Overview of SDH and SONET overhead processing commonalities and differences.

- The SDH information is based on ITU-T G.707, G.783 and ETSI EN 300 417-x-1 (x=1..7,9)
- The SONET information is based on ANSI T1.105, T1.231 and Telcordia GR253

If you find errors or have additional information or remarks, please notify me: hhelvoort@chello.nl

A	Adaptation function
AIS	Alarm Indication Signal
AISS	AIS Seconds
APS	Automatic Protection Switch
AU	Administrative Unit
BIP	Bit Interleaved parity
C	Connection function
DEG	Degraded
ERDI	Enhanced RDI
EXC	Excessive
F_EBC	Far end Errored Block Count
F_DS	Far end Defect Second
FOP	Failure Of Protocol
LOF	Loss Of Frame
LOP	Loss Of Pointer
LOPS	LOP Seconds
N_EBC	Near end Errored Block Count
N_DS	Near end Defect Second
NDF	New Data Flag
NIM	Non Intrusive Monitor function
NPJC	Negative Pointer Justification Counter
OFS	Out of Frame Second
PJE+	positive Pointer Justification Event
PJE-	negative Pointer Justification Event
PDI	Payload Defect Indicator
PLM	PayLoad Mismatch
PM	Performance Monitoring
PPJC	Positive Pointer Justification Counter
PT	Path Termination function
RDI	Remote Defect Indication
RDIc	Remote connectivity Defect Indication
RDIp	Remote payload Defect Indication
RDIs	Remote server Defect Indication
REI	Remote Error Indication
RFI	Remote Failure Indication
SD	Signal Degrade
SEFS	Severely Errored Frame Second
SF	Signal fail
SPE	Synchronous Payload Envelope
STS	Synchronous Transport Signal
TIM	Trace identifier Mismatch
TU	Tributary Unit
UNEQ	Unequipped
VC	Virtual Container
VCAT	Virtual conCATenation
VT	Virtual Tributary

OH byte	Direction	Process	Location	SDH Regenerator Section RS-0/1/4/16/64/256	SONET Section STS-1/3/12/48/192/768
A1A2 - frame alignment signal	Source	insertion		y	y
	Sink	defect - LOF		OOF: 5 frames LOF: 3 ms with filtering	OOF: 4 frames LOF: 3 ms
		PM (OFS [SEFS])		n	y
		PM – N_DS		y	y
		consequent action - AIS		y	y
		consequent action - RDI		y	y
		protection switching - SF		y	y
B1 - BIP8	Source	calculation		y	y
	Sink	defect – DEG (in regenerator applications)		y	n
		PM – N_EBC		n, under study in G.829	y, based on BIP8 violations
		Protection Switching - SF		n	n
		Protection Switching - SD		n	n
C1 - … OBSOLETE	Source	insertion		#1..#N	#1..#3N
	Sink	ignored		y	y
J0 - section trace identifier	Source	insertion		16 byte string	1 byte string (64 byte string is under study)
	Sink	defect - TIM		y	n
		PM – N_DS		y	n
		consequent action - AIS		y	n
		consequent action - RDI		n/a	n/a
		protection switching - SF		n/a	n/a
		acceptance & reporting		y	y
Z0 - growth	Source	insertion -fixed stuff		(N-1) Z0 bytes	(3N-1) Z0 bytes
	Sink	ignore		y	y
E1 - Order Wire	Source	insertion - external		y	y (but not used)
	Sink	extract		y	y (but not used)
F1 - user channel	Source	insertion - internal or external		y	n
	Sink	extract		y	n
D1-D3 - RS DCC	Source	insertion		y	y
	Sink	extract		y	y
NU - national use	Source	insertion - fixed stuff or external		y	fixed stuff

	Sink	ignore		y	y
unmarked	Source	insertion - fixed stuff: all-0's		y	y
	Sink	ignore		y	y

