

E1+Jitter+Wander+Data

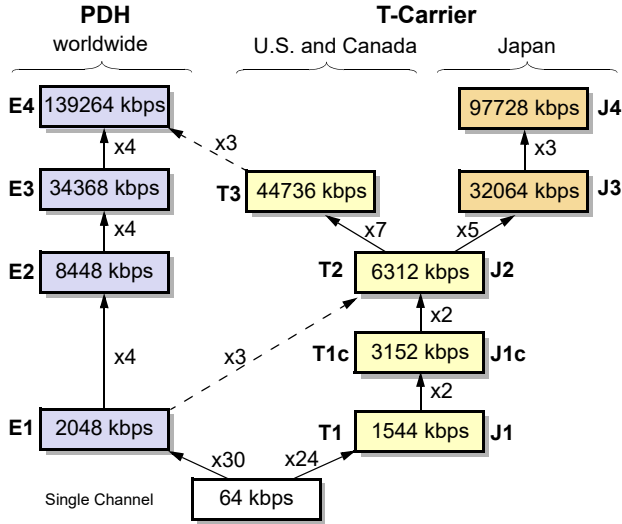


Fig. 1 PDH and T-carrier hierarchies

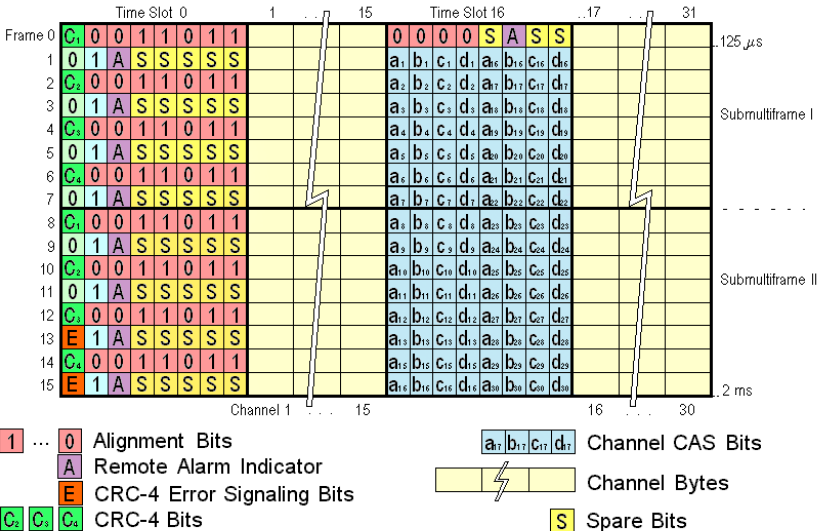


Fig. 2 The E1 frame is the first hierarchy level.

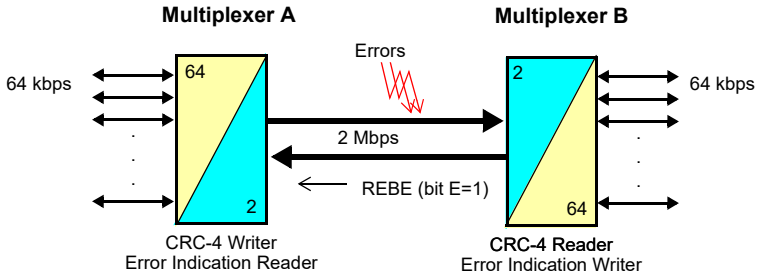


Fig. 3 The A multiplexer calculates and writes the CRC code, and the multiplexer B reads and checks the code.

