Sun Microsystems

901 San Antonio Rd

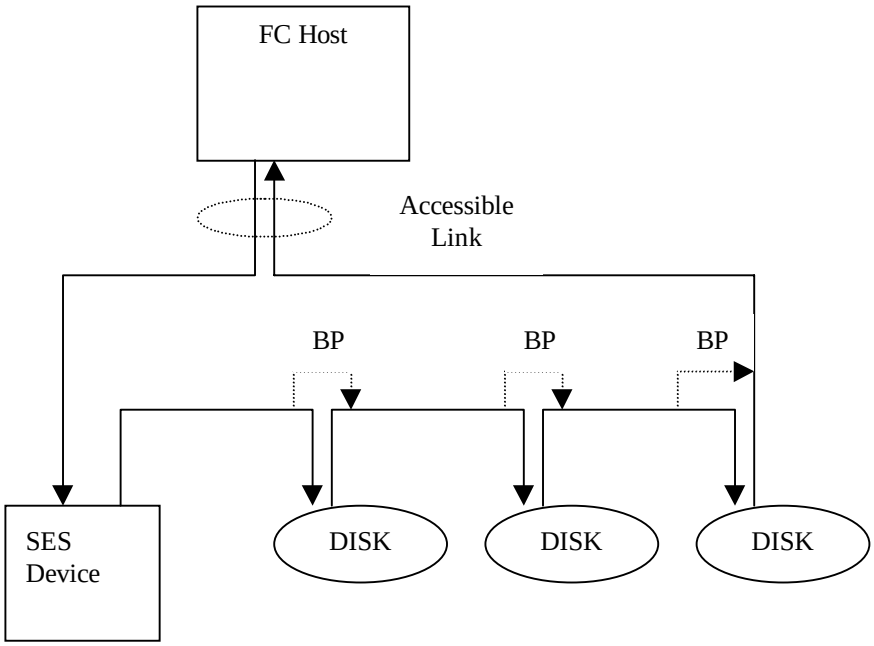
Palo Alto, CA 94303-4900

Doc:	T11/97-XXXr0
Date:	February 12, 1998
Project:	T11.2
Ref Doc.:	none
Reply to:	Bob Snively

To: T11 Membership
From: Bob Snively

Subject: Error detection mechanisms

This information is provided to T11.2 to provide the requested information about various error detection and presentation mechanisms provided in the higher levels of the Fibre Channel. An example of a typical Fibre Channel configuration is shown in the following figure. Note that the SES (SCSI Enclosure Services) device and the disks are typically placed in an enclosure such that data links are not accessible by anyone except the circuit designers. Mechanical interruption of the circuits at the printed wire or circuit level is typically required to study those internal links. The only link accessible for direct study and jitter injection is typically the link between the host and the enclosure. Bypass circuits in the enclosure are typically managed by the SES device, which may use both Fibre Channel and out-of-band communication (typically Ethernet) to control and sense the states of the bypass circuits.



There are at least four mechanisms defined in upper layers of the Fibre Channel standards that can be used to provide helpful error counting and error monitoring functions. Those mechanisms are described in the following paragraphs.

SCSI Command Failure error detection mechanism

Most SCSI drivers (and the corresponding TCP/IP programs) have mechanisms to transmit arbitrary data patterns across the link. These patterns can be selected very carefully to exacerbate known marginal jitter conditions. By carefully selecting the type of transmission (read or write) and the initiator and target selected, various combinations of the link elements of the complete loop can be verified for proper operation in the established jitter environment.

A SCSI command failure will have a very high probability that failures are associated with the data frames, since the number of bits transmitted during the data frames is much larger than the number of bits transmitted in other frames. SCSI command failures typically are actually counts of commands that have identified one or more missing frames associated with CRC failures or 8B10B code violations. The error messages will typically be either timeout indications or incomplete sequence indications.

The actual presentation mechanism for the SCSI failure is operating system dependent. The programs that are used to generate the test sequences are typically vendor specific benchmark and verification programs that exploit standard SCSI behavior.

SCSI Enclosure Services management

The SCSI enclosure services management and similar out-of-band manipulation of the loop configuration allows the testing of complete configurations by successive elimination or inclusion of links. The actual detection of the failures can be by any of the error detection mechanisms.

Intelligent hub

Intelligent hubs may have various types of error detection circuitry, including verification of loss of synchronization, loss of signal, detection of 8B10B encoding violations, and other errors. The actual error detection provided by a particular intelligent hub is vendor specific. Those errors are typically available through various types of communication links. The links may be in-band TCP/IP access to MIBs meeting SNMP requirements. The links may include out-of-band RS-232 links or Ethernet links accessing similar error information. The links may include out-of-band communication through a display panel or indicators on the intelligent hub. This form of error communication is helpful in isolating the behavior of individual links in a large configuration.

Extended Link Service interrogation of error counters

This is the most generic form of presenting detected error counts. The Extended Link Service (ELS) called “Read Link Error Status Block” (RLS) is defined in the FC-PH Fibre Channel standard in section 21.4.11. The ELS requests a payload containing an identifying code and a Link Error Status Block (LESB) which is defined in FC-PH section 29.8. The following information is contained in the ELS accept payload.

RLS Accept Payload, including LESB definition

Word (4 bytes)	Word of LSB	Function
0	n.a.	’02 00 00 00’ RLS Accept Payload code
1	0	Link Failure Count
2	1	Loss of Synch Count
3	2	Loss of Signal Count
4	3	Primitive Sequence Protocol Error
5	4	Invalid Transmission Word
6	5	Invalid CRC Count

The detailed definition of each of the counting mechanisms is vendor specific. The choice of which counters are implemented for a given node is vendor specific. Many low-cost devices that are normally not exposed to accessible links

do not implement the RLS Extended Link Service. The details of counting these errors are vendor specific. In particular, a short burst of errors is often related to a single error incident and may be counted as a single failure.

Loop attached devices can only count CRC if they are OPEN or OPENED. Devices in the monitoring state do not count CRC errors.

None of these 32-bit counters are reset. The error counter must be read and compared with the previous reading to determine the actual number of counted events since the last reading. The counter wraps to 0 after it reaches the value of 'FF FF FF FF'h.

Summary

The error detection and reporting capabilities are adequate to perform verification of proper operation of links in a loop or point-to-point environment. While most link elements are not available for the convenient insertion of measured amounts of jitter, error rates for those that are available can be determined reasonably accurately with the error information available at the system or link level.

Sincerely,

Bob Snively
Sun Microsystems
650-786-6694
bob.snively@sun.com