AGILENT points the way to SDH

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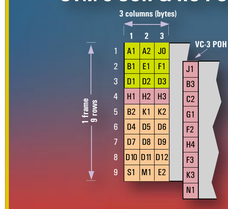
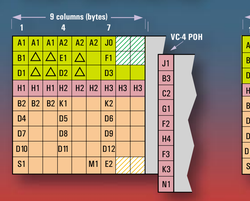
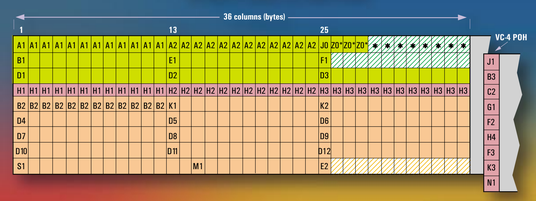
STM-0 SOH & HO-POH



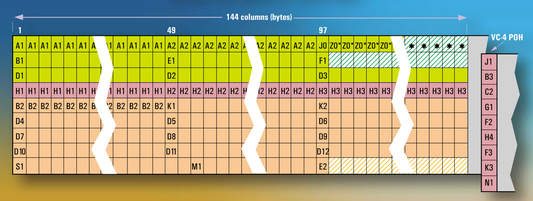
STM-1 SOH & HO-POH



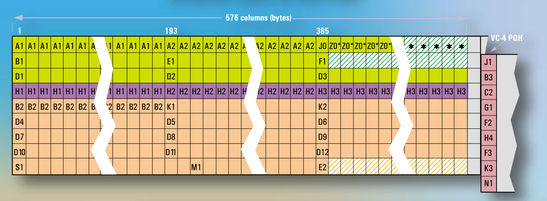
STM-4 SOH & HO-POH



STM-16 SOH & HO-POH



STM-64 SOH & HO-POH



Lower order VC-n POH

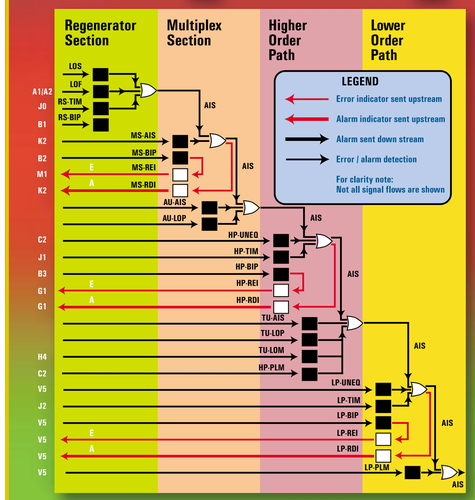
VC-11	VC-12	VC-2
V5	V5	V5
25	34	106
J2	J2	J2
25	34	106
N2	N2	N2
25	34	106
K4	K4	K4
25	34	106

Number of bytes of data separating fields.

STM-0	51.84 Mb/s
STM-1	155.52 Mb/s
STM-4	622.08 Mb/s
STM-16	2488.32 Mb/s
STM-64	9953.28 Mb/s

Key

- Bytes reserved for national use.
- Unscrambled bytes, therefore care should be taken with their contents.
- Media dependent bytes



Events

Physical/regenerator section

LOS	Loss of signal
OOF	Out of frame
LOF	Loss of frame
B1	Regenerator section BIP error
RS-TIM	Regenerator section trace identifier mismatch

Multiplex section

B2	Multiplex section BIP error
MS-AIS	Multiplex section AIS
MS-RDI	Multiplex section remote defect indication
MS-REI	Multiplex section remote error indication

