

Figure 1 SDH and Sonet multiplexing map.

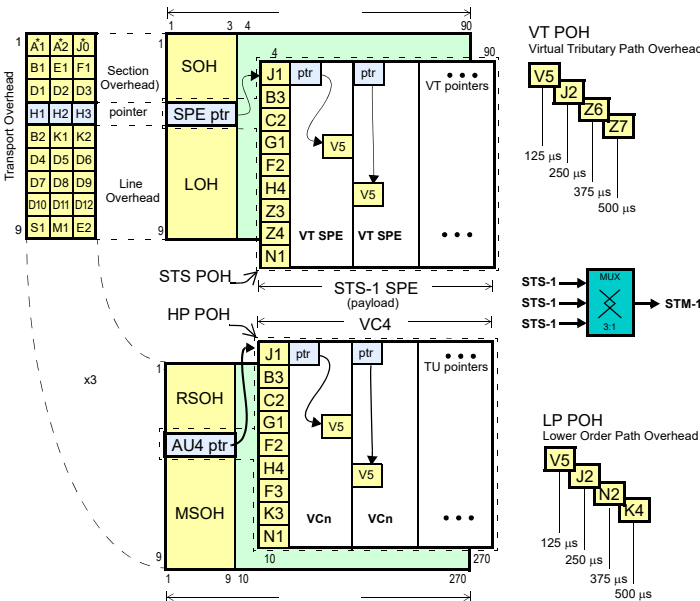


Figure 2 STS-1 and STM-1 frames.

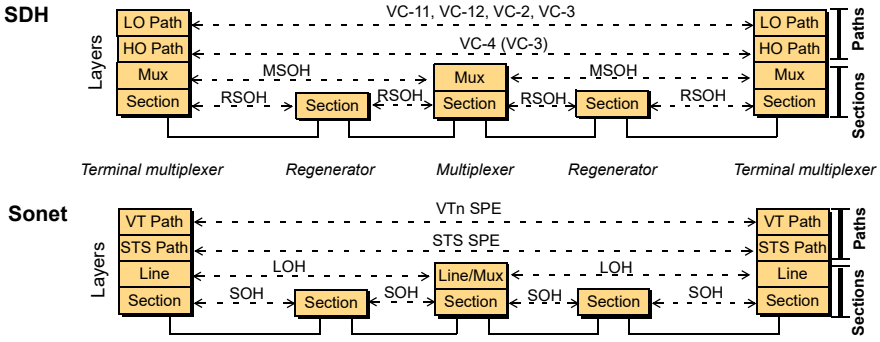


Figure 3 SDH and Sonet layered client/server model.

