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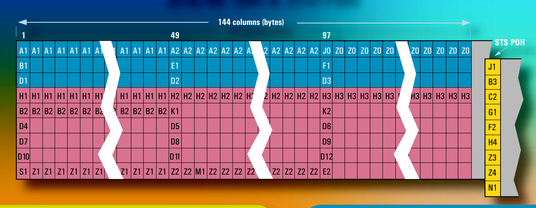
Agilent Technologies
Innovating the HP Way

STS-1 TOH & STS POH

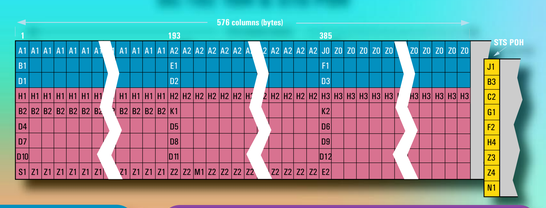
STS-3 TOH & STS POH

STS-12 TOH & STS POH

STS-48 TOH & STS POH



OC-192 TOH & STS POH



Virtual tributary VTn POH

Optical	Rate
OC-1 / STS-1	51.84 Mb/s
OC-3 / STS-3	155.52 Mb/s
OC-12	622.08 Mb/s
OC-48	2488.32 Mb/s
OC-192	9953.28 Mb/s

STS-1 numbers in an OC-3	
STS-3 #i STS-1 # Scheme	1 to N Scheme
1,1	1
1,2	2
1,3	3

Order of transmission in a byte-interleaved OC-3 is (1,1), (1,2), (1,3) or 1, 2, 3.

STS-1 numbers in an OC-12	
STS-3 #i STS-1 # Scheme	1 to N Scheme
1,1	1
1,2	2
1,3	3
2,1	4
2,2	5
2,3	6
3,1	7
3,2	8
3,3	9
4,1	10
4,2	11
4,3	12

Order of transmission in a byte-interleaved OC-12 is (1,1), (2,1), (3,1), (4,1), (1,2), (2,2), (3,2), (4,2), (1,3), (2,3), (3,3), (4,3) or 1, 4, 7, 10, 2, . . . , 12.

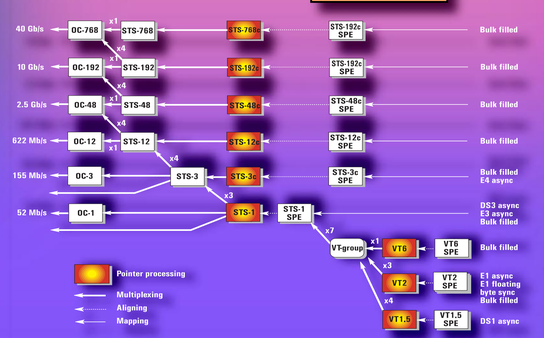
STS-1 numbers in an OC-48			
STS-3 #i STS-1 # Scheme	1 to N Scheme	STS-3 #i STS-1 # Scheme	1 to N Scheme (cont.)
1,1	1	6,1	25
1,2	2	6,2	26
1,3	3	6,3	27
2,1	4	10,1	28
2,2	5	10,2	29
2,3	6	10,3	30
3,1	7	11,1	31
3,2	8	11,2	32
3,3	9	11,3	33
4,1	10	12,1	34
4,2	11	12,2	35
4,3	12	12,3	36
5,1	13	13,1	37
5,2	14	13,2	38
5,3	15	13,3	39
6,1	16	14,1	40
6,2	17	14,2	41
6,3	18	14,3	42
7,1	19	15,1	43
7,2	20	15,2	44
7,3	21	15,3	45
8,1	22	16,1	46
8,2	23	16,2	47
8,3	24	16,4	48

Order of transmission in a byte-interleaved OC-48 is (1,1,1), (2,1,1), . . . , (16,1,1), (1,2,1), . . . , (16,3) or 1, 4, . . . , 46, 2, . . . , 48.

