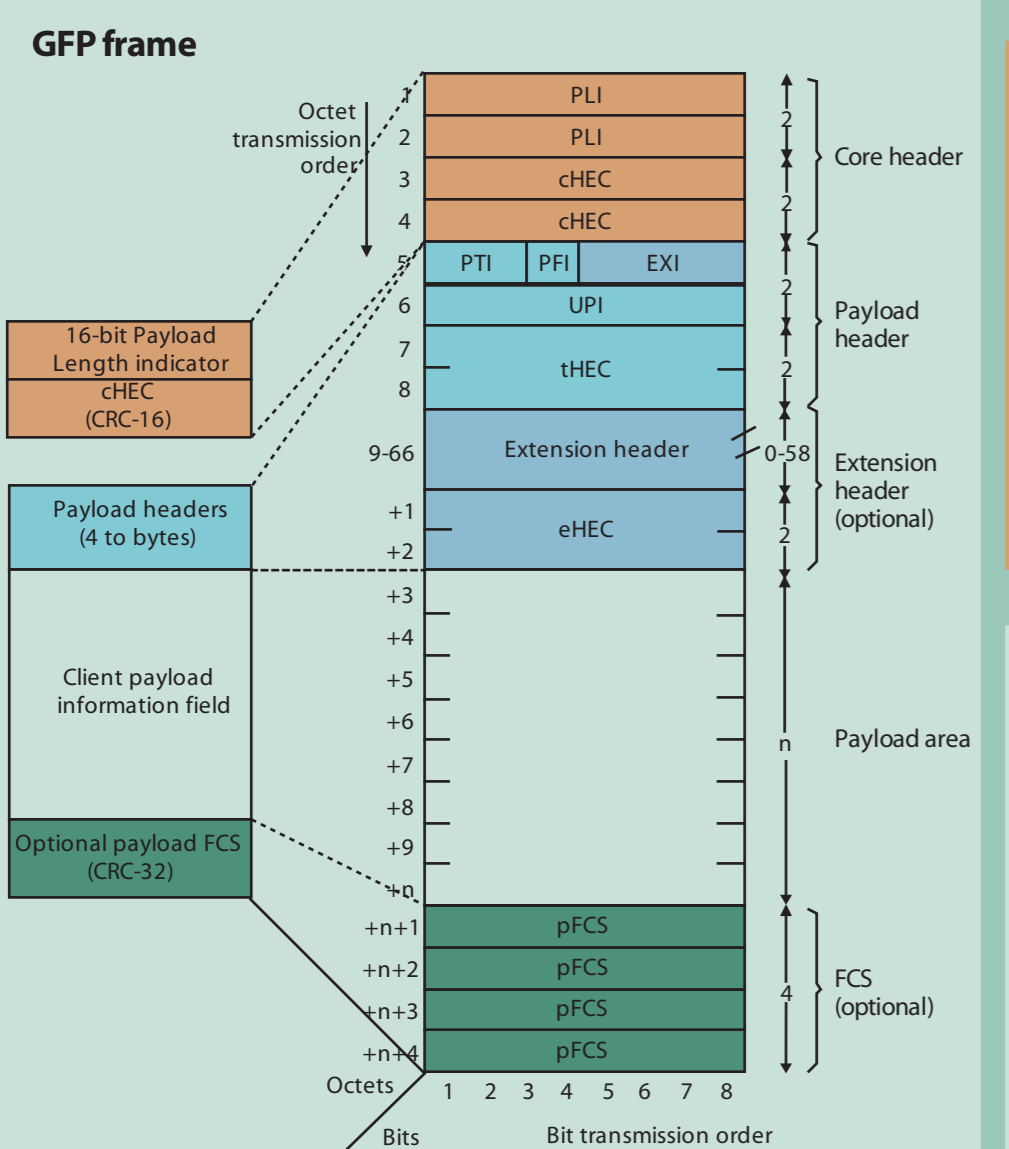
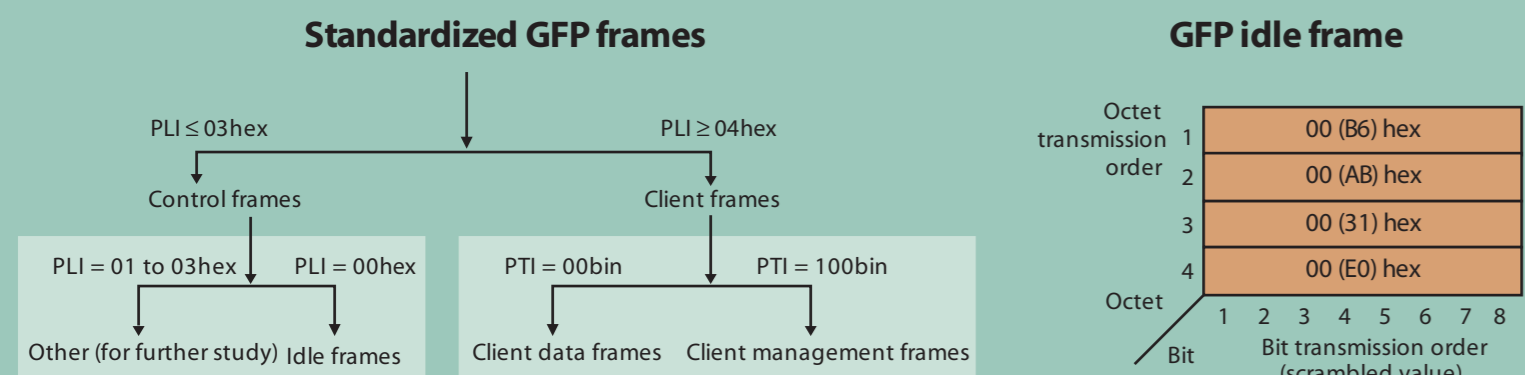