OH byte	Direction	Process	Location	SDH Multiplex Section MS-0/1/4/16/64/256	SONET Line STS-1/3/12/48/192/768
B2 - BIP24N (defect and PM based on BIP24N violations)	Source	calculation		y	y
	Sink	defect – EXC/DEG or DEG		dDEG based on 1 second PM info	dEXC/dDEG based on 10^{-x} algorithm
		PM – N_EBC		y	y
		Protection Switching - SF		y	n
		Protection Switching - SD		y	y
E2 - Order Wire	Source	insertion - external			
	Sink	extract			
D4-D12 - MS DCC	Source	insertion		y	y
	Sink	extract		y	y
K1[1-8] K2[1-5(8)] linear APS	Source	insertion		K2[6-8] not used	K2[6-8] used for switching type indication
	Sink	extraction		K2[6-8] not used	K2[6-8] used for switching type indication
		defect - FOP		y	y
K1[1-8] K2[1-8] ring APS	Source	insertion		y	y
	Sink	extraction		y	y
		defect -FOP		y	y
K2[6-8] – RDI [RDI-L]	Source	insertion		min 1 frame	min 20 frames
	Sink	defect – RDI		y	y
		PM – F_DS		y	y
K2[6-8] - MS-AIS	Source	-			
	Sink	defect -AIS		y	y
		PM – N_DS		y	y
		consequent action - AIS		y	y
		consequent action - RDI		y	y
		protection switching - SF		y	y
M1 - REI [REI-L] (PM based on BIP24N violations)	Source	insert BIP violation number		MS-0: n/a MS-1/4/16/64/256: y	STS-1: n/a STS-3/12/48/192/768: y
	Sink	PM – F_EBC		MS-0: n/a MS-1/4/16/64/256: y	STS-1: n/a STS-3/12/48/192/768: y
NU - national use	Source	insertion - fixed stuff or external		y	fixed stuff (all-0's)
	Sink	ignore		y	y
S1 - synchronisation status message	Source	insertion		SDH code set	SONET code set
	Sink	extract		SDH code set	SONET code set
		consequent action - …..			
Z1, Z2 - growth	Source	insertion - fixed stuff: all-0's		n.a.	y
	Sink	ignore		n.a.	y
unmarked	Source	insertion - fixed stuff: all-0's		y	y
	Sink	ignore		y	y

OH byte	Direction	Process	Location	SDH Administrative Unit AU-3/4/4-4c/4-16c/4-64c	SONET STS-1/3c/12c/48c/192c
H1H2 – AU [STS] and TU-3 pointer	Source	pointer generation	A	ss = 10	ss = 10 (old ss = 00)
		consequent action - AIS	A	250 µs	125 µs
		increment action	A	y	y
		decrement action	A	y	y
		new pointer action	A	y	y
		non-gapped pointer adjustments	A	y	y
		enhanced wander performance (dithering method to reduce wander)	A	n	n
		PM – PJE+, PJE-	A	y	n
		PM – PPJC-Gen, NPJC-Gen, PJCS-Gen, PJCDiff	A	n	y
	Sink	SS-bits	A	ignore	ignore
		pointer interpretation	A	y (see Note)	y (see Note)
		increment detection	A	majority of D bits	majority of D bits, or 8 out of 10
		decrement detection	A	majority of I bits	majority of I bits, or 8 out of 10
		NDF enabled detection	A	y	y
		defect - AIS	A	y	y

		defect - LOP	A	y	y
		PM – PPJC-Det, NPJC-Det, PJCS-Det	A	n	y
		PM – N_DS	PT	y	y
		consequent action - AIS (on defect)	A	250 µs	125 µs
		consequent action - AIS (on AIS indication)	A	n	y
		consequent action - RDI	PT	y	y
		consequent action - ERDI-server	PT	n	y
		protection switching - SF	A	y	y
H1H2 – AU [STS] pointer	Sink	AU [STS] multiplex structure determination	A	MS SPring limited to the AU's being part of the protection capacity in a MS SPRING ring that are not deselected (locked out). Other AU's may only change type on provisioning.	BLSR, STS pipe Automatic mode default, Fixed mode selectable per STS3 group.
H3 – AU [STS] justification opportunity	Source	insertion - data during justification action	A	y	y
		insertion - fixed stuff otherwise	A	y	y
	Sink	extract – data during justification action	A	y	y
		ignore - otherwise	A	y	y

Note - SONET pointer processing is defined by Telcordia where the standard T1.105 is unclear, i.e.:
1. Pass all 1's H1/H2 byte downstream immediately without waiting for AIS declaration which occurs after 3 frames.
2. Declare LOP condition if no 3 consecutive normal or no 3 consecutive AIS H1/H2 bytes are received in an 8 frame window (e.g. alternating AIS/normal pointer will result in LOP).
3. Use 8 out of 10 criteria instead of majority vote for increment/decrement decision (Objective).