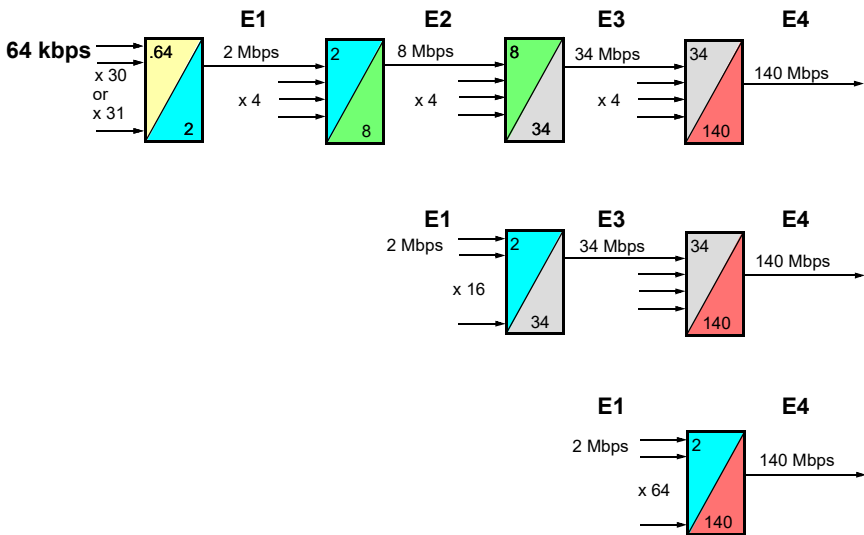
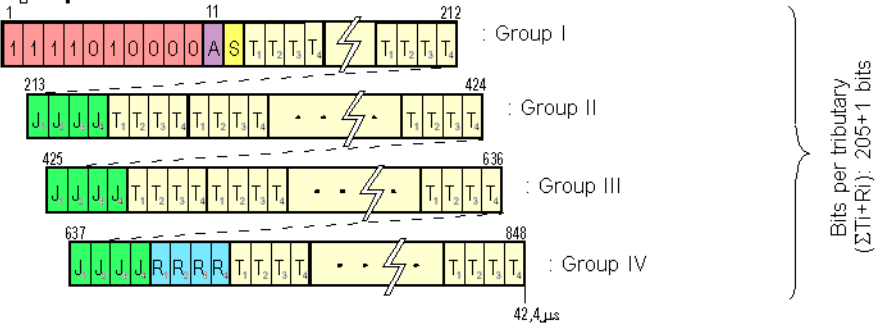


Fig. 4 The PDH hierarchy

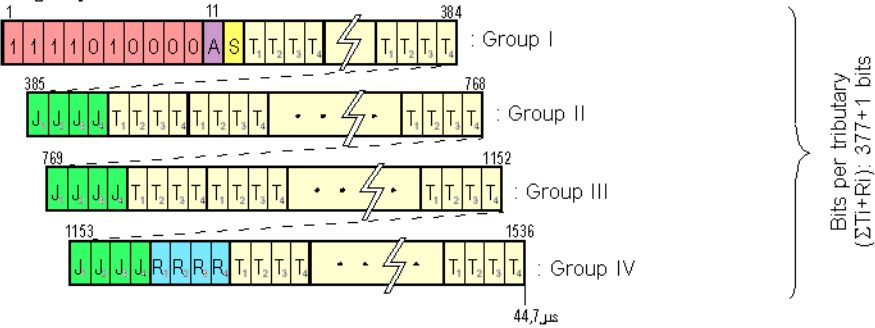
Standard	Binary Rate	Size	Frame/s	Code	Amplitude	Attenuation
G.704/732	2,048 kbps±50 ppm	256 bits	8,000	HDB3	2.37-3.00V	6 dB
G.742	8,448 kbps±30 ppm	848 bits	9,962.2	HDB3	2.37V	6 dB
G.751	34,368 kbps±20 ppm	1536 bits	22,375.0	HDB3	1.00V	12 dB
G.751	139,264 kbps±15 ppm	2928 bits	47,562.8	CMI	1.00V	12 dB

