230
C	3	0	14	34	54	74	94	114	134	154	174	194	214	234
C	4	0	18	38	58	78	98	118	138	158	178	198	218	238
C	5	0	22	42	62	82	102	122	142	162	182	202	222	242

Table II.3/G.705 – Relationship between TU-12 address and location of columns within a P4s TUG-3 structured payload

TU-12 address			Location of columns in a P4s TUG3 occupied by TU-12 (K, L, M)			
K	L	M	1st column	2nd column	3rd column	4th column
A	1	1	19	75	131	187
A	1	2	37	93	149	205
A	1	3	56	112	168	224
A	2	1	21	77	133	189
A	2	2	40	96	152	208
A	2	3	59	115	171	227
A	3	1	24	80	136	192
A	3	2	43	99	155	211
A	3	3	61	117	173	229
A	4	1	27	83	139	195

Table II.3/G.705 – Relationship between TU-12 address and location of columns within a P4s TUG-3 structured payload

TU-12 address			Location of columns in a P4s TUG3 occupied by TU-12 (K, L, M)			
K	L	M	1st column	2nd column	3rd column	4th column
A	4	2	45	101	157	213
A	4	3	64	120	176	232
A	5	1	29	85	141	197
A	5	2	48	104	160	216
A	5	3	67	123	179	235
A	6	1	32	88	144	200
A	6	2	51	107	163	219
A	6	3	69	125	181	237
A	7	1	35	91	147	203
A	7	2	53	109	165	221
A	7	3	72	128	184	240
B	1	1	20	76	132	188
B	1	2	39	95	151	207
B	1	3	57	113	169	225
B	2	1	23	79	135	191
B	2	2	41	97	153	210
B	2	3	60	116	172	228
B	3	1	25	81	137	193
B	3	2	44	100	156	212
B	3	3	63	119	175	231
B	4	1	28	84	140	196
B	4	2	47	103	159	215
B	4	3	65	121	177	233
B	5	1	31	87	143	199
B	5	2	49	105	161	218
B	5	3	68	124	180	236
B	6	1	33	89	145	201
B	6	2	52	108	164	220
B	6	3	71	127	183	239
B	7	1	36	92	148	204
B	7	2	55	111	167	223
B	7	3	73	129	185	241
C	1	1	6	66	126	186
C	1	2	26	86	146	206
C	1	3	46	106	166	226

Table II.3/G.705 – Relationship between TU-12 address and location of columns within a P4s TUG-3 structured payload

TU-12 address			Location of columns in a P4s TUG3 occupied by TU-12 (K, L, M)			
K	L	M	1st column	2nd column	3rd column	4th column
C	2	1	10	70	130	190
C	2	2	30	90	150	210
C	2	3	50	110	170	230
C	3	1	14	74	134	194
C	3	2	34	94	154	214
C	3	3	54	114	174	234
C	4	1	18	78	138	198
C	4	2	38	98	158	218
C	4	3	58	118	178	238
C	5	1	22	82	142	202
C	5	2	42	102	162	222
C	5	3	62	122	182	242

Table II.4/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-3 structured payload

TU-11 address			Location of columns in a P4s TUG3 occupied by TU-11 (K, L, M)		
K	L	M	1st column	2nd column	3rd column
A	1	1	19	93	168
A	1	2	37	112	187
A	1	3	56	131	205
A	1	4	75	149	224
A	2	1	21	96	171
A	2	2	40	115	189
A	2	3	59	133	208
A	2	4	77	152	227
A	3	1	24	99	173
A	3	2	43	117	192
A	3	3	61	136	211
A	3	4	80	155	229
A	4	1	27	101	176
A	4	2	45	120	195

Table II.4/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-3 structured payload