OH byte	Direction	Process	Location	SDH Path VC-3/4/4-Xc (X=4,16,64,256)	SONET Path STS-1/3c/12c/48c/192c SPE
B3 - BIP8	Source	calculation	PT	y	y
	Sink	defect EXC./DEG or DEG	PT	dDEG based on 1 second PM info	dEXC/dDEG based on 10^{-x} algorithm
		PM – N_EBC	PT	count errored blocks	count BIP violations (count errored blocks if ERDI supported)
		Protection Switching - SF	NIM	n	y
		Protection Switching - SD	PT	y	n/a
			NIM	y	y
C2 - UNEQ	Source	insertion – all-0's	C	y	y
	Sink	defect -UNEQ	PT	y, ETSI specification requires extra robustness for bursts of errors	y
			NIM		
		PM – N_DS	PT	y	n
			NIM	y	n
		consequent action - AIS	PT	y	?
		consequent action - RDI	PT	y	n
		consequent action - ERDI-connectivity	PT	n	y
		protection switching - SF	PT	y	n/a
			NIM	y	y
C2 - VC-AIS	Source	creation			
	Sink	defect – AIS	PT	n	n
			NIM	y	n
		PM – N_DS	PT	n	n
			NIM	y	n
		consequent action - AIS	PT	n	n
		consequent action - RDI	PT	n	n
		consequent action - ERDI-server	PT	n	n
		protection switching - SF	PT	n	n
			NIM	y	n
C2 - payload type	Source	insertion	A	y	y
	Sink	defect – PLM	A	y (under study)	y
			NIM	n	y
		consequent action - AIS	A	y	y
		consequent action - RDI	A	n	n
		consequent action - ERDI-payload	A	n	y
		protection switching - SF	A	y	y
			NIM	n	n
		acceptance & reporting	A	y	y
			NIM	n	y

C2 - Payload Defect Indicator	Source	insertion - number of VT's within STS1 in signal fail	A/PT	n	y
	Sink	defect – PDI	NIM	n	y
		protection switching - SF	NIM	n	y
		acceptance & reporting		n	y
F2 - user channel	Source	insertion - internal or external	A	y	y
	Sink	ignore or extract	A	y	y
F3 - user channel (SDH)	Source	undefined – fixed stuff insertion	A	y	n/a
	Sink	ignored	A	y	n/a
Z3 – growth (SONET)	Source	undefined – fixed stuff insertion	A	n/a	y
	Sink	ignored	A	n/a	y
G1[5] – RDI [RDI-P]	Source	insertion	PT	min 1 frame	min 20 frames
	Sink	defect - RDI	PT	5 frames	10 frames
			NIM		
		PM – F_DS	PT	y	y
			NIM	y	y
G1[1-4] - REI [REI-P]	Source	insertion of BIP violation number	PT	y	y
	Sink	PM – F_EBC	PT	count errored blocks	count BIP violations (count errored blocks if ERDI supported)
			NIM		
G1[5-7] - ERDI	Source	insertion	A	n	y
			PT	n	y
	Sink	defects - RDIs, RDIc, RDIp	A	n	y
			PT	n	y
			NIM	n	y
		PM (RDIs, RDIc) – F_DS – T1.231 does specify its use for PM, but this is not realy needed; the use of RDI will be sufficient. RDI = RDIs + RDIc	PT	n	y
			NIM	n	y
G1[8] - reserved	Source	insertion – fixed stuff “0”		y	y
	Sink	ignore		y	y
H4[1-8]	Source	insertion – fixed stuff / VCAT overhead	A	y	y
	Sink	Ignore	A	y	y
H4[1-6] – TU multiframe alignment signal	Source	insertion – fixed stuff “111111”	A	y	y
	Sink	ignore	A	y	y
H4[7-8] – TU multiframe alignment signal	Source	insertion	A	y	y
	Sink	defect – LOM for TU1/2 [VT]	A	y	y
		consequent action - AIS for TU1/2 [VT]	A	y	y
		protection switching - SF for TU1/2 [VT]	A	y	y
J1 - path trace identifier	Source	insertion	PT	16 byte string	64 byte string
		insertion – unequipped (all-0’s)	C	y	y
	Sink	defect -TIM	PT	y	y
			NIM	y	n
		fault cause – UNEQ (all zeroes detection)	PT		
		PM – N_DS	PT	y	n (ERDI: y)
			NIM	y	n (ERDI: y)
		consequent action - AIS	PT	y	n ?
		consequent action - RDI	PT	y	n ?
		consequent action - ERDI-connectivity	PT	n	y
		protection switching - SF	PT	y	n/a
			NIM	y	n
		acceptance & reporting	PT	y	y
			NIM	y	y
K3[1-4]- linear APS (under study)	Source	insertion			
	Sink	extraction			
K3[5-6] - reserved	Source	insertion			
	Sink	ignore			
K3[7-8] – 16 kbit/s path data link (details are under study)	Source	insertion			
	Sink	extraction			
Z4 (SONET)	Source	insertion		N/a	fixed stuff
	Sink	ignore		N/a	y