# Evolution of Next Generation Networks

## Generic Framing Procedure (GFP)

GFP supports the rate adaptation between frame/packet-based traffic and synchronous traffic



**PDU length indicator (PLI) field**  
The 2-octet PLI field: A binary number representing the number of octets in the GFP payload area. Minimum value of the PLI field in a GFP client frame is 4 octets.

**Core HEC (cHEC) field**  
The 2-octet core header error control field: CRC-16 error control code protecting the integrity of the contents of the core header by enabling both single-bit error correction and multi-bit error detection.

**Payload type identifier (PTI)**  
A 3-bit subfield identifying the type of GFP client frame.

**GFP client management frame user payload identifier**

UPI value	Usage
0000 0000 and 1111 1111	Reserved
0000 0001	Client signal fail (loss of client signal)
0000 0010	Client signal fail (loss of character synchronization)
0000 0011 through 1111 1110	Reserved for future use

**Payload FCS indicator (PFI)**  
A 1-bit subfield indicating the presence or absence of the payload FCS field.

**User payload identifier (UPI)**  
An 8-bit field identifying the type of payload conveyed in the GFP payload information field.

**Extension header identifier (EXI)**  
A 4-bit sub-field of the type field identifying the type of extension header.

**GFP extension header identifiers**

Extension header identifier type bits	Usage
0000	Null extension header
0001	Linear frame
0010	Ring frame
Others	Reserved

**Channel ID (CID) field**  
The CID is an 8-bit binary number used to indicate one of 256 communication channels at a GFP termination point.

**Spare field**  
The 8-bit spare field, reserved for future use.

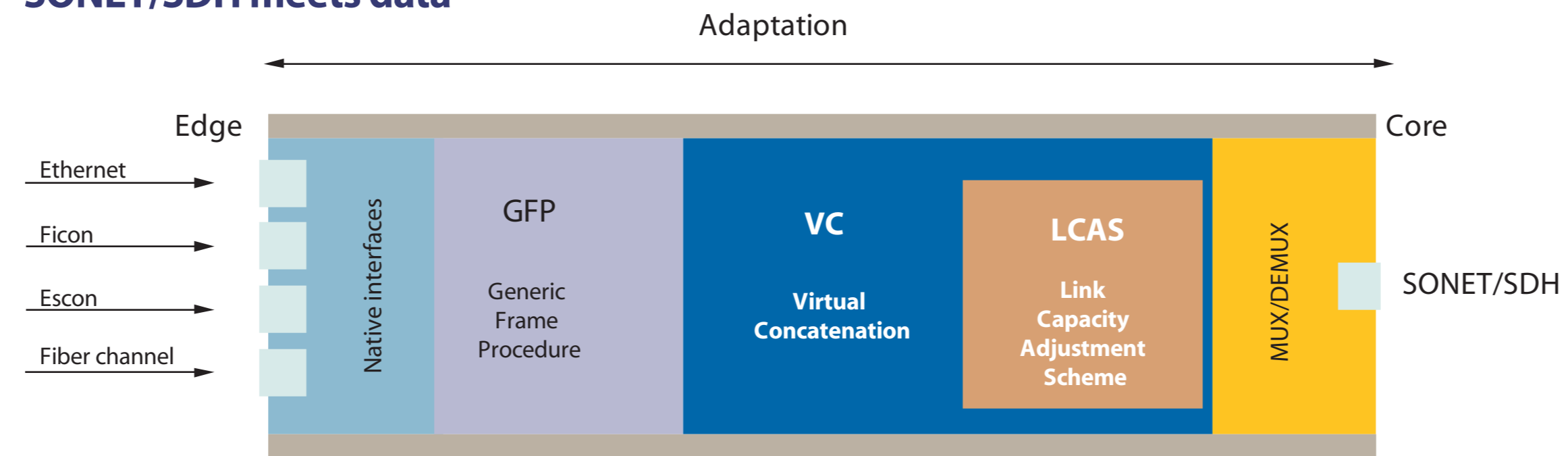
**Extension HEC (eHEC) field**  
CRC-16 error control code that protects the integrity of the contents of the extension headers.