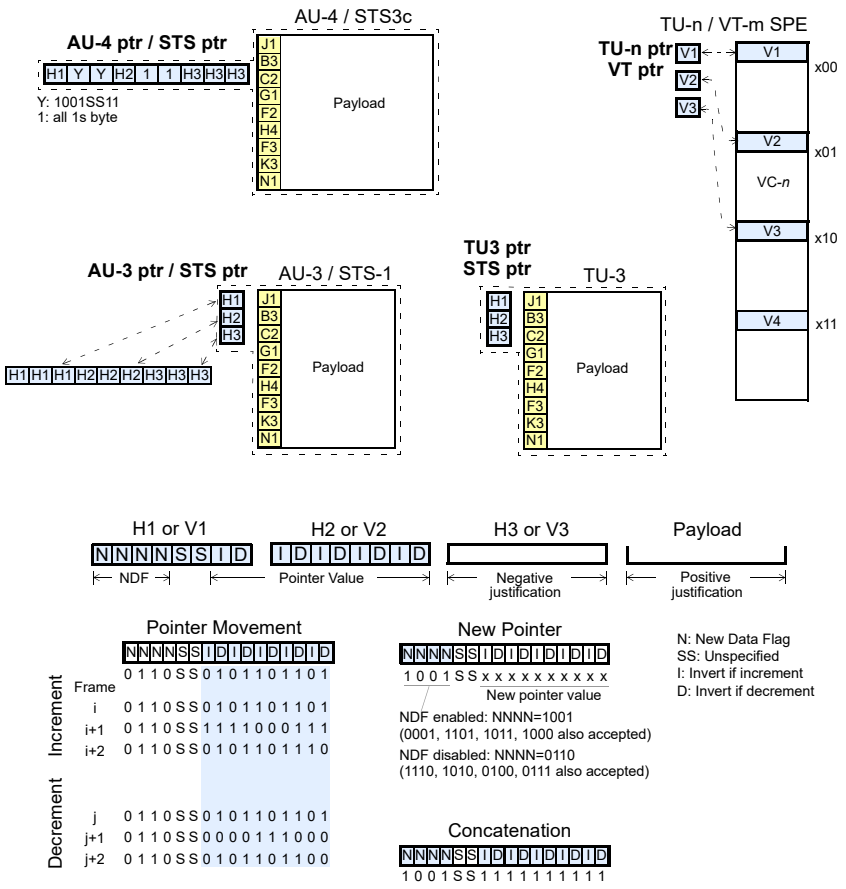


Figure 4 Pointer formats, codification and procedures.

STS-1/STM-0

1	A1*	A2*	J0*
B1	E1	F1	
D1	D2	D3	
H1	H2	H3	
B2	K1	K2	
D4	D5	D6	
D7	D8	D9	
D10	D11	D12	
9	S1	M1	E2

1 STM-1/STS-3/OC-3 9

1	A1*	A1*	A1*	A2*	A2*	A2*	J0*	X*	X*
B1	^	^	^	E1	^		F1	X	X
D1	^	^	^	D2	^		D3		
Pointer (s)									
B2	B2	B2	K1				K2		
D4			D5				D6		
D7			D8				D9		
D10			D11				D12		
9	S1					M1	E2	X	X

J0: Section Trace
 A1= 11110110 Frame Alignment
 A2= 00101000: Frame Alignment
 B1: Section Parity Code BIP-8
 B2: Multiplex Parity Code BIP-n x 24
 D1-D3: 192 kbps OA&M data
 D4-D12: 576 kbps OA&M data
 E1, E2: 64 kbps orderwire channels
 F1: 64 kbps user channel
 H1, H2, H3: pointer bytes
 K1, K2: Request/answer APS channels
 F1: 64 kbps user channel
 M0, M1: Re-sending of B2 errors
 Z0: reserved
 * Non-scrambled bytes
 X bytes reserved for national use
 ^ Media-dependent bytes

STM-4/OC-4

1	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	J0*	Z0*	Z0*	Z0*	X*	X*	X*	X*	X*	X*	
B1								^	^	E1					^	^			F1	X	X	X	X	X	X
D1								^	^	D2					^	^			D3						
Pointer (s)																									
B2	B2	B2	B2	B2	B2	B2	B2	B2	K1										K2						
D4									D5										D6						
D7									D8										D9						
D10									D11										D12						
9	S1														M1				E2	X	X	X	X	X	X

STM-16/OC-48

1	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	J0*	Z0*	Z0*	Z0*	X*	X*	X*	X*	X*	X*	
B1	+	+	+	+	+	+	+	+	+	^	+	+	+	+	+	+	+	+	F1	X	X	X	X	X	X	X	X	X	
D1	+	+	+	+	+	+	+	+	+	^	+	+	+	+	+	+	+	+	D3	+	+	+	+	+	+	+	+	+	
Pointer (s)																													
B2	B2	B2	B2	B2	B2	B2	B2	B2	B2	K1									+	+	+	+	+	+	+	+	+	+	
D4										D5										D6	+	+	+	+	+	+	+	+	+
D7										D8										D9	+	+	+	+	+	+	+	+	+
D10										D11										D12	+	+	+	+	+	+	+	+	+
9	S1	+	+	+	+	+	+	+	+						M1				E2	X	X	X	X	X	X	X	X	X	

STM-64/OC-192

1	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A1*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	A2*	J0*	Z0*	Z0*	Z0*	X*	X*	X*	X*	X*	X*		
B1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	F1	X	X	X	X	X	X	X	X	X		
D1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	D3	+	+	+	+	+	+	+	+	+		
Pointer (s)																															
B2	B2	B2	B2	B2	B2	B2	B2	B2	B2	B2	K1								+	+	+	+	+	+	+	+	+	+	+		
D4											D5									D6	+	+	+	+	+	+	+	+	+		
D7											D8									D9	+	+	+	+	+	+	+	+	+		
D10											D11									D12	+	+	+	+	+	+	+	+	+		
9	S1	+	+	+	+	+	+	+	+	+					M0	M1				E2	X	X	X	X	X	X	X	X	X		

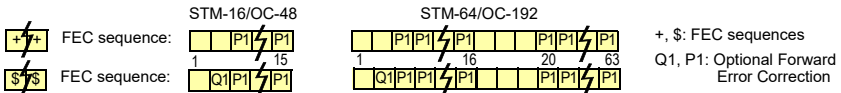


Figure 5 STM-N/OC-M frames.

