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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital transmission systems – Terminal equipments –
General

Characteristics of Plesiochronous Digital Hierarchy (PDH) equipment functional blocks

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RECOMMENDATION G.705

CHARACTERISTICS OF PLESIOCHRONOUS DIGITAL HIERARCHY (PDH) EQUIPMENT FUNCTIONAL BLOCKS

(Montreal, 2000)

Summary

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

Keywords

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 G.742 and G.751.

This Recommendation uses the same specification methodology as the one used in ITU-T Recommendation 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 functions 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 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; all 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 Recommendation E.862 (1992), *Dependability planning of telecommunication networks*.
- [2] ITU-T Recommendation G.703 (1998), *Physical electrical characteristics of hierarchical digital interfaces*.
- [3] ITU-T Recommendation G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44 736 kbit/s hierarchical levels*.
- [4] ITU-T Recommendation G.706 (1991), *Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704*.
- [5] ITU-T Recommendation G.743 (1988), *Second order digital multiplex equipment operating at 6312 kbit/s and using positive justification*.
- [6] ITU-T Recommendation G.752 (1980), *Characteristics of digital multiplex equipments based on a second order bit rate of 6312 kbit/s and using positive justification*.
- [7] ITU-T Recommendation G.775 (1998), *Loss of signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) and clearance criteria*.
- [8] ITU-T Recommendation G.781 (1999), *Synchronization layer functions*.
- [9] ITU-T Recommendation G.783 (2000), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.
- [10] ITU-T Recommendation G.805 (1995), *Generic functional architecture of transport networks*.
- [11] ITU-T Recommendation G.806 (2000), *Characteristics of Transport Equipment – Description Methodology and Generic Functionality*.
- [12] ITU-T Recommendation G.810 (1996), *Definitions and terminology for synchronization networks*.
- [13] ITU-T Recommendation G.812 (1998), *Timing requirements of slave clocks suitable for use as node clocks in synchronization networks*.
- [14] ITU-T Recommendation G.823, *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy*.
- [15] ITU-T Recommendation G.824, *The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy*.
- [16] ITU-T Recommendation G.826 (1999), *Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate*.
- [17] ITU-T Recommendation M.3010 (1996), *Principles for a telecommunications management network*.
- [18] ITU-T Recommendation G.742 (1988), *Second order digital multiplex equipment operating at 8448 kbit/s and using positive justification*

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

3 Terms and Definitions

Access Point (AP) - See Recommendation G.805 [10].

Access Point Identifier (APId) - See Recommendation G.831.

Adaptation function (A) - See Recommendation G.805.

Adapted Information (AI) – See Recommendation G.806 [11].

Administrative Unit (AU) - See Recommendation G.707.

Administrative Unit Group (AUG) - See Recommendation G.707.

Alarm - See Recommendation G.806.

All-ONEs – See Recommendation G.806.

Anomaly - See Recommendation G.806.

Atomic function – See Recommendation G.806.

AUn-AIS - See Recommendation G.707.

Bidirectional trail/connection type – See Recommendation G.806.

Bit Interleaved Parity (BIP) - See Recommendation G.707.

Broadcast connection type – See Recommendation G.806.

Characteristic Information (CI) – See Recommendation G.806.

Client/server layer – See Recommendation G.806.

Connection - See Recommendation G.805.

Connection function (C) – See Recommendation G.806.

Connection Matrix (CM) – See Recommendation G.806.

Connection Point (CP) – See Recommendation G.806.

Consolidation - See Recommendation G.806.

Common Management Information Service Element (CMISE) - See Recommendation X.710 and ISO/IEC 9595.

Compound function - See Recommendation G.806.

Data Communications Channel (DCC) - See Recommendation G.784.

Defect - See Recommendation G.806.

Failure - See Recommendation G.806.

Fault - See Recommendation G.806.

Fault cause – See Recommendation G.806.

Function - See Recommendation G.806.

Grooming - See Recommendation G.806.

Layer – See Recommendation G.806.

Management Information (MI) - See Recommendation G.806.

Management Point (MP) - See Recommendation G.806.

Network Connection (NC) - See Recommendation G.805.

Network Element Function (NEF) - See Recommendation G.784.

Path – See Recommendation G.806.

Pointer Justification Event (PJE) – See Recommendation G.783 [9].

Process - See Recommendation G.806.

Reference point - See Recommendation G.806.

Remote Defect Indication (RDI) - See Recommendation G.806.

Remote Error Indication (REI) - See Recommendation G.806.

Remote Information (RI) - See Recommendation G.806.

Remote Point (RP) – See Recommendation G.806.

Server Signal Degrade (SSD) - See Recommendation G.806.