OH byte	Direction	Process	Location	SDH	SONET
				Path	Path
				VC-2/12/11	VT-6/2/1.5
J2 - path trace identifier	Source	insertion	PT	16 byte string	16 byte string
		insertion – unequipped (all-0’s)	C	y	y
	Sink	defect -TIM	PT	y	n
			NIM	y	n

		fault cause – UNEQ (all zeroes detection)	PT		
		PM – N_DS	PT	y	n (ERDI: y)
			NIM	y	n (ERDI: y)
		consequent action - AIS	PT	y	n ?check T1.231, GR253?
		consequent action - RDI	PT	y	n ?check?
		consequent action - ERDI-connectivity	PT	n	y
		protection switching - SF	PT	y	n/a
			NIM	y	n
		acceptance & reporting	PT	y	y
			NIM	y	y
K4[1] – extended signal label	Source	Insertion		y	y
	Sink	extraction		y	y
K4[2] – VCAT overhead	Source	Insertion		y	y
	Sink	extraction		y	y
K4[1-4] – linear APS (under study)	Source	insertion			n/a
	Sink	extraction			n/a
K4[5-7] – Reserved	Source	insertion – fixed stuff (“000” or “111”)		n	n/a
	Sink	ignored		n	n/a
K4[8] – 2 kbit/s path data link (under study)	Source	insertion			n/a
	Sink	extraction			n/a
V1V2 – TU [VT] pointer	Source	pointer generation	A	y	y
		consequent action - AIS	A	1000 µs	500 µs
		increment action	A	y	y
		decrement action	A	y	y
		new pointer action	A	y	y
		non-gapped pointer adjustments	A	y	y
		enhanced wander performance (dithering method to reduce wander)	A	n	n
		PM – PJE+, PJE-	A	n	n
		PM – PPJC-Gen, NPJC-Gen, PJCS-Gen, PJCDiff	A	n	y
	Sink	pointer interpretation	A	y (note)	y (note)
		increment detection	A	majority of D bits	majority of D bits, or 8 out of 10
		decrement detection	A	majority of I bits	majority of I bits, or 8 out of 10
		NDF enabled detection	A	y	y
		defect – AIS	A	y	y
		defect – LOP	A	y	y
		PM – PPJC-Det, NPJC-Det, PJCS-Det	A	n	y
		PM – N_DS	PT	y	y
			NIM	y	y
		consequent action - AIS (on defect)	A	1000 µs	500 µs
		consequent action - AIS (on AIS indication)	A	n	y
		consequent action – RDI	PT	y	y
		consequent action - ERDI-server	PT	n	y
		protection switching – SF	A	y	y

Note - Although pointer processing differences between the SONET and SDH standards may be hard to find, Bellcore does impose additional requirements where the standard is unclear. SONET is supposed to also meet the additional Bellcore requirements, i.e.