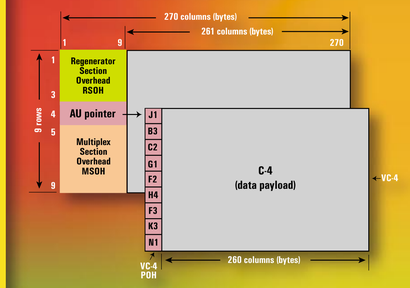
Higher order path

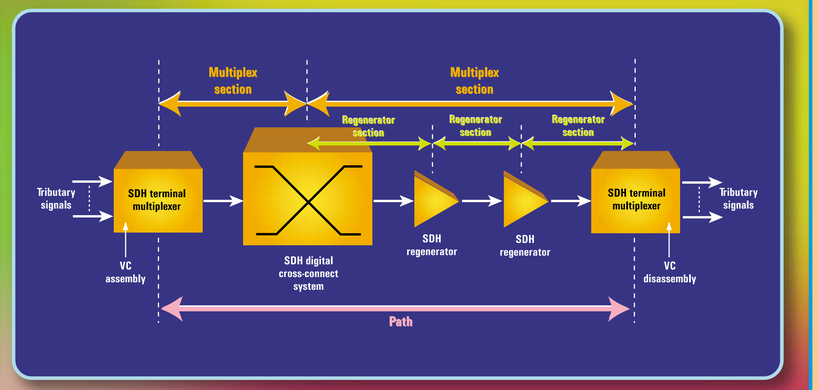
AU-LOP	Loss of AU pointer
AU-NDF	AU pointer – New data flag
AU-AIS	AU alarm indication signal
B3	HP BIP errors
HP-UNEQ	HP unequipped
HP-RDI	HP remote defect indication
HP-REI	HP remote error indication
HP-TIM	HP trace identifier mismatch
HP-PLM	HP payload label mismatch

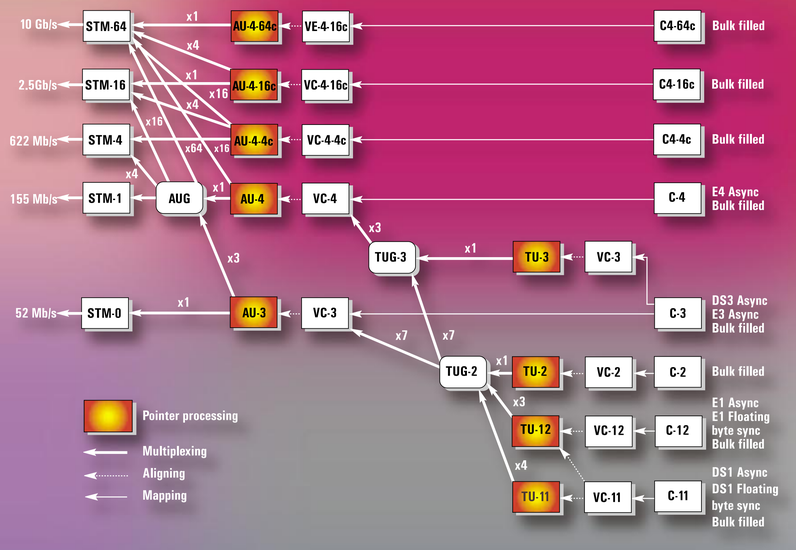
Lower order path

TU-LOP	Loss of TU pointer
TU-NDF	TU pointer – New data flag
TU-AIS	TU alarm indication signal
TU-LOM	TU loss of multiframe alignment
BIP-2/B3	LP BIP errors
LP-UNEQ	LP unequipped
LP-RDI	LP remote defect indication
LP-REI	LP remote error indication
LP-RFI	LP remote failure indication
LP-TIM	LP trace identifier mismatch
LP-PLM	LP payload label mismatch

STM-1 frame (to ITU-T G.707)







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RSOH

Regenerator section overhead

A1,A2 Provides a frame alignment pattern (A1 = F6 H, A2 = 28 H). The frame alignment word of an STM-N frame is 3 x N A1 bytes followed by 3 x N A2 bytes.

J0 Regenerator section trace. (16-byte frame including CRC7). Supports continuity testing between transmitting and receiving device on each regenerator section.

Z0 Spare. Reserved for future international standardization.

B1 Provides regenerator section monitoring. The regenerator section BIP-8 provides end-to-end error performance monitoring across an individual regenerator section and is calculated over all bits of the previous STM-N frame after scrambling. Computed value is placed in B1 byte before scrambling.