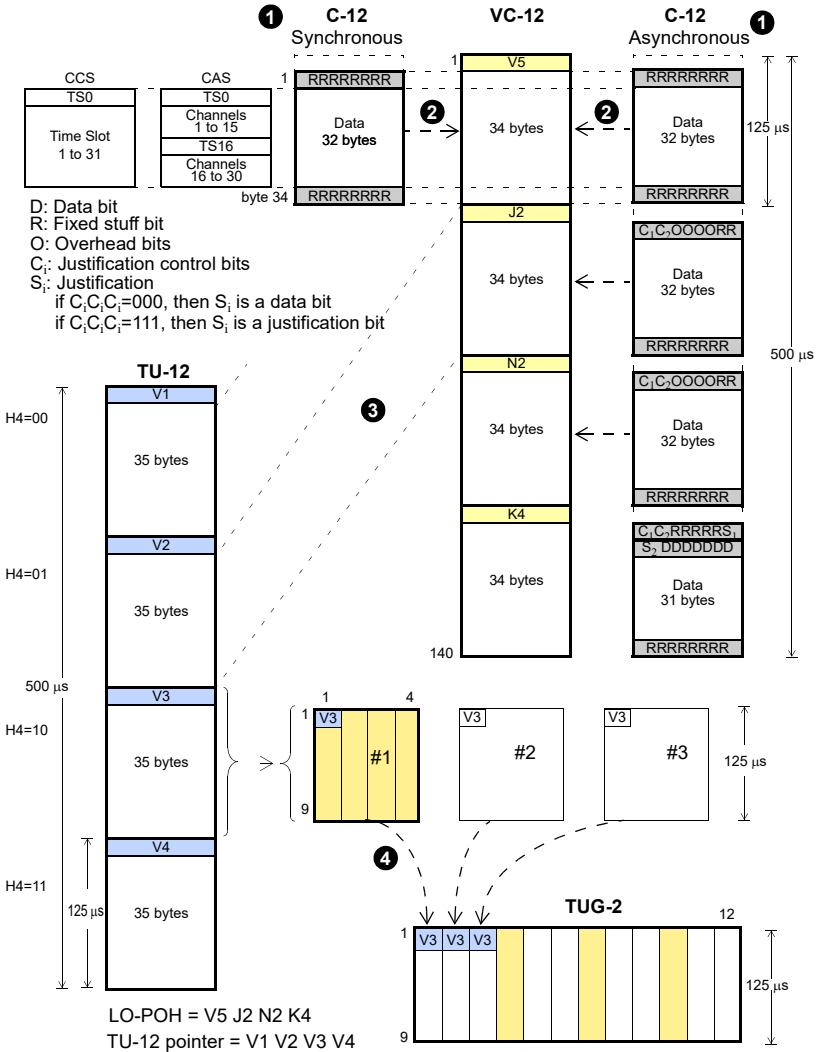
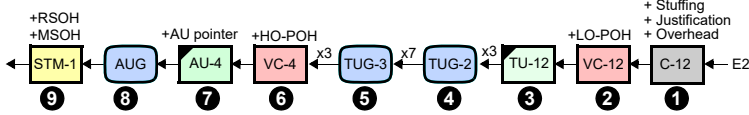


Figure 6 Synchronous and asynchronous transport of a 2-Mbit/s circuit (I).