1. Pass all 1's H1/H2 byte downstream immediately without waiting for AIS declaration which occurs after 3 frames.
2. Declare LOP condition if no 3 consecutive normal or no 3 consecutive AIS H1/H2 bytes are received in an 8 frame window (e.g. alternating AIS/normal pointer will result in LOP).
3. Use 8 out of 10 criteria instead of majority vote for increment/decrement decision (Objective).

V3 – TU [VT] justification opportunity	Source	insertion - data during justification action	A	y	y
		insertion - fixed stuff otherwise	A	y	y
	Sink	extract – data during justification action	A	y	y
		ignore - otherwise	A	y	y
V4 – reserved	Source	insertion – fixed stuff	A	y	y
	Sink	ignore	A	y	y
V5[1-2] – BIP2	Source	calculation	PT	y	y
	Sink	defect EXC./DEG or DEG	PT	dDEG based on 1 second PM info	dEXC/dDEG based on 10^{-x} algorithm
			NIM		
		PM – N_EBC	PT	count errored blocks	count BIP violations (count errored blocks if ERDI supported)
			NIM		
		Protection Switching - SF	NIM	n	y
		Protection Switching - SD	PT	y	n/a
			NIM	y	y
V5[3] - REI [REI-V]	Source	insertion of BIP violation number	PT	y	y
	Sink	PM – F_EBC	PT	y	y
			NIM	y	y
V5[4] – VC-2/12 [VT-6/2] reserved	Source	insertion – fixed stuff “0”		y	y
	Sink	ignore		y	y

V5[4] – VC11 [VT1.5] RFI	Source	insertion	PT	y	y
	Sink	defect – RFI ???	PT	y	y
		PM ??	PT		
V5[5-7] - UNEQ	Source	insertion	C	y	y
	Sink	defect -UNEQ	PT	y, ETSI specification requires extra robustness for bursts of errors	y
			NIM		
		PM – N_DS	PT	y	n
			NIM	y	n
		consequent action - AIS	PT	y	?
		consequent action - RDI	PT	y	n
		consequent action - ERDI-connectivity	PT	n	y
		protection switching - SF	PT	y	n/a
			NIM	y	y
V5[5-7] - VC-AIS	Source	creation			
	Sink	defect – AIS	PT	n	n
			NIM	y	n
		PM – N_DS	PT	n	n
			NIM	y	n
		consequent action - AIS	PT	n	n
		consequent action - RDI	PT	n	n
		consequent action - ERDI-server	PT	n	n
		protection switching - SF	PT	n	n
			NIM	y	n
V5[5-7] - payload type if value is '101' use extended signal label in K4[1]	Source	insertion	A	y	y
	Sink	defect – PLM	A	y (under study)	y
			NIM	n	y
		consequent action - AIS	A	y	y
		consequent action - RDI	A	n	n
		consequent action - ERDI-payload	A	n	y
		protection switching - SF	A	y	y
			NIM	n	n
		acceptance & reporting	A	y	y
			NIM	n	?
V5[8] – RDI [RDI-V]	Source	insertion	PT	min 1 frame	min 20 frames
	Sink	defect - RDI	PT	5 frames	10 frames
			NIM		
		PM – F_DS	PT	y	y
			NIM	y	y
Z7[5-7] – ERDI (SONET)	Source	insertion	A	n/a	y
			PT	n/a	y
	Sink	defects - RDIs, RDIc, RDIp	A	n/a	y
			PT	n/a	y
			NIM	n/a	y
		PM (RDIs, RDIc) – F_DS	PT	n/a	y
			NIM	n/a	y

In general VC [STS] NIMs are used in the following applications:

1. provide detection of connectivity and error defects for SNC/N protection switch; e.g. in dual node ring interworking and (linear) path protection applications.
2. be used as a "work around" for tandem connection monitoring when TCOH processing (N1 bytes) is not supported
3. aid in fault localisation within a VC [STS] trail
4. performing single ended maintenance of a VC [STS] trail by monitoring at an intermediate [midspan] node.