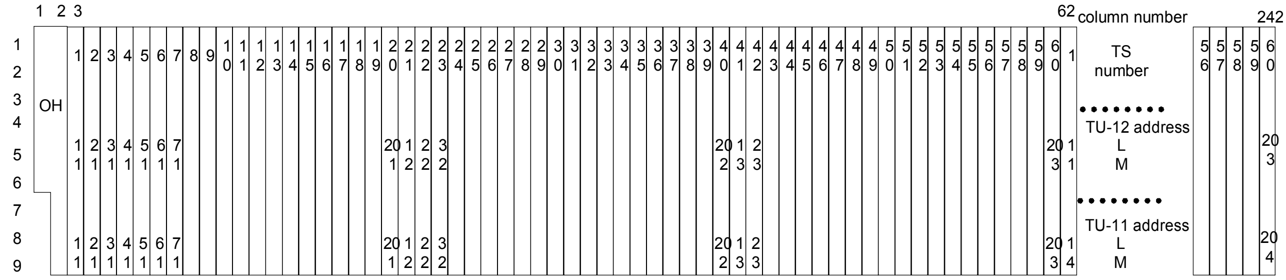
TU-11 address			Location of columns in a P4s TUG3 occupied by TU-11 (K, L, M)		
K	L	M	1st column	2nd column	3rd column
A	4	3	64	139	213
A	4	4	83	157	232
A	5	1	29	104	179
A	5	2	48	123	197
A	5	3	67	141	216
A	5	4	85	160	235
A	6	1	32	107	181
A	6	2	51	125	200
A	6	3	69	144	219
A	6	4	88	163	237
A	7	1	35	109	184
A	7	2	53	128	203
A	7	3	72	147	221
A	7	4	91	165	240
B	1	1	20	95	169
B	1	2	39	113	188
B	1	3	57	132	207
B	1	4	76	151	225
B	2	1	23	97	172
B	2	2	41	116	191
B	2	3	60	135	210
B	2	4	79	153	228
B	3	1	25	100	175
B	3	2	44	119	193
B	3	3	63	137	212
B	3	4	81	156	231
B	4	1	28	103	177
B	4	2	47	121	196
B	4	3	65	140	215
B	4	4	84	159	233
B	5	1	31	105	180
B	5	2	49	124	199
B	5	3	68	143	218
B	5	4	87	161	236

Table II.4/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-3 structured payload

TU-11 address			Location of columns in a P4s TUG3 occupied by TU-11 (K, L, M)		
K	L	M	1st column	2nd column	3rd column
B	6	1	33	108	183
B	6	2	52	127	201
B	6	3	71	145	220
B	6	4	89	164	239
B	7	1	36	111	185
B	7	2	55	129	204
B	7	3	73	148	223
B	7	4	92	167	241
C	1	1	6	86	166
C	1	2	26	106	186
C	1	3	46	126	206
C	1	4	66	146	226
C	2	1	10	90	170
C	2	2	30	110	190
C	2	3	50	130	210
C	2	4	70	150	230
C	3	1	14	94	174
C	3	2	34	114	194
C	3	3	54	134	214
C	3	4	74	154	234
C	4	1	18	98	178
C	4	2	38	118	198
C	4	3	58	138	218
C	4	4	78	158	238
C	5	1	22	102	182
C	5	2	42	122	202
C	5	3	62	142	222
C	5	4	82	162	242

APPENDIX III

Relationship between TU-2/12/11 address, and location of columns within a P4s TUG-2 structured payload



NOTE – The columns containing a given TU-12 (respectively TU-11) are located every 60th column (respectively 80th column).

Figure III.1/G.705 – P4s TUG-2 payload (20 x TUG2)

Table III.1/G.705 – Relationship between TU-2 address and location of columns within a P4s TUG-2 structured payload

TU-2 address		**Location of columns in a P4s TUG2 occupied by TU-2 (K, L, M)**											
L	M	1	2	3	4	5	6	7	8	9	10	11	12
1	0	3	23	43	63	83	103	123	143	163	183	203	223
2	0	4	24	44	64	84	104	124	144	164	184	204	224
3	0	5	25	45	65	85	105	125	145	165	185	205	225
4	0	6	26	46	66	86	106	126	146	166	186	206	226
5	0	7	27	47	67	87	107	127	147	167	187	207	227
6	0	8	28	48	68	88	108	128	148	168	188	208	228
7	0	9	29	49	69	89	109	129	149	169	189	209	229
8	0	10	30	50	70	90	110	130	150	170	190	210	230
9	0	11	31	51	71	91	111	131	151	171	191	211	231
10	0	12	32	52	72	92	112	132	152	172	192	212	232
11	0	13	33	53	73	93	113	133	153	173	193	213	233
12	0	14	34	54	74	94	114	134	154	174	194	214	234
13	0	15	35	55	75	95	115	135	155	175	195	215	235
14	0	16	36	56	76	96	116	136	156	176	196	216	236
15	0	17	37	57	77	97	117	137	157	177	197	217	237
16	0	18	38	58	78	98	118	138	158	178	198	218	238
17	0	19	39	59	79	99	119	139	159	179	199	219	239
18	0	20	40	60	80	100	120	140	160	180	200	220	240
19	0	21	41	61	81	101	121	141	161	181	201	221	241
20	0	22	42	62	82	102	122	142	162	182	202	222	242

Table III.2/G.705 – Relationship between TU-12 address and location of columns within a P4s TUG-2 structured payload