Table 1 The PDH hierarchy figures

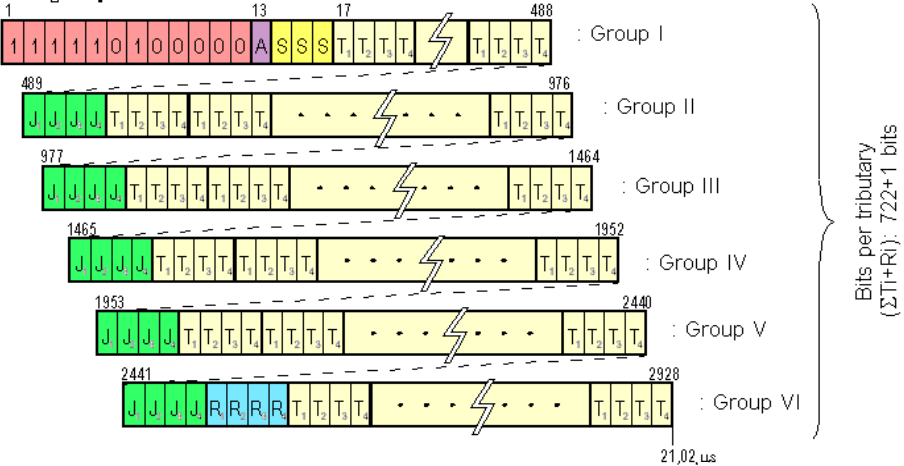
8 Mbps



34 Mbps



140 Mbps



- 1 ... 0 Frame Alignment Signal (Fas)
- S Spare Bits
- A Remote Alarm Indicator

- T₁ T₂ T₃ T₄ Tributary Bits
- J₁ J₂ J₃ J₄ Justification Control Bits
- R₁ R₂ R₃ R₄ Justification Opportunity Bits

Fig. 5 The higher PDH hierarchies. A bit-oriented justification process is used to fit tributaries created with clock impairments.

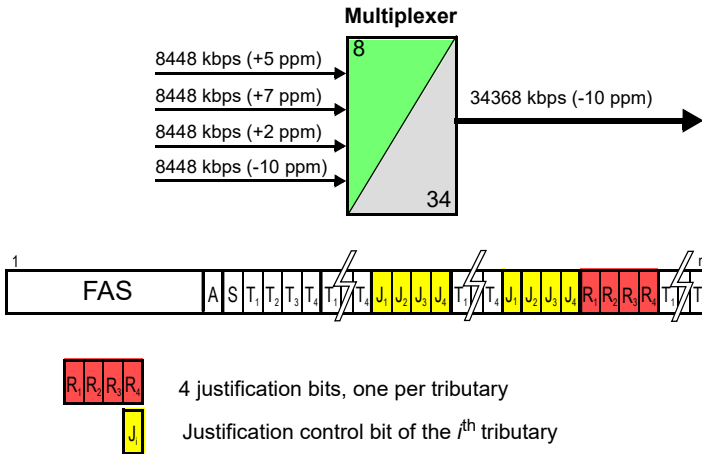
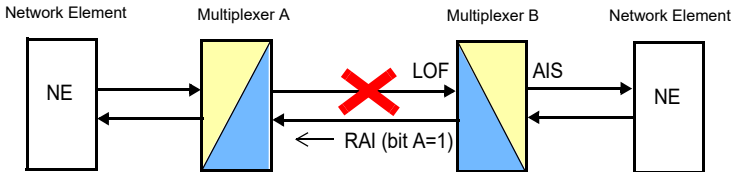
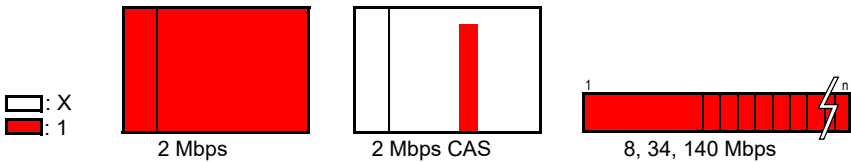


Fig. 6 PDH hierarchies are not synchronous, and variations can be expected in the bit rate clock - in this case a justification mechanism is implemented. If all $J_j=1$, then the R_j bit does not contain information. If all $J_j=0$, then R_j contains information.