**Type HEC (tHEC) field**  
The 2-octet type header error control field contains a CRC-16 error control code that protects the integrity of the contents of the type field.

**Null extension header**  
This extension header applies to a logical point-to-point configuration, where the transport path is dedicated to one client signal.

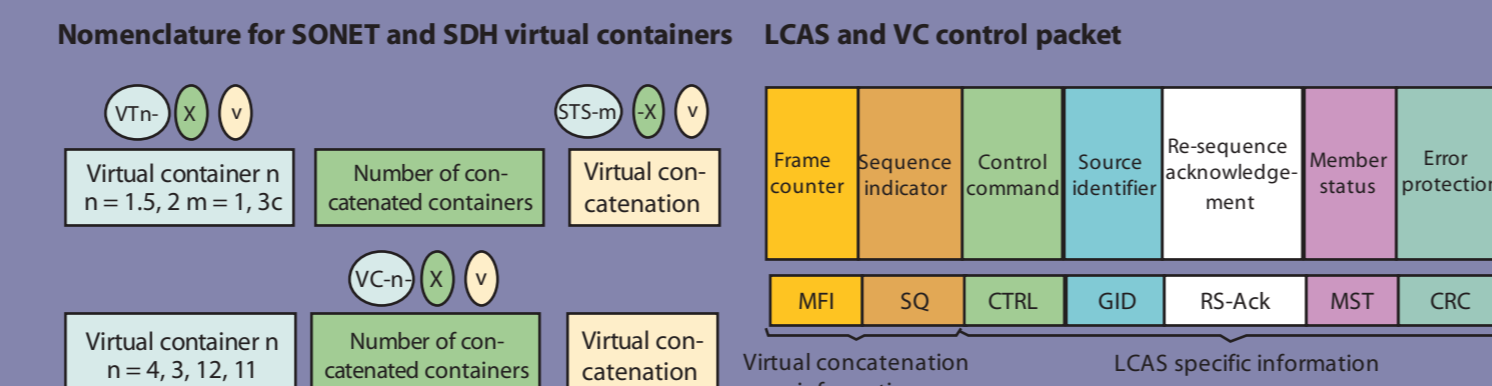
**Ring extension header**  
For further study.

## SONET/SDH meets data



## Virtual Concatenation (VC) and Link Capacity Adjustment Scheme (LCAS)

VC supports the efficient use of transport capacity, LCAS enables the hitless bandwidth provisioning.



	High-order VC-3/4, STS-1/3c	Low-order VC-11/12, VT-1.5/2
<b>VC</b>	<p>Frame counter (MFI): A combination of the 1<sup>st</sup> multiframe and the 2<sup>nd</sup> multiframe MFI = 0-4095</p> <p>Sequence indicator (SQ): Number to identify each member in the VCG SQ = 0-255</p>	<p>Frame counter (MFI): Multi frame counter MFI = 0-31</p> <p>Sequence indicator (SQ): Number to identify each member in the VCG SQ = 0-63</p>
<b>LCAS</b>	<p>Member status (MST): The status of all members (256) is transferred in 64 ms.</p> <p>MST = 0 → Link OK MST = 1 → Link FAIL</p>	<p>Member status (MST): The status of all members (64) is transferred in 128 ms.</p> <p>MST = 0 → Link OK MST = 1 → Link FAIL</p>