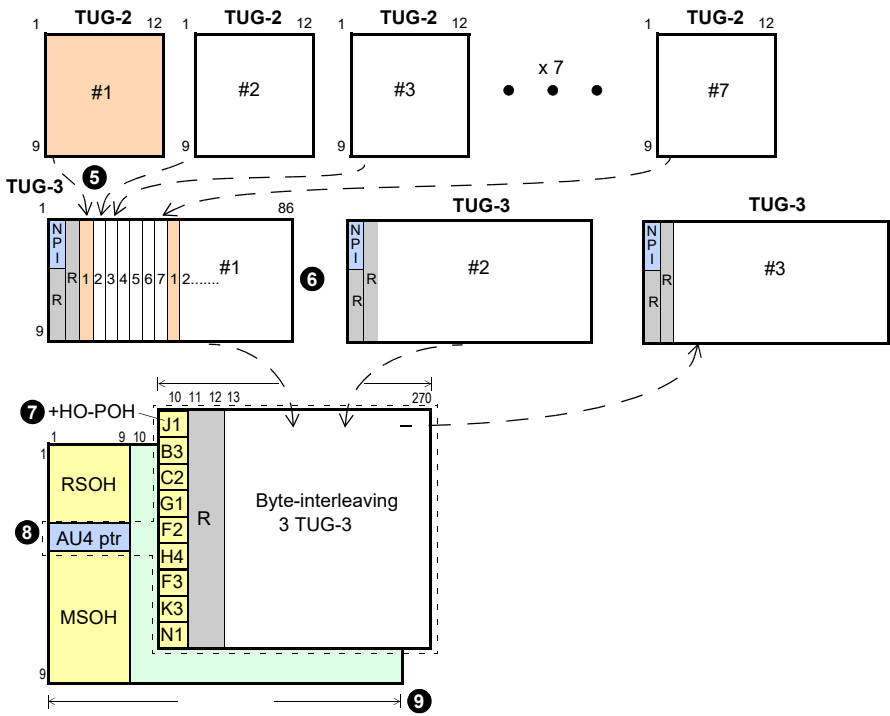


Figure 7 Synchronous and asynchronous transport of a 2-Mbps circuit (II).

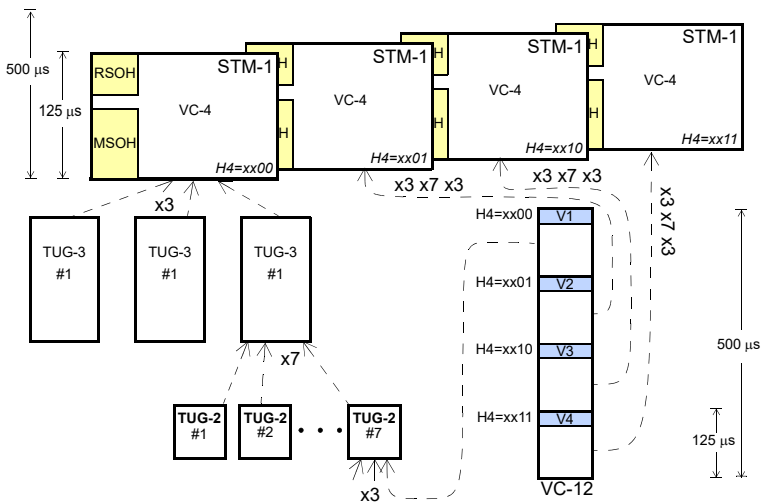


Figure 8 VC-12 is a multiframe and needs four STM-1 frames (500 μ s) for full mapping.

Nine bytes Path Overhead (POH)

SDH SONET

J1	J1	Path trace, message with CRC
B3	B3	BIP-8 parity control
C2	C2	Signal label (mapping)
G1	G1	Path status
F2	F2	Path user channel (voice or data)
H4	H4	Position and sequence indicator
F3	F3	Path user channel (voice or data)
K3	Z3	Automatic Protection Switching
N1	Z4	Tandem Connection Monitoring

C2:

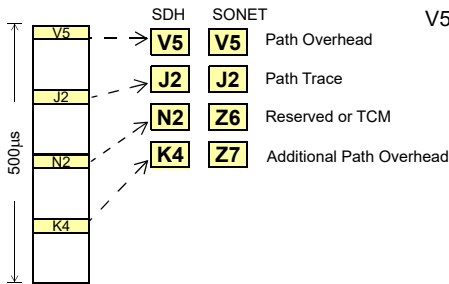
00: unequipped	14: DQDB
01: reserved	15: FDDI
02: TUG	16: HDLC/PPP
03: locked TU	17: SDL
04: E3, T3	18: HDLS/LAPS
12: E4	1A: 10GEthernet
13: ATM	FE: Test-Signal

K3:

APS	HODL	Spare
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APS: Automatic Protection
HODL: Higher Order Data Link

Four bytes Path Overhead (POH)



N2:

BIP-2	1	I-AIS	TC REI	OEI	TC-API, TC-RDI ODI, reserved
-------	---	-------	--------	-----	---------------------------------

BIP-2 for Tandem Connection calculated over the VC
I-AIS: Incoming AIS
TC-REI: Remote Indication Error in a TC subnetwork
OEI (Outgoing Error Indication)
Multiframe: TC-API (Access Point Identifier)
TC-RDI (RDI in Tandem Connection)
ODI (Outgoing Defect Indication)