Alarm Management:



AIS Formats:



RAI Formats:

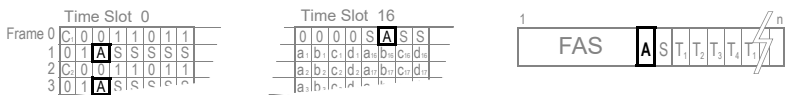


Fig. 7 When a multiplexer detects an LOS or LOF, it sends an RAI to its partner multiplexer and forwards an AIS to the next NE.

ID	Detection Criteria
AIS	Alarm Indication Signal. It is detected if there are two or less zeros (ITU-T G.775).
LOF	Loss of Frame alarm. It is raised after three consecutive frames with FAS error or three consecutive signalling bits (ITU-T G.706).
LOS	Loss of Frame Signal alarm.
RAI	Remote Alarm Indication. It is detected after three consecutive frames with the A bit equal to 1 (ITU-T G.732).
FAS error	Frame Alignment Signal error, indicating an incorrect bit in the alignment word.
Bit error	Bit sequence mismatch (when the transmitted pattern is known).
Code error	Violation on coding sequence.
CRC-LOM	Cyclic Redundancy Checksum - Loss of Multiframe. Activated if there is LOF, and deactivated after one correct FAS and two correct CRC-MFAS (ITU-T G.706).
CAS-LOM	Channel-Associated Signalling - Loss of Multiframe. Raised after two consecutive MFAS errors or two multiframe with time slot 16 bits equal to 0 (ITU-T G.732).
CAS-MRAI	Channel-Associated Signalling - Multiframe Remote Alarm Indication. Detected after two consecutive frames with the MRAI bit equal to 1 (ITU-T G.732).
CAS-MAIS	Channel-Associated Signaling - Multiframe Alarm Indication Signal. Detected if there are less than three zeros in the time slot 16 during two consecutive multiframe.
CRC error	Cyclic Redundancy Check error. Raised if one or more bits are erroneous, whenever CRC-LOM is off (ITU-T G.706).
REBE	Remote End Block Error. Raised if the first bit of the frames 14 and 16 is 0 (ITU-T G.706).

Table 2 2 Mbps events: alarms, errors and event indications

ID	Explanation
AIS	Alarm Indication Signal. This is detected if less than six zeros in a frame in the case of 140 Mbps, or less than three zeros in 34 Mbps and 8 Mbps.
LOF	Loss of Frame alarm. Raised after four consecutive frames with FAS error
LOS	Loss of Frame Signal alarm
RAI	Remote Alarm Indication. Detected after two consecutive frames with A equals 1
FAS error	Frame alignment signal error. One or more incorrect bits in the alignment word.

Table 3 PDH events: alarms, errors and event indications for all the hierarchies

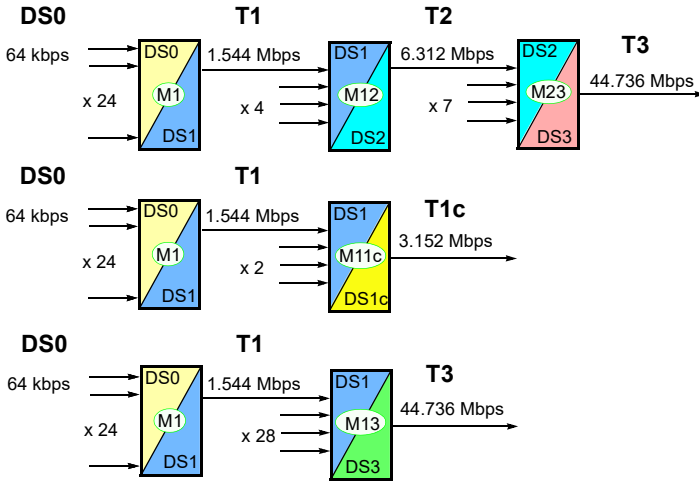


Fig. 8 T-Carrier hierarchy (US)