**Parameters that are identical for high and low order VC**

Ctrl: → table LCAS CTRL words

GID: Group identification bit, 1 bit identical for all members of the VCG in the multiframe. The content is given by a PRBS 2<sup>11</sup>-1

RS-Ack: Re-sequence acknowledge bit. Toggling value between 0 ↔ 1

### Sequence and multiframe indicator for the H4 coding

H4 byte multiframe		MFI1	MFI2
Bit 1 to 4	Bit 5 to 8	0	0
MFI2 (bit 1-4)	MFI2 (bit 5-8)	0	0
CTRL	0	0	1
GID "000x"	0	0	1
Reserved "0000"	0	1	0
Reserved "0000"	0	1	0
CRC-8	0	1	0
CRC-8	0	1	1
Member status (MST)	1	0	0
Member status (MST)	1	0	0
RS-Ack "000x"	1	0	1
Reserved "0000"	1	0	1
Reserved "0000"	1	1	0
Reserved "0000"	1	1	0
SQ (bit 1-4)	1	1	0
SQ (bit 5-8)	1	1	1

### Sequence and multiframe indicator for the Z7/K4 [1] coding

Z7/K4 [1] coding	
Frame count	Sequence indicator (SQ)
CTRL	GID
Spare	Member status
CRC-3	

### Sequence and multiframe indicator for the Z7/K4 [2] coding

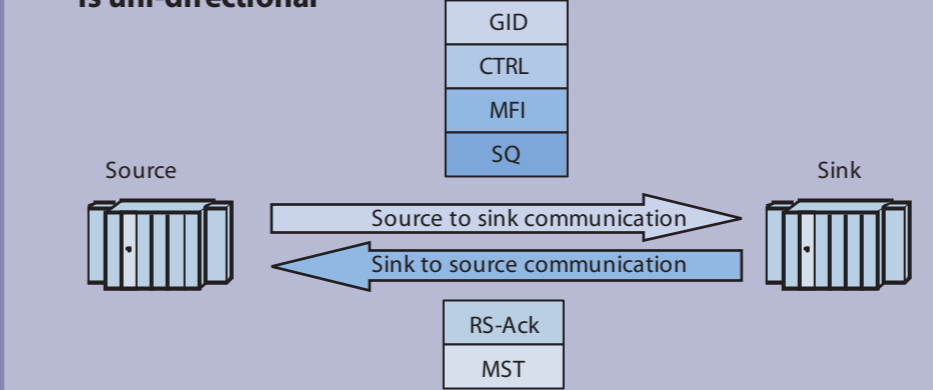
Z7/K4 [2] coding	
Frame count	Sequence indicator (SQ)
CTRL	GID
Spare	Member status
CRC-3	

LCAS CTRL words

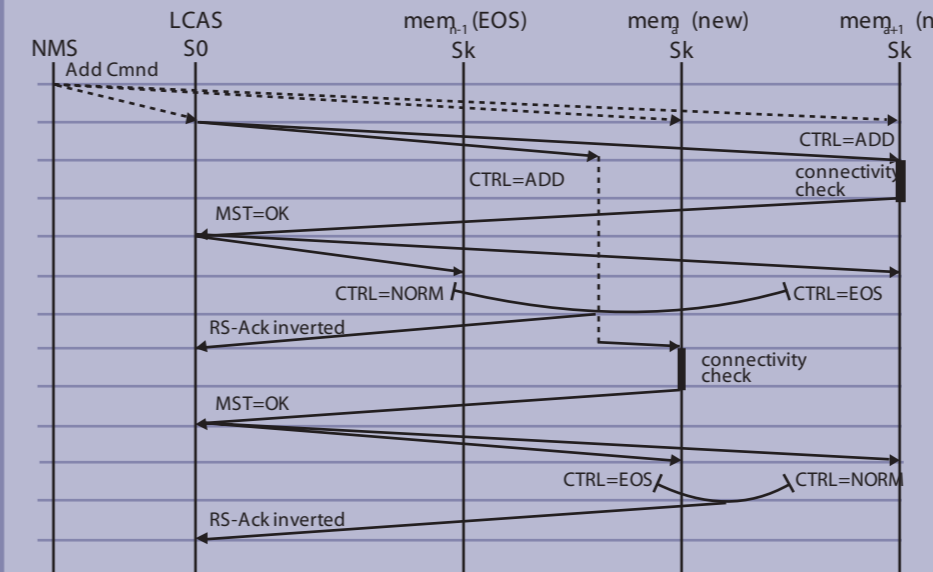
Value mib	Com- mand	Remarks
0000	FIXED	non-LCAS mode
0001	ADD	This member is about to be added to the group
0010	NORM	Normal transmission
0011	EOS	End of sequence indication and normal transmission
0101	IDLE	This member is not part of the group or about to be removed
1111	DNU	Do Not Use (the payload) the Sk side reported FAIL status

At initiation of a VCG source all members shall send CTRL = IDLE.