E1 Provides local orderwire channel for voice communications between regenerators, hubs and remote terminal locations.

F1 Allocated for user's purposes (eg, temporary data/voice channel connection for special maintenance applications).

D1–D3 192 kb/s message-based data communications channel providing administration, monitor, alarm and maintenance functions between regenerator section termination equipment.

MSOH

Multiplex section overhead

B2 Provides multiplex section error monitoring. The BIP-N x 24, of an STM-N frame, provides end-to-end error performance monitoring across an individual multiplex section and is calculated over all bits of the previous STM-N frame except for the first three rows of SOH. Computed value is placed in B2 byte before scrambling.

K1,K2 Two bytes allocated for APS signaling for multiplex section protection. K2 (b6–b8) contains MS-RDI and MS-AIS status information.

Linear APS messages

ITU-T G.783 protection switching protocol	
K1 byte	**Condition**
b1–b4	
1 1 1 1	Lockout of protection
1 1 1 0	Forced switch
1 1 0 1	Signal fail high priority
1 1 0 0	Signal fail low priority
1 0 1 1	Signal degrade high priority
1 0 1 0	Signal degrade low priority
1 0 0 1	Unused
1 0 0 0	Manual switch
0 1 1 1	Unused
0 1 1 0	Wait-to-restore
0 1 0 1	Unused
0 1 0 0	Exercise
0 0 1 1	Unused
0 0 1 0	Reverse request
0 0 0 1	Do not revert
0 0 0 0	No request
b5–b8	Selects channel used by APS messages
K2 byte	**Condition**
b1–b4	Selects bridged channel used
b5	Determines automatic protection switch architecture
b6–b8	0 0 0 – Reserved for future use 0 0 1 – Reserved for future use 0 1 0 – Reserved for future use 0 1 1 – Reserved for future use 1 0 0 – Reserved for future use 1 0 1 – Reserved for future use 1 1 0 – MS-RDI 1 1 1 – MS-AIS

Ring APS messages

ITU-T G.841 protection switching protocol	
K1 byte	**Condition**
b1–b4	
1 1 1 1	Lockout of protection (span) or signal fail (protection)
1 1 1 0	Forced switch (span)
1 1 0 1	Forced switch (ring)
1 1 0 0	Signal fail (span)
1 0 1 1	Signal fail (ring)
1 0 1 0	Signal degrade (protection)
1 0 0 1	Signal degrade (span)
1 0 0 0	Signal degrade (ring)
0 1 1 1	Manual switch (span)
0 1 1 0	Manual switch (ring)
0 1 0 1	Wait-to-restore
0 1 0 0	Exerciser (span)
0 0 1 1	Exerciser (ring)
0 0 1 0	Reverse request (span)
0 0 0 1	Reverse request (ring)
0 0 0 0	No request
b 5–b8	Destination node ID
K2 byte	**Condition**
b1–b4	Source node ID
b5	Path code: 0 – short path; 1 – long path
b6–b8	0 0 0 – Idle 0 0 1 – Bridged 0 1 0 – Bridged and switched 0 1 1 – Reserved for future use 1 0 0 – Reserved for future use 1 0 1 – Reserved for future use 1 1 0 – MS-RDI 1 1 1 – MS-AIS

D4–D12 Provide 576 kb/s data communication channel between multiplex section termination equipment. Used to carry network administration and maintenance information.

S1 Synchronization status messages. S1 (b5–b8) indicates which of the four levels of synchronization is being used at the transmit end of a multiplex section.

S1 byte b5–b8	SDH synchronization quality level description
0 0 0 0	Quality unknown (existing sync network)
0 0 0 1	Reserved
0 0 1 0	G.811
0 0 1 1	Reserved
0 1 0 0	G.812 transit
0 1 0 1	Reserved
0 1 1 0	Reserved
0 1 1 1	Reserved
1 0 0 0	G.812 local
1 0 0 1	Reserved
1 0 1 0	Reserved
1 0 1 1	Synchronous equipment timing source (SETS)
1 1 0 0	Reserved
1 1 0 1	Reserved
1 1 1 0	Reserved
1 1 1 1	Do not use for synchronization

M1 Multiplex section remote error indication (MS REI). Conveys the number of B2 errors detected by downstream equipment.