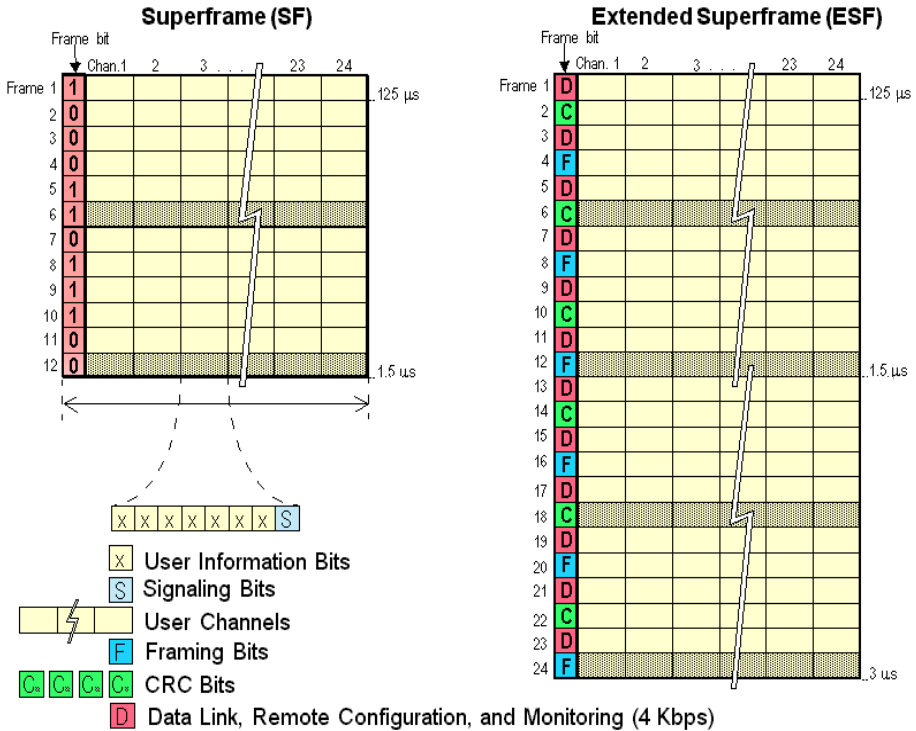


Fig. 9 The T1 frame and superframe

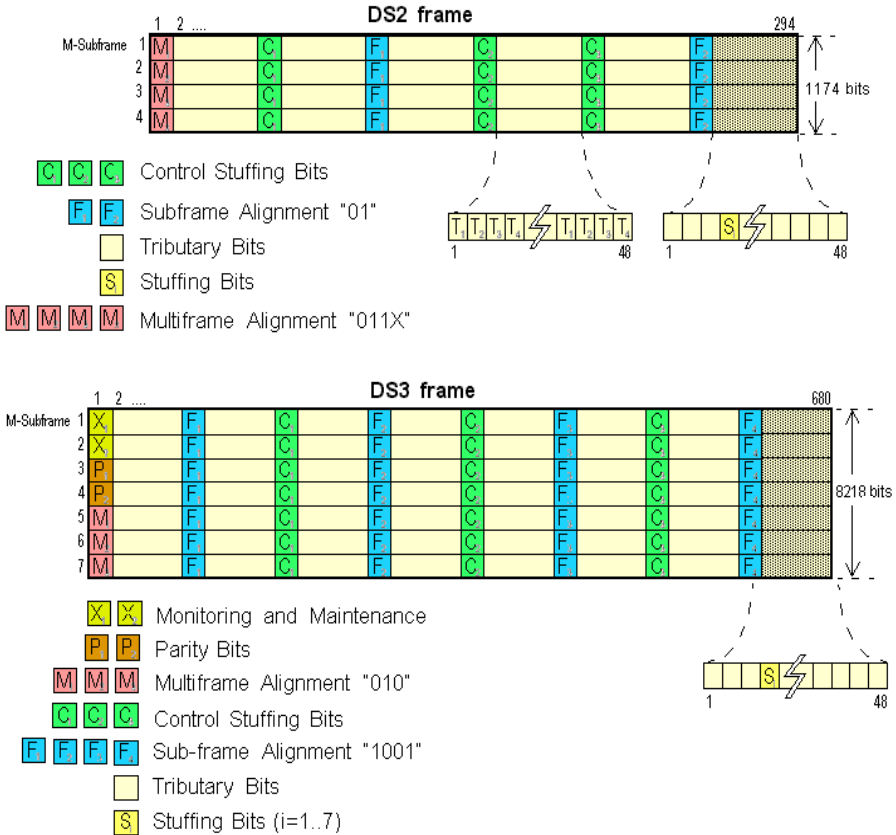


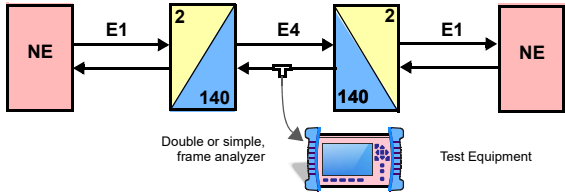
Fig. 10 The DS2 frame or M12 multiplexing and DS3 frame.

00110010 11111111	DS3 equipment failure	Service Affecting (SA), requires quick attention
00011110 11111111	DS3 equipment failure	Non-Service Affecting (NSA)
00000000 11111111	DS1 equipment failure	Service Affecting (SA), requires quick attention
00001010 11111111	DS1 equipment failure	Non-Service Affecting (NSA)
00011100 11111111	DS3 LOS	Loss of Signal
00101010 11111111	Multiple DS1 LOS	Multiple Loss of Signal in the DS1 tributaries
00111100 11111111	Single DS1 LOS	Loss of Signal received from a DS1
00000000 11111111	DS3 OOF	Out of Frame in the DS3 signal
00101100 11111111	DS2 AIS	Alarm Indication Signal received from a DS2

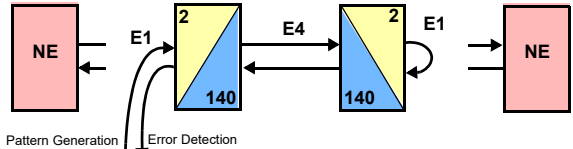