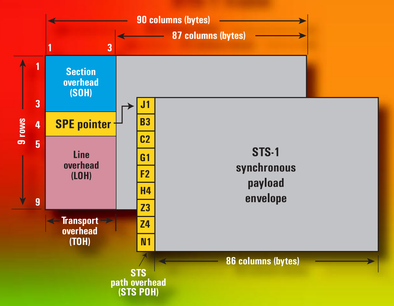
STS-1 numbers in an OC-192			
STS-3 #i STS-1 # Scheme	1 to N Scheme	STS-3 #i STS-1 # Scheme	1 to N Scheme (cont.)
1,1	1	33,1	97
1,2	2	33,2	98
1,3	3	33,3	99
2,1	4	34,1	100
2,2	5	34,2	101
2,3	6	34,3	102
3,1	7	35,1	103
3,2	8	35,2	104
3,3	9	35,3	105
4,1	10	36,1	106
4,2	11	36,2	107
4,3	12	36,3	108
5,1	13	37,1	109
5,2	14	37,2	110
5,3	15	37,3	111
6,1	16	38,1	112
6,2	17	38,2	113
6,3	18	38,3	114
7,1	19	39,1	115
7,2	20	39,2	116
7,3	21	39,3	117
8,1	22	40,1	118
8,2	23	40,2	119
8,3	24	40,3	120
9,1	25	41,1	121
9,2	26	41,2	122
9,3	27	41,3	123
10,1	28	42,1	124
10,2	29	42,2	125
10,3	30	42,3	126
11,1	31	43,1	127
11,2	32	43,2	128
11,3	33	43,3	129
12,1	34	44,1	130
12,2	35	44,2	131
12,3	36	44,3	132
13,1	37	45,1	133
13,2	38	45,2	134
13,3	39	45,3	135
14,1	40	46,1	136
14,2	41	46,2	137
14,3	42	46,3	138
15,1	43	47,1	139
15,2	44	47,2	140
15,3	45	47,3	141
16,1	46	48,1	142
16,2	47	48,2	143
16,3	48	48,3	144
17,1	49	49,1	145
17,2	50	49,2	146
17,3	51	49,3	147
18,1	52	50,1	148
18,2	53	50,2	149
18,3	54	50,3	150
19,1	55	51,1	151
19,2	56	51,2	152
19,3	57	51,3	153
20,1	58	52,1	154
20,2	59	52,2	155
20,3	60	52,3	156
21,1	61	53,1	157
21,2	62	53,2	158
21,3	63	53,3	159
22,1	64	54,1	160
22,2	65	54,2	161
22,3	66	54,3	162
23,1	67	55,1	163
23,2	68	55,2	164
23,3	69	55,3	165
24,1	70	56,1	166
24,2	71	56,2	167
24,3	72	56,3	168
25,1	73	57,1	169
25,2	74	57,2	170
25,3	75	57,3	171
26,1	76	58,1	172
26,2	77	58,2	173
26,3	78	58,3	174
27,1	79	59,1	175
27,2	80	59,2	176
27,3	81	59,3	177
28,1	82	60,1	178
28,2	83	60,2	179
28,3	84	60,3	180
29,1	85	61,1	181
29,2	86	61,2	182
29,3	87	61,3	183
30,1	88	62,1	184
30,2	89	62,2	185
30,3	90	62,3	186
31,1	91	63,1	187
31,2	92	63,2	188
31,3	93	63,3	189
32,1	94	64,1	190
32,2	95	64,2	191
32,3	96	64,3	192

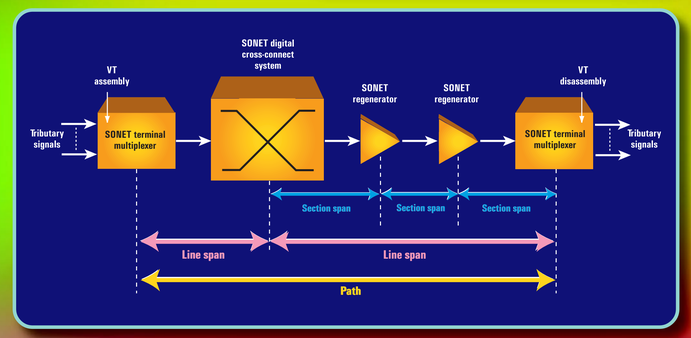
Order of transmission in a byte-interleaved OC-192 is (1,1,1), (2,1,1), . . . , (64,1,1), (1,2,1), . . . , (64,3) or 1, 4, 7, 10, . . . , 190, 2, . . . , 191, 3, . . . , 192.