Server Signal Fail (SSF) - See Recommendation G.806.

Signal Degrade (SD) - See Recommendation G.806.

Signal Fail (SF) - See Recommendation G.806.

Sub-Network Connection (SNC) - See Recommendation G.805.

Telecommunications Management Network (TMN) - See Recommendation M.3010.

Termination Connection Point (TCP) - See Recommendation G.806.

Timing Information (TI) - See Recommendation G.806.

Timing Point (TP) - See Recommendation G.806.

Trail - See Recommendation G.805.

Trail Signal Degrade (TSD) - See Recommendation G.806.

Trail Signal Fail (TSF) - See Recommendation G.806.

Trail termination function (TT) - See Recommendation G.806.

Trail Trace Identifier (TTI) - See Recommendation G.707.

NE Transit Delay - See Recommendation G.806.

Tributary Unit (TU-m) - See Recommendation G.707.

TUm-AIS - See Recommendation G.707.

Virtual Container (VC-n) - See Recommendation G.707.

Undefined bit - See Recommendation G.806.

Undefined byte - See Recommendation G.806.

4 Abbreviations

For the purpose of this Recommendation, the following abbreviations are used:

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 Seconds
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 1 544 kbit/s
E12	Electrical interface signal 2 048 kbit/s
E22	Electrical interface signal 8 448 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	Recommendation 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
HPP	Higher order Path Protection
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 Communications 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	1 544 kbit/s layer (transparent)
P12s	2 048 kbit/s PDH path layer with synchronous 125 µs frame structure according to G.704 [3]
P12x	2 048 kbit/s layer (transparent)
P21x	6 312 kbit/s layer (transparent)
P22e	8 448 kbit/s PDH path layer with 4 plesiochronous 2 048 kbit/s
P22x	8 448 kbit/s layer (transparent)
P31e	34 368 kbit/s PDH path layer with 4 plesiochronous 8 448 kbit/s
P31s	34 368 kbit/s PDH path layer with synchronous 125 µs frame structure according to 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 G.832
P4x	139 264 kbit/s layer (transparent)
PDH	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)
SPI	SDH Physical Interface
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
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 Recommendation 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 Pqe (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 defect as specified by Recommendation G.706.

6.2.5.5 Pqs (q=4, 31) Loss of Frame defect (dLOF)

If the frame alignment is deemed to be lost (OOF state), a Pqs 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 Pqs 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 and 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 Pqe (q=4, 31, 22) frame alignment

The function shall perform the frame alignment of the Pqe (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 μ s) basic frame and (2 ms) CRC-4 multiframe phase recovery process shall operate as specified in Recommendation 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 Pqs (q=4, 31) frame alignment

The frame alignment of the Pqs (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 BIP8 violations are detected in a block of 1 000 frames.

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

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

NOTE 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.

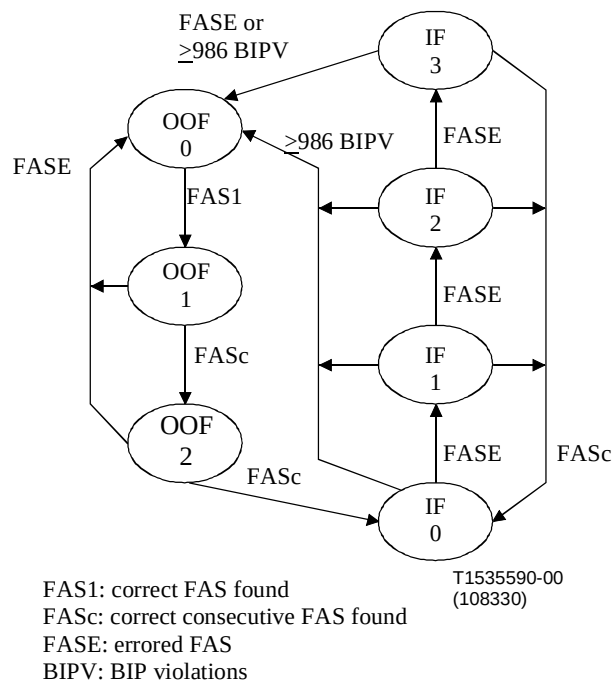


FIGURE 8-1/G.705
Frame alignment state diagram

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 (*Eq*) (*q*=4, 31, 32, 22, 21, 12, 11)

The PDH physical section layers are the 139 264, 44 736, 34 368, 6 312, 2 048 and 1 554 kbit/s section layers.

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

The PDH 1 554 kbit/s hierarchy physical section layers are the 44 736, 6 312, and 1 554 kbit/s section layers. The PDH 2 048 kbit/s hierarchy physical section layers are the 139 264, 34 368, 8 448 and 2 048 kbit/s section layers.