Table 4 C-bit parity: alarm and status signal codes

Test and Measurement;

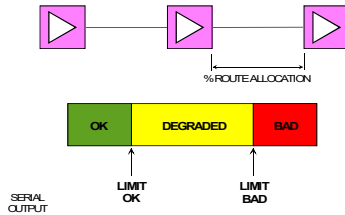
In-Service-Measurement (ISM)



Out-of-Service-Measurement (OOSM)



Performance Measurement



	10GE	OWD	T1/E1	IP	PRP	SyncE	PTP	NTP	Tap	VoIP	Serial	Contrlr	IRIG-B	Goose	SV	C37.94	GPON	NGPON	XGSPON
AT-One			★								★	★							
AT-2048			★								★	★							
Ether.Giga		★	★	✓		★	★	★			★					★			
Ether.Giga				★															
GPONdtr 4.5k																		★	
GPONdtr 9.5k																		★	★
GPONdtr 10k																		★	★
Net.Hunter				✓				○	○	○					○	○			
Net.Shark				✓				○	○	★					○	○			
Net.Storm				○											○	○			
Net.Time 0			★	★	★	★	★	★						★					
Net.Time φ			★	★	★	★	★	★						★					
Net.Time τ			★	★	★	★	★	★											
VoIP.Master																			
xGenius	★	★	★	★		★	★	★	✓	○	★	★	★	○	○	★			
Zeus			★	★		★	★	★	✓	○	★	★	★	★	★	★			

★ Best ✓ Good ○ Partial

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