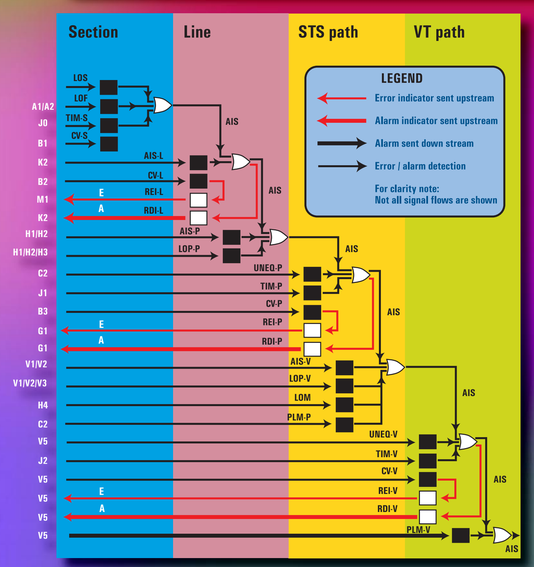
STS-1 numbers in STS-N/OC-N signals (N = 3, 12, 48 or 192)



STS-1 frame







Events

Section level

- LOS — Loss of signal
- OOF — Out of frame
- LOF — Loss of frame
- CV-S — Section code violation
- TIM-S — Regenerator section trace identifier mismatch

Line level

- CV-L — Line code violation
- AIS-L — Line AIS
- RDI-L — Line remote defect indication
- REI-L — Line remote error indication

STS path level

- LOP-P — STS loss of pointer
- NDF-P — STS new data flag
- AIS-P — STS AIS
- CV-P — STS code violation
- UNEQ-P — STS unequipped
- RDI-P — STS remote defect indication
- REI-P — STS remote error indication
- TIM-P — STS trace identifier mismatch
- PLM-P — STS path label mismatch

VT path level

- LOP-V — VT loss of pointer
- NDF-V — VT pointer – new data flag
- AIS-V — VT AIS
- LOM — Loss of multiframe
- CV-V — VT code violation
- UNEQ-V — VT unequipped
- RDI-V — VT remote defect indication
- REI-V — VT remote error indication
- RFI-V — VT remote failure indication
- TIM-V — VT trace identifier mismatch
- PLM-V — VT path label mismatch

Section overhead

SOH

A1,A2 Frame alignment pattern (A1 = F6 H, A2 = 28 H).

J0 Section trace. Supports continuity testing between transmitting and receiving device on each section span.

Z0 Section growth byte. Reserved for further study.

B1 Section monitoring. The section BIP-8 is calculated over all bits of the previous STS-N frame after scrambling and placed in the B1 byte of the current STS-N frame before scrambling.

E1 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 section termination equipment.

Line overhead

LOH

B2 Line error monitoring. The BIP-8 is calculated over all bits of the line overhead and the envelope capacity of the previous STS-N frame before scrambling and placed in the B2 byte of the current STS-N frame before scrambling.

K1,K2 Two bytes used on the protection line for automatic protection switching (APS) signaling for line level protection switch.

APS messages

Linear APS messages

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	Exercize
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 – Provisional mode is unidirectional 1 0 1 – Provisional mode is bidirectional 1 1 0 – RDI-L 1 1 1 – AIS-L

Ring APS messages

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	Exercizer (span)
0 0 1 1	Exercizer (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 request; 1 – long path request
b6–b8	0 0 0 – Idle 0 0 1 – Bridged 0 1 0 – Bridged and switched 0 1 1 – Extra traffic (ET) on protection channels 1 0 0 – Reserved for future use 1 0 1 – Reserved for future use 1 1 0 – RDI-L 1 1 1 – AIS-L

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

S1 byte b5–b8	Quality level	SONET synchronization quality level description
0 0 0 1	1	Stratum 1 traceable
0 0 0 0	2	Synchronized – traceability unknown
0 1 1 1	3	Stratum 2 traceable
1 0 1 0	4	Stratum 3 traceable
1 1 0 0	5	SONET minimum clock traceable
n/a	6	Stratum 4 traceable
1 1 1 1	7	Do not use for synchronization
1 1 1 0	user-assignable	Reserved for network synchronization use

S1 Synchronization status messages. S1 (b5–b8) indicates the levels of synchronization being used at the transmit end of a line span.

Z1 Allocated for future growth.

M0 STS-1 line remote error indication (REI-L). Defined only for STS-1. Conveys the error count detected, using the line BIP-8 code, by the downstream line terminating equipment.

M1 STS-N line remote error indication (REI-L). Defined for N ≥ 3. Conveys the error count detected, using the line BIP-8 code, by the downstream line terminating equipment.

E2 Express orderwire channel for voice communications between line terminating equipment.

H1–H3 The payload pointer contained in the H1 and H2 bytes of the line overhead designates the location of the byte where the STS SPE begins. Bits 6 to 16 of H1H2 carry the pointer value (0 to 782). The payload pointers H1 and H2 are also used to indicate a concatenated payload by transmitting the pointer word '1 0 0 1 X X 1 1 1 1 1 1 1 1 1 1' in the second through Nth STS-1 in an STS-Nc. The H3 byte is allocated for SPE frequency justification purposes and can carry 'live' information from a STS SPE when a negative pointer adjustment occurs.