E2 Provides express orderwire channel for voice communications between multiplex section terminating equipment.

H1–H3 AU pointer bytes are associated with, but not part of, the MSOH. The pointer contained in H1 and H2 points to the location where the VC-n begins. The last ten bits (b7–b16) of H1H2 carry the pointer value (0 to 782). The H3 bytes are "pointer action" bytes and carry "live" information, from a VC-4, during the STM-N frame in which a negative pointer adjustment occurs.

Concatenation -
The linking together of various data structures, for example two channels joined to form a single channel. in SDH, a number (M) of TUs can be linked together to produce a concatenated container, M times the size of the TU. An example of this is the concatenation of five TU-2s to carry a 32 Mbit/s video signal, known as VC-2-5c. Once assembled, any concatenated VC structure is multiplexed, switched, and transported through the network as a single entity.

Tandem Connection Monitoring -
A Tandem Connection is a bi-directional connection between two TCTEs (Tandem Connection Terminating Elements) along an SDH path, which is managed as a separate entity. the tandem path is formed from an SDH Virtual Container (VC) with special maintenance signals carried in the path overhead (POH) bytes. These bytes enable monitoring of tandem paths, performance analysis and fault location - the ability to 'finger point'.

HO-POH

Higher order path overhead

J1 The first byte in the Virtual Container. Its location is indicated by the AU pointer (H1H2 bytes). Provides a higher order trail trace. identifier (64-byte free format string or 16-byte frame including CRC7). Supports end-to-end monitoring of a higher order path.

B3 Provides higher order path error monitoring. The BIP-8 is calculated over all bits of previous VC-n. Computed value is placed in B3 byte before scrambling.

C2 Higher order path signal label. Indicates composition or the maintenance status of the associated container.

C2 byte mapping

b1–b4	b5–b8	Hex code	Interpretation
0 0 0 0	0 0 0 0	0 0	Unequipped or supervisory-unequipped
0 0 0 0	0 0 0 1	0 1	Equipped - non-specific
0 0 0 0	0 0 1 0	02	TUG-structure
0 0 0 0	0 0 1 1	03	Locked TU
0 0 0 0	0 1 0 0	04	Asynchrsonous mapping of 34368 kb/s or 44736 kb/s into the Container-3 (C-3)
0 0 0 1	0 0 1 0	12	Asynchronous mapping of 139264 kb/s into the Container-4 (C-4)
0 0 0 1	0 0 1 1	13	ATM mapping
0 0 0 1	0 1 0 0	14	MAN (DQDB) mapping
0 0 0 1	0 1 0 1	15	FDDI mapping
1 1 1 1	1 1 1 0	FE	Q.181 test signal (TSS1 to TSS3) mapping
1 1 1 1	1 1 1 1	FF	VC-AIS

G1 Higher order path status. Sends status and performance monitoring information from receiving path terminating equipment to originating equipment. Allows status and performance of two-way path to be monitored at either end.

REI				RDI			Spare
b1	b2	b3	b4	b5	b6	b7	b8

G1 (b5–b7) coding and interpretation

b5–b7	Meaning	Triggers
000	No remote defect	No remote defect
001	No remote defect	No remote defect
010	Remote payload defect	LCD
011	No remote defect	No remote defect
100	Remote defect	AIS, LOP, TIM, UNEQ (or PLM, LCD)
101	Remote server defect	AIS, LOP
110	Remote connectivity defect	TIM, UNEQ
111	Remote defect	AIS, LOP, TIM, UNEQ (or PLM, LCD)

F2 Higher order path user channel. Allocated for network operator communications between path terminations.

H4 Position indicator. Multiframe phase indication for TU structured payloads.