G1:

REI	RDI	E-RDI	Spare
-----	-----	-------	-------

REI (Remote Error Indication) BIP-8 violation count
RDI (Remote Defect Indication) is sent back
E-RDI (Enhanced RDI information)
(RDI=0) 10: Payload defect (PLM)
(RDI=1) 01: Server defect (AIS, LOP),
(RDI=1) 10: Connectivity defect (TIM, UNEQ)

N1:

IEC	TC REI	OEI	TC-API, TC-RDI ODI, reserved
-----	--------	-----	---------------------------------

IEC Incoming Error Count, BIP-8 errors in Tandem Conn.
TC-REI: Remote Error Indication in a TC subnetwork
OEI: Outgoing Error Indication
Multiframe: TC-API (Access Point Identifier)
TC-RDI (RDI in Tandem Connection)
ODI (Outgoing Defect Indication)

H4:

x	x	1	1	x	x	LO Seq
---	---	---	---	---	---	--------

LO Multiframe Sequence
xx11xx00: pointer to V1
xx11xx01: pointer to V2
xx11xx10: pointer to V3
xx11xx11: pointer to V4

H4:

MF12 (frames 0 and 1) SQ (frames 14 and 15)	Multiframe Indicator 1
--	------------------------

VC-3/4-Xv sequence
bit 5-8: MF11 multiframe indicator (0 to 15)
frame 0 bit 1-4 MF12 MSB Multiframe Indicator 2
frame 1 bit 1-4 MF12 LSB
frame 14 bit 1-4 SQ MSB sequence indicator
frame 15 bit 1-4 SQ LSB sequence indicator

V5:

BIP-2	REI	RFI	Signal Label	RDI
-------	-----	-----	--------------	-----

BIP-2 bit 1: odd bit parity of the previous VC
bit 2: even bit parity
REI (Receive Error Indication)
RFI (Remote Failure Indication)
VC signal label (mapping)
000 - Unequipped
001 - Reserved
010 - Asynchronous floating
011 - Bit synchronous
100 - Byte synchronous
101 - Extended signal label
110 - Test Signal O.181
111 - VC- AIS
RDI (Remote Defect Indication)

K4:

ESL	VC	APS	E-RDI	DL
-----	----	-----	-------	----

ESL (Extended Signal Label) 32 bits multiframe
bits 1-11 Multiframe Alignment
bits 12-19:
09: ATM
0A: HDLC/PPP
0B: HDLC/LAPS
0C: Concatenated test signal
bits 20-32: 0 (reserved for future)
VC (Lower Order Virtual Concatenation)
APS: Automatic Protection Switching channel
E-RDI (Enhanced RDI information)
(RDI=0) 010: Payload defect (PLM)
(RDI=1) 101: Server defect (AIS, LOP),
(RDI=1) 110: Connectivity defect (TIM, UNEQ)
DL: Lower-Order Data Link

Figure 9

Nine bytes Path Overhead is attached to VC3, VC4 and VC4-Xc. Four bytes Path Overhead is attached to VC11, VC12 and VC2.