TU-12 address		Location of columns in a P4s TUG2 occupied by TU-12 (L, M)			
L	M	1st column	2nd column	3rd column	4th column
1	1	3	63	123	183
1	2	23	83	143	203
1	3	43	103	163	223
2	1	4	64	124	184
2	2	24	84	144	204
2	3	44	104	164	224
3	1	5	65	125	185
3	2	25	85	145	205
3	3	45	105	165	225
4	1	6	66	126	186
4	2	26	86	146	206
4	3	46	106	166	226
5	1	7	67	127	187
5	2	27	87	147	207
5	3	47	107	167	227
6	1	8	68	128	188
6	2	28	88	148	208
6	3	48	108	168	228
7	1	9	69	129	189
7	2	29	89	149	209
7	3	49	109	169	229
8	1	10	70	130	190
8	2	30	90	150	210
8	3	50	110	170	230
9	1	11	71	131	191
9	2	31	91	151	211
9	3	51	111	171	231
10	1	12	72	132	192
10	2	32	92	152	212
10	3	52	112	172	232
11	1	13	73	133	193
11	2	33	93	153	213
11	3	53	113	173	233
12	1	14	74	134	194
12	2	34	94	154	214

Table III.2/G.705 – Relationship between TU-12 address and location of columns within a P4s TUG-2 structured payload

TU-12 address		Location of columns in a P4s TUG2 occupied by TU-12 (L, M)			
L	M	1st column	2nd column	3rd column	4th column
12	3	54	114	174	234
13	1	15	75	135	195
13	2	35	95	155	215
13	3	55	115	175	235
14	1	16	76	136	196
14	2	36	96	156	216
14	3	56	116	176	236
15	1	17	77	137	197
15	2	37	97	157	217
15	3	57	117	177	237
16	1	18	78	138	198
16	2	38	98	158	218
16	3	58	118	178	238
17	1	19	79	139	199
17	2	39	99	159	219
17	3	59	119	179	239
18	1	20	80	140	200
18	2	40	100	160	220
18	3	60	120	180	240
19	1	21	81	141	201
19	2	41	101	161	221
19	3	61	121	181	241
20	1	22	82	142	202
20	2	42	102	162	222
20	3	62	122	182	242

Table III.3/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-2 structured payload

TU-11 address		Location of columns in a P4s TUG2 occupied by TU-11 (L, M)		
L	M	1st column	2nd column	3rd column
1	1	3	83	163
1	2	23	103	183
1	3	43	123	203
1	4	63	143	223
2	1	4	84	164
2	2	24	104	184
2	3	44	124	204
2	4	64	144	224
3	1	5	85	165
3	2	25	105	185
3	3	45	125	205
3	4	65	145	225
4	1	6	86	166
4	2	26	106	186
4	3	46	126	206
4	4	66	146	226
5	1	7	87	167
5	2	27	107	187
5	3	47	127	207
5	4	67	147	227
6	1	8	88	168
6	2	28	108	188
6	3	48	128	208
6	4	68	148	228
7	1	9	89	169
7	2	29	109	189
7	3	49	129	209
7	4	69	149	229
8	1	10	90	170
8	2	30	110	190
8	3	50	130	210
8	4	70	150	230
9	1	11	91	171

Table III.3/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-2 structured payload

TU-11 address		Location of columns in a P4s TUG2 occupied by TU-11 (L, M)		
L	M	1st column	2nd column	3rd column
9	2	31	111	191
9	3	51	131	211
9	4	71	151	231
10	1	12	92	172
10	2	32	112	192
10	3	52	132	212
10	4	72	152	232
11	1	13	93	173
11	2	33	113	193
11	3	53	133	213
11	4	73	153	233
12	1	14	94	174
12	2	34	114	194
12	3	54	134	214
12	4	74	154	234
13	1	15	95	175
13	2	35	115	195
13	3	55	135	215
13	4	75	155	235
14	1	16	96	176
14	2	36	116	196
14	3	56	136	216
14	4	76	156	236
15	1	17	97	177
15	2	37	117	197
15	3	57	137	217
15	4	77	157	237
16	1	18	98	178
16	2	38	118	198
16	3	58	138	218
16	4	78	158	238
17	1	19	99	179
17	2	39	119	199

Table III.3/G.705 – Relationship between TU-11 address and location of columns within a P4s TUG-2 structured payload

TU-11 address		**Location of columns in a P4s TUG2 occupied by TU-11 (L, M)**		
L	M	1st column	2nd column	3rd column
17	3	59	139	219
17	4	79	159	239
18	1	20	100	180
18	2	40	120	200
18	3	60	140	220
18	4	80	160	240
19	1	21	101	181
19	2	41	121	201
19	3	61	141	221
19	4	81	161	241
20	1	22	102	182
20	2	42	122	202
20	3	62	142	222
20	4	82	162	242

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