F3 Higher order path user channel. Allocated for network operator communications between path terminations.

K3 Higher order path automatic protection switching (b1–b4). The rest of the bits (b5–b8) are allocated for future use.

N1 Higher order tandem connection monitoring. There are two possible implementations described in Annex C and Annex D of ITU-T G.707. In Annex C, the N1 byte provides a tandem connection Incoming Error Count (IEC) and the remaining four bits provide an end-to-end data link. The Annex D option contains an incoming error count (IEC), tandem connection REI (TC-REI), outgoing error indication (OEI) and a 76-byte multiframe containing a tandem connection access point identifier (TC-APId).

N1 byte structure

IEC				TC-REI	OEI	TC-APId, TC-RDI, ODI, reserved	
b1	b2	b3	b4	b5	b6	b7	b8

N1 (b7–b8) multiframe structure

Frame number	b7 and b8 definition
1–8	Frame alignment signal: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
9–12	TC-APId byte # 1 (1 C_1 C_2 C_3 C_4 C_5 C_6 C_7)
13–16	TC-APId byte # 2 (0 X X X X X X)
17–20	TC-APId byte # 3 (0 X X X X X X)
:	:
65–68	TC-APId byte # 15 (0 X X X X X X)
69–72	TC-APId byte # 16 (0 X X X X X X)
73–76	TC-RDI, ODI and reserved (see table below)

Frame number	N1 b7 definition	N1 b8 definition
73	Reserved (default = "0")	TC-RDI
74	ODI	Reserved (default = "0")
75	Reserved (default = "0")	Reserved (default = "0")
76	Reserved (default = "0")	Reserved (default = "0")

LO-POH

Lower order path overhead

(for VC-11, VC-12 or VC-2)

V5 Provides BIP-2 error checking, signal label and path status information.

BIP-2		REI	RFI	Signal label			RDI
b1	b2	b3	b4	b5	b6	b7	b8

V5 (b5–b7) signal label

b5–b7	Meaning
000	Unequipped or supervisory-unequipped
001	Equipped – non-specific
010	Asynchronous
011	Bit synchronous
100	Byte synchronous
101	Reserved for future use
110	Q.181 test signal (TSS4)
111	VC-AIS

J2 Lower order trail trace identifier (16-byte frame including CRC7). Supports end-to-end monitoring of a lower order path.

N2 Lower order tandem connection monitoring. Contains BIP-2 error checking, AIS, tandem connection REI (TC-REI), outgoing error indication (OEI) and a 76-byte multiframe containing a tandem connection access point identifier (TC-APId).

N2 byte structure

BIP-2		"1"	Incoming AIS	TC-REI	OEI	TC-APId, TC-RDI, ODI, reserved	
b1	b2	b3	b4	b5	b6	b7	b8

N2 (b7–b8) multiframe structure

Frame number	b7 and b8 definition
1–8	Frame alignment signal: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
9–12	TC-APId byte # 1 (1 C_1 C_2 C_3 C_4 C_5 C_6 C_7)
13–16	TC-APId byte # 2 (0 X X X X X X)
17–20	TC-APId byte # 3 (0 X X X X X X)
:	:
65–68	TC-APId byte # 15 (0 X X X X X X)
69–72	TC-APId byte # 16 (0 X X X X X X)
73–76	TC-RDI, ODI and reserved (see table below)

Frame number	N2 b7 definition	N2 b8 definition
73	Reserved (default = "0")	TC-RDI
74	ODI	Reserved (default = "0")
75	Reserved (default = "0")	Reserved (default = "0")
76	Reserved (default = "0")	Reserved (default = "0")

K4 Lower order path automatic protection switching (b1–b4) and enhanced remote defect indication (b5–b7).

K4 (b5–b7) coding and interpretation

b5–b7	Meaning	Triggers
000		
001	No remote defect	No remote defect
010	Remote payload defect	LCD, PLM
011		
100		
101	Remote server defect	AIS, LOP
110	Remote connectivity defect	TIM, UNEQ
111		