Z2 Allocated for future growth.

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.

STS path overhead

STS POH

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

B3 STS path error monitoring. The BIP-8 is calculated over all bits of previous STS SPE. Computed value is placed in B3 byte before scrambling.

C2 Indicates the content of the STS SPE, including the status of the mapped payloads.

C2 byte mapping			
b1–b4	**b5–b8**	**Hex code**	**Interpretation**
0 0 0 0	0 0 0 0	0 0	Unequipped
0 0 0 0	0 0 0 1	0 1	Equipped – non-specific payload
0 0 0 0	0 0 1 0	0 2	VTstructured STS-1 SPE
0 0 0 0	0 0 1 1	0 3	Locked VT mode
0 0 0 0	0 1 0 0	0 4	Asynchronous mapping for DS3
0 0 0 1	0 0 1 0	1 2	Asynchronous mapping for DS4NA
0 0 0 1	0 0 1 1	1 3	Mapping for ATM
0 0 0 1	0 1 0 0	1 4	Mapping for DQDB
0 0 0 1	0 1 0 1	1 5	Asynchronous mapping for FDDI

G1 Path terminating and performance. Sends status and performance information from receiving path terminating equipment to originating equipment. Allows status and performance of complete duplex path to be monitored at either end. Bits 1 to 4 of the G1 byte indicate the count of interleaved-bit block errors, based on the B3 count, to the upstream path terminating equipment.

REI-P				RDI-P			Undefined
b1	b2	b3	b4	b5	b6	b7	b8

G1 (b5–b7) coding and interpretation		
b5–b7	**Interpretation**	**Triggers**
0 0 0	No remote defect	No defects
0 0 1	No remote defect	No defects
0 1 0	Remote payload defect	LCD-P, PLM-P
0 1 1	No remote defect	No defects
1 0 0	Remote defect	AIS-P, LOP-P
1 0 1	Remote server defect	AIS-P, LOP-P
1 1 0	Remote connectivity defect	TIM-P, UNEQ-P
1 1 1	Remote defect	AIS-P, LOP-P

F2 Allocated for user communication purposes between STS path terminating equipment.

H4 The H4 byte is allocated for use as a mapping-specific indicator byte. For VTstructured STS-1 SPEs, the byte is used as a multiframe indicator.

Z3,Z4 Allocated for future growth.

N1 Allocated for tandem connection maintenance and the path data channels. Bits 1 to 4 are used to provide tandem connection incoming error count (IEC). Bits 5 to 8 are used to provide the path data channel. Please refer to ANSI T1.105.05 for more information.

VT path overhead

(for VT1.5, VT2 or VT6)

VT POH

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

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

V5 (b5–b7) signal label	
b5–b7	**Interpretation**
0 0 0	Unequipped
0 0 1	Equipped – non-specific payload
0 1 0	Asynchronous mapping
0 1 1	Bit synchronous mapping (no longer valid for DS1)
1 0 0	Byte synchronous mapping
1 0 1	Unassigned
1 1 0	Unassigned
1 1 1	Unassigned

J2 VT path trace identifier. Supports end-to-end monitoring of a path.

Z6 VT path growth and reserved for future use. Z6 is defined as N2 in SDH and is allocated for lower order tandem connection.

Z7 VT path growth with the following exception. Bits 5 to 7 provide enhanced RDI-V. Bits 5 to 7, in combination with bit 8 of V5 provide codes to indicate both the old version and enhanced version of RDI-V. Z7 is defined as K4 in SDH and bits 1 to 4 are allocated as a VT path APS overhead channel. Bits 5 to 7 of K4 provide RDI-V.

Z7 (b5 – b7) coding and interpretation				
V5 bit 8/ Z7 bit 5	**Z7 bit 6**	**Z7 bit 7**	**Interpretation**	**Triggers**
0	0	0	No remote defect	No defects
0	0	1	No remote defect	No defects
0	1	0	Remote payload defect	PLM-V
0	1	1	No remote defect	No defects
1	0	0	Remote defect	AIS-V, LOP-V
1	0	1	Remote server defect	AIS-V, LOP-V
1	1	0	Remote connectivity defect	UNEQ-V
1	1	1	Remote defect	AIS-V, LOP-V

Need a SONET test solution? Turn to Agilent®.

Data subject to change. For full details and latest information on SONET standards, please refer to Telcordia Generic Requirements GR-253 and GR-1230, and American National Standards Institute T1.105.

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