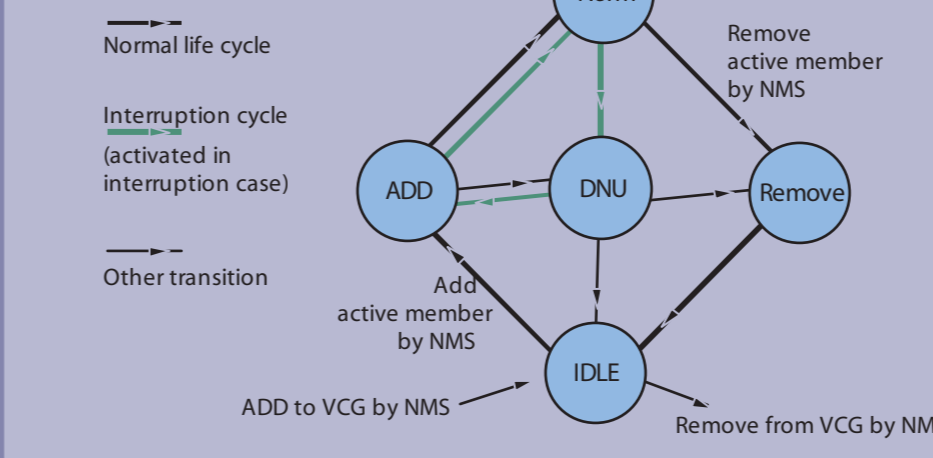
### LCAS communication is uni-directional



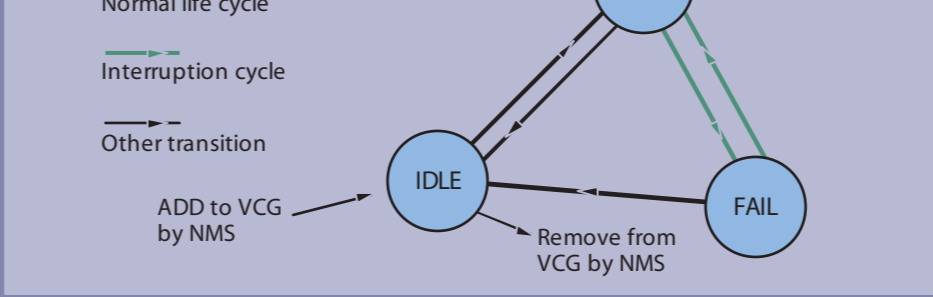
### Example for ADD command



### Source state machine



### Sink state machine



## Events and Abbreviations

Events NewSONET/SDH with NewGen Module 2.5G In accordance with ITU-T G.707 / G.783 / G.7041 / G.7042 / ANSI T.105 and IEEE 802.x / ISO-IEC 8802-3