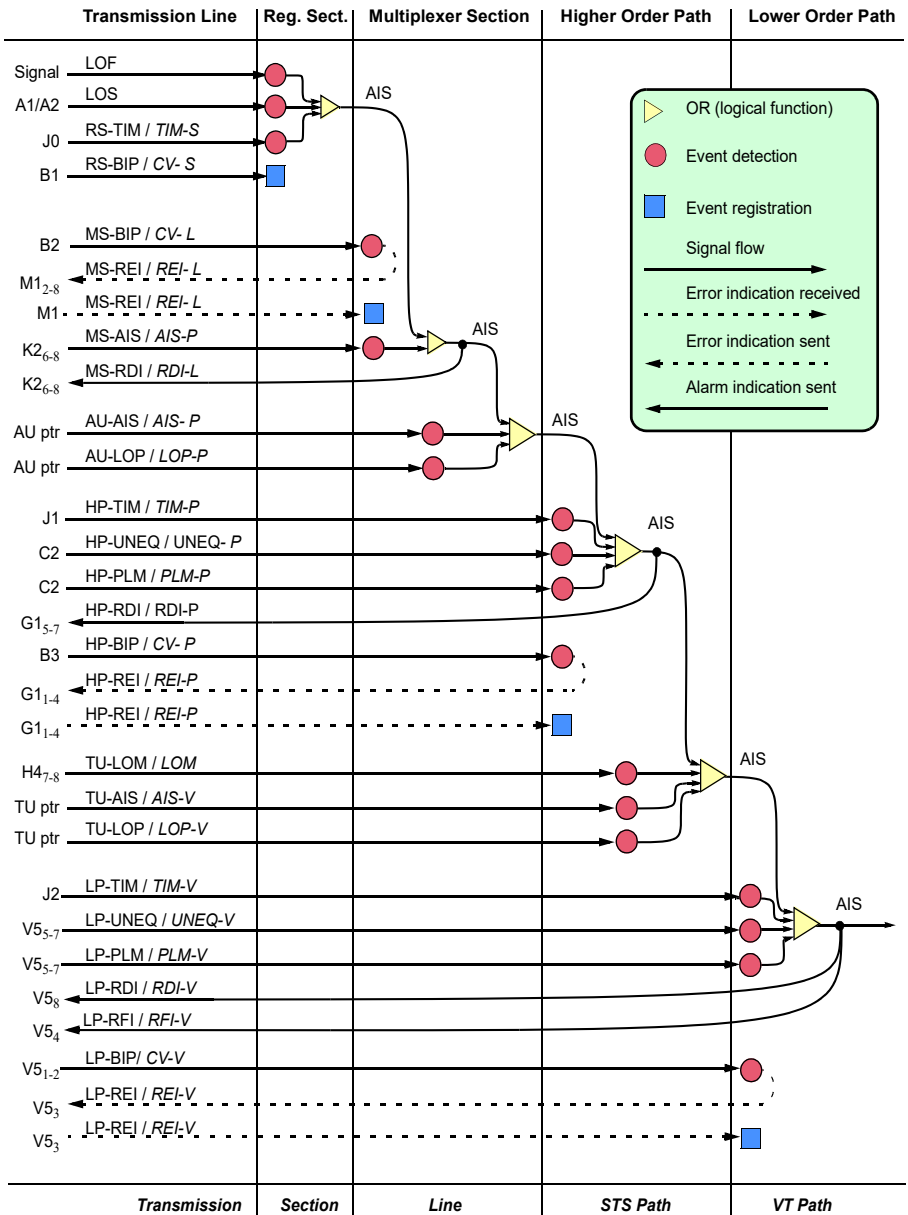


Figure 10 Events management. SDH in regular characters, SONET in *italic*.

Acronyms

AIS	Alarm Indication Signal	NDF	New Data Flag
API	Access Path Identifier	OA&M	Operation, Administration and Maintenance
APS	Automatic Protection Switching	OC-<i>n</i>	Optical Carrier level <i>n</i>
ATM	Asynchronous Transfer Mode	ODI	Outgoing Defect Indication
AU	Administrative Unit	OEI	Outgoing Error Indication
AUG	Administrative Unit Group	PLM	Payload Mismatch
BIP	Bit-Interleaved Parity	POH	Path Overhead
CV	Code Violation	PPP	Point to Point Protocol
DQDB	Distributed Queue Dual Bus	RDI	Remote Defect Indication
ESL	Extended Signal Label	REI	Remote Error Indication
FDDI	Fibre Digital Data Interface	RFI	Remote Failure Indication
FEC	Forward Error Correction	RS	Regenerator Section
HDLC	High-level Data Link Control	RSOH	Regenerator Section Overhead
HODL	Higher Order Data Link	SDH	Synchronous Digital Hierarchy
HP	Higher Order Path	SOH	Section Overhead
LAPS	Link Access Procedure – SDH	SONET	Synchronous Optical Network
LO Path	Lower Order Path	SPE	Synchronous Payload Envelope
LOF	Loss of Framing	STM-<i>n</i>	Synchronous Transport Module level <i>n</i>
LOH	Lower Order Overhead	STS-<i>n</i>	Synchronous Transport Signal level <i>n</i>
LOM	Loss Of Multiframing	TC	Tandem Connection
LOP	Loss Of Pointer	TIM	Trace Identifier Mismatch
LOS	Loss Of Signal	TS	Time Slot
LP	Lower-Order Path	TU	Tributary Unit
MS	Multiplexor Section	TUG	Tributary Unit Group
MSOH	Multiplexor Section Overhead	VC	Virtual Container
MUX	Multiplexor	VT	Virtual Tributary