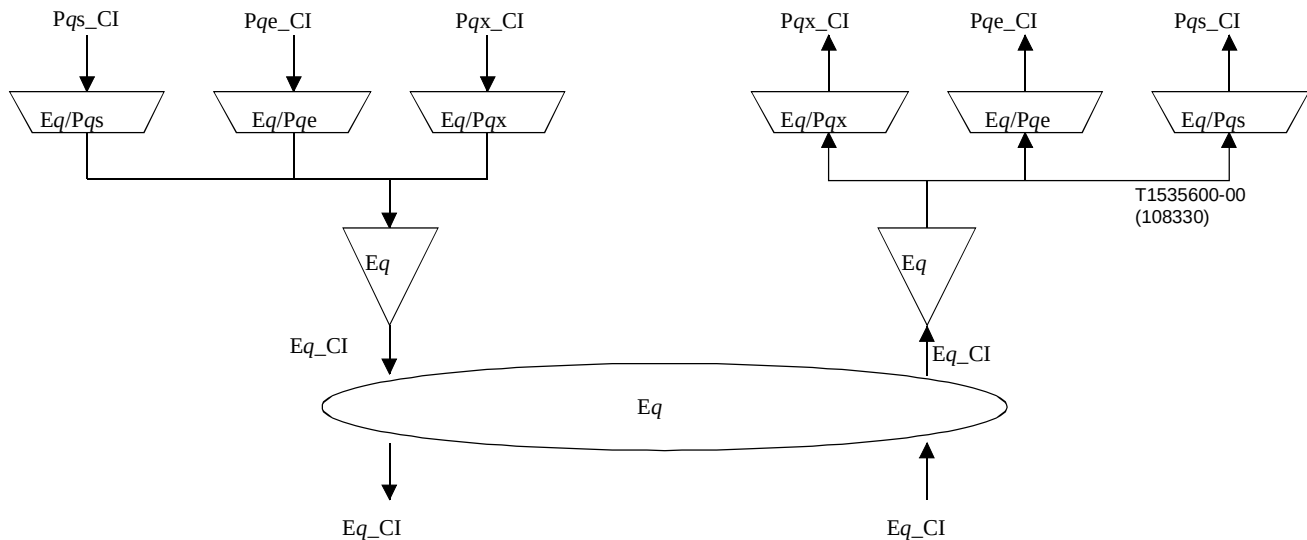


FIGURE 9-1/G.705

PDH Electrical section layer (Eq , ($q=4, 32, 31, 22, 21, 12, 11$)) atomic functions
 (The Eq_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 - 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 Recommendation 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 Recommendation 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 Recommendation 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 Recommendation 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 Recommendation G.704 [3] or G.752 [6] (see Figure 9-4).

NOTE - The signal specified by Recommendation 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 Recommendation 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 Recommendation G.751. It contains four 8 448 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 Recommendation 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 Recommendation G.703.

E22 layer AP

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

The information passing across the E22/P22e AP is a 8 448 kbit/s signal with co-directional bit timing. It contains four 2 048 kbit/s tributary signals (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 Recommendation G.703.

E21 layer AP

The information passing across the E21/P21x AP is a plesiochronous 6 312 kbit/s signal of non-specified content with co-directional bit timing.

The information passing across the E21/P21e AP is a 6 312 kbit/s signal with co-directional bit timing specified by Recommendation 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 Recommendation G.703.

NOTE - This recommendation is limited to the Network Node Interface (NNI).

E12 layer AP

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

The information passing across the E12/P12s AP is a 2 048 kbit/s signal with co-directional bit timing with a frame structure specified by Recommendation 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 Recommendation G.703.

NOTE - B8ZS allows supporting unconstrained clear channel applications.

E11 layer AP

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

The information passing across the E11/P11s AP is a 1 544 kbit/s signal with co-directional bit timing with a frame structure specified by Recommendation G.704.