Abbreviation NewSONET/SDH	Definition	Generation and detection criteria	Abbreviation NewSONET/SDH	Definition	Generation and detection criteria
<b>STS PATH/TRIBUTARY UNIT</b>			<b>GFP Events</b>		
OOM1	Out of Multiframe 1	OOM1 error detected in the MF12 multiframe or first multiframe is in OOM1	CH_SINGL	Core Header Single Error	Least significant cHEC bit is inverted
OOM2	Out of Multiframe 2	OOM2 error detected in the MF12 multiframe or first multiframe is in OOM2	CH_MULT	Core Header Multiple Error	Two least significant cHEC bits are inverted
SQM	Sequence indicator Mismatch	Accepted sequence number does not match expected sequence number	TH_SINGL	Payload Type Header Single error	Least significant tHEC bit is inverted
LOA	Loss of Alignment	Alignment process cannot perform alignment of VCG members. Maximum differential delay exceeded.	TH_MULT	Payload Type Header Multiple error	Two least significant tHEC bits are inverted
<b>Virtual Tributary PATH / LO - PATH</b>			<b>GFP PayL/FCS LFD</b>		
OOM1	Out of Multiframe 1	OOM1 error detected in MF12 multiframe or first multiframe is in OOM1	Optional CRC errors	Check sum errors (CRC) in GFP frame	Detect Type header state machine not in SYNC state. Generate insert multi bit error in core header of GFP frame.
OOM2	Out of Multiframe 2	OOM2 error detected in MF12 multiframe or first multiframe is in OOM2	Loss of Frame Definition	Loss of Frame Definition	Check sum errors (CRC) in MAC frame. Detect alarm frame with "loss of sign" or "loss of character" in Type field LPI Generate select "loss of sign" or "loss of character"
SQM	Sequence indicator Mismatch	Accepted sequence number does not match expected sequence number	Client Signal Fail	Client Signal Fail	Detect alarm frame with "loss of sign" or "loss of character" in Type field LPI Generate select "loss of sign" or "loss of character"
LOA	Loss of Alignment	Alignment process cannot perform alignment of VCG members. Maximum differential delay exceeded.	<b>MAC Events</b>		
<b>LCAS Events</b>			In Range errors	Only with IEEE 802.3. Payload length differs from value in length field	
LOC	Loss of Transport Capacity	Member does not carry payload	Run/frame	Only with IEEE 802.3 and Eth II frame is shorter than minimum frame length (64 byte)	
LOPC (TX-RX)	Loss of Partial Transport Capacity	Certain number of VCG members have no transport capacity	Overized	Certain number of VCG members have no transport capacity	
LOT (TX-RX)	Loss of Total Transport Capacity	No VCG member has transport capacity - all in LOC state (number 1 threshold)	MAC FCS Jabber frame	Check sum errors (CRC) in MAC frame. Only with IEEE 802.3 and Eth II frame exceeds maximum frame length and has invalid FCS	
FOP_CRC	Failure of Protocol - excessive CRC errors	More than 3 consecutive CRC errors	Lost frames	Missing sequence number in JDSU test frame	
<b>Native Services</b>			Errored frame	Aggregate all frame errors	1. Run/frame 2. Too long frame 3. In range length error frame
<b>Service</b>			LPAC	Loss of Performance Assessment Capability	Check all valid MAC criteria. No analyzable frames received for specific time interval or Higher Priority Alarm. Time interval is 10 sec.
<b>Ethernet</b>					
10BaseT	12.5 Mb/s	LAN, VPN, NAS, data networks			
100BaseT	1.25 Mb/s	WANS			
1000BaseT	1.25 Gb/s	WANS			
10GE WAN	9.953 Gb/s	WANS			
10GE LAN	10.313 Gb/s	Metro networks			
<b>Fiber Channel</b>					
FC eighth speed	132.813 Mb/s				
FC quarter speed	265.625 Mb/s				
FC half speed	531.250 Mb/s				
FC full speed	1.063 Gb/s	SANS, Video, networks			
FC double speed	2.125 Gb/s				
FC quadruple speed	4.250 Gb/s				
<b>ESCON / FICON</b>					
Enterprise Systems Connection	200 Mb/s	SANS, E-commerce			
Fiber Connection	1 Gb/s				
<b>Abbreviations</b>					
ADM	Add/Drop Multiplexer	GFPF	Frame mapped GFP	MAC	Media Access Control
APS	Automatic Protection Switching	GFP/T	Transparent mapped GFP	MAPOS	Multiple Access Protocol over SONET/SDH
cHEC	Core Header Error Control	GID	Group Identification	MFI	Multi Frame Indicator
CD	Channel Definition	GMPLS	Generalized Multi Protocol Label Switching	MST	Member Status
CRC	Cyclic Redundancy Check	HEC	Header Error Control	NAS	Network Attached Storage
CSF	Client Signal Fail	HDL	High-level Data Link Control	NE	Network Element
DVB	Digital Video Broadcasting	HD	High Order	NMS	Network Management System
eHEC	Extension Header Error Control	LAN	Local Area Network	OTN	Optical Transport Network
ESCON	Enterprise Systems Connection	LAPS	Link Access Protocol SDH	PDU	Protocol Data Unit
EXI	Extension Header Identifier	LCAS	Link Capacity Adjustment Scheme	PLI	PDU Length Identifier
FC	Fiber Channel	LO	Low Order	PFI	PDU Length Identifier
FCS	Frame Check Sequence			PTI	Payload Type Identifier
FICON	Fiber Connection			RPR	Resilient Packet Ring
GFP	Generic Framing Procedure			RS-Ack	Re-Sequence Acknowledge

To learn more, visit [www.jdsu.com/ont](http://www.jdsu.com/ont)



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