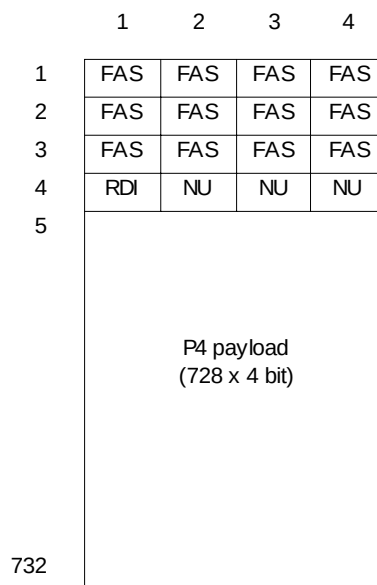


FIGURE 9-2/G.705

Decoded E4/P4e_AI_D signal

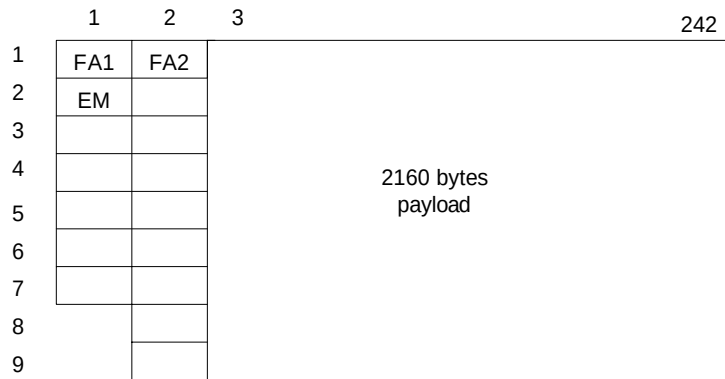


FIGURE 9-3/G.705
Decoded E4/P4s_AI_D signal

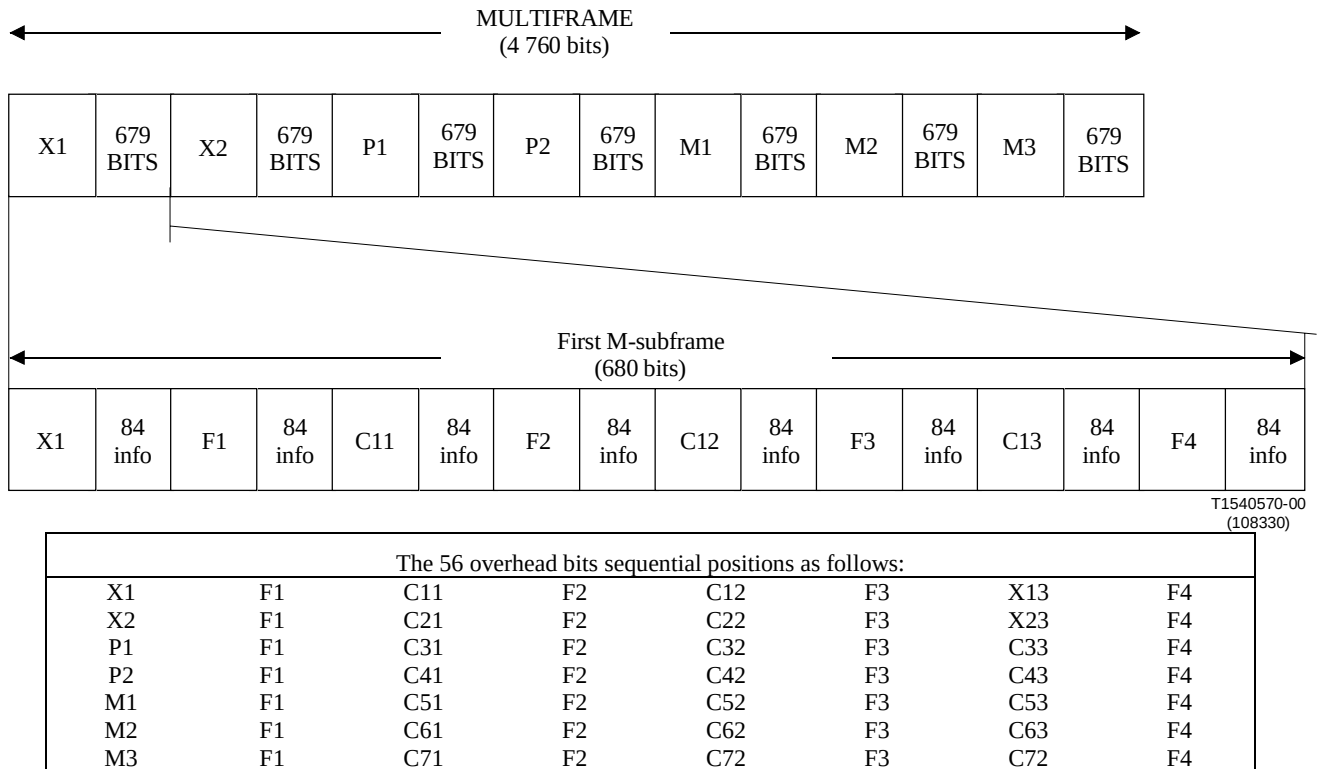


FIGURE 9-4/G.705
Decoded E32/P32e_AI_D signal

Recommendation G.705

Recommendation G.705

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