



FC Link Incidents

FC_BB_E Representation

Proposal for addition to FC-BB-5

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The Issue – LB Comment IBM-021

- The draft does not provide definitions for ethernet based link incident codes to replace or map to those currently available based on the Fibre Channel physical layer. These are necessary to support the Link Incident Reporting procedure using the RLIR ELS (see FC-LS 4.3.32)

Background - History

- Link Incident reporting is in-band management protocol for reporting of link failures and degraded link performance.
- Its implementation is a requirement of ESCON (SBCCS) and FICON (FC-SB-3) standards.
- The link incident reporting protocol for FICON was implemented using new Extended Link Services (currently defined in FC-LS-2) so that this functionality could be extended to the greater fibre channel space.
- Known deployments exist in both FICON and FCP attached storage devices, in FICON channels, and Fibre Channel switches.

Background – FC-LS-2 (T11/08-373v0)

- FC-LS-2 provides 3 extended link services that are used in the link incident reporting process.
 - RNID – Request Node ID
To obtain identifying information from the port at the other end of the link
 - LIRR – Link Incident Report Registration
To register for receipt of link incident reports
 - RLIR (4.2.24) – Registered Link Incident Report
To communicate link incidents to registered recipients
- The Link Incident Reporting Procedure is described in FC-LS-2 - **4.2.24.2**

Background – FC Link Incident Codes

Table 72 – Incident Code values

Value	Meaning
00h	Reserved.
01h	Implicit incident: A condition, caused by an event known to have occurred within the incident port, has been recognized by the incident port. The condition affects the attached link in such a way that it may cause a link incident to be recognized by the connected port.
02h	Bit-error-rate threshold exceeded: The incident port has detected that the Error Interval Count equals the Error Threshold (see FC-FS-2).
03h	Link Failure - Loss-of-Signal or synchronization: The incident port has recognized a Loss-of-Synchronization condition, and it persisted for more than the R_T_TOV timeout period (see FC-FS-2).
04h	Link Failure - NOS recognized: The NOS has been recognized by the incident port (see FC-FS-2)
05h	Link Failure - Primitive Sequence timeout: The incident port has recognized either a Link-Reset-Protocol timeout (see FC-FS-2), or a timeout when timing for the appropriate response while in the LF1 State and after NOS is no longer recognized (see FC-FS-2).
06h	Link Failure - Invalid Primitive Sequence for port state: The incident port recognized either a LR or LRR Primitive Sequence while in the OL3 State (see FC-FS-2).
07h	Link Failure - Loop Initialization time out: The incident port failed to complete loop initialization within the normal loop time out period (see FC-AL-2).
08h	Link Failure – receiving LIP(F8): The incident port is receiving LIP(F8) indicating some other port on the loop is experiencing a Loss-of-Signal condition.
09h -FFh	Reserved.

Bit Error Rate Threshold – FC-FS-3 rev0.80 (09-112v0)

19.4.9

- The optional bit-error-rate thresholding process is designed to detect an increased error rate before performance degradation becomes serious. When the specified bit-error-rate threshold is reached, a Registered Link Incident Report (RLIR) ELS shall be generated as required by the RLIR ELS (see FC-LS-2).
- The bit-error rate is measured during frame, Primitive Signal, and Primitive Sequence reception
- **Error Intervals**
 - An Error Interval is a time period during which one or more **invalid Transmission Words** are recognized...
 - Only the first error in an Error Interval is counted toward the Error Threshold; and
 - The default value for the Error Interval is 1.5
- **Bit-Error-Rate-Thresholding Measurement**
 - Measurement of bit-error-rate thresholding shall be accomplished by counting the number of Error Intervals that occur in an Error Window. When the Error Interval Count equals the Error Threshold, the threshold is exceeded and an RLIR shall be generated
 - The default value for the Error Threshold is 15.
 - The default value for the Error Window is 300 seconds (5 minutes)

What to do with 802?

- What is the 802.3 equivalent to an FC Invalid Transmission Word?
The 8B/10B PHYs in 802.3 do not maintain a count of bad transmission words (or 8B/10B errors). The 64B/66B and 10GBASE-T PHYs do and it is reported in the Errored blocks counter register 45.2.3.12.4 (but not in any Clause 30 managed object). Possibly you could accumulate the counts read from that register for this count. It would be the closest analog in 802.3 but it is only available from some of the relevant PHYs. Another option is aSymbolErrorDuringCarrier but I'm not sure how widely it is supported. It also has the disadvantage of only monitoring the link when it is carrying traffic while errored blocks monitors for errors regardless of whether the link is idle or not.
- Counting a threshold of Errored Frame Seconds as defined by OAM (802.3-2005 Clause 57) as the number of errored frames in a one second window is very similar in nature to Bit Error Rate Thresholding and serves the same purpose to detect unhealthy/degraded links before they become not operational. An errored frame in this definition essentially counts FCS errors. However, errored frames can only be detected when there is I/O traffic on the link.
- We have made all of these counters available in the FC-BB-E Link Error Status Block
- An change in Errored Blocks (MDIO Reg 3.33.7:0) is the most equivalent to Fibre Channel and is preferred. There is a concern about availability on the relevant PHYs. Should we provide an alternative?

Link Failures in FC-BB-E

- Physical Link Failures

- Loss of light

- aLoseMediaCounter (oMAU)

- Counts the number of times that the aMediaAvailable attribute changes from the enumeration “available” to any other enumeration. Mandatory for MAU type “AUI,” optional for all others. (see next slide)

- Remote Fault

- The other end of the link detects a loss of light and either indicates remote fault sequence or begins speed negotiation

- Virtual Link Failure

- Detected by the Virtual Link Maintenance Protocol

aMediaAvailable

- Contains information useful for determining causes for link failure
An ENUMERATED value list that has the following entries:
- other (1), --undefined
- unknown (2), --initializing, true state not yet known
- available (3), --link or light normal, loopback normal
- not available (4), --link loss or low light, no loopback
- remote fault (5), --remote fault with no detail
- invalid signal (6), --invalid signal, applies only to 10BASE-FB
- remote jabber (7), --remote fault, reason known to be jabber
- remote link loss (8), --remote fault, reason known to be far-end link loss
- remote test (9), --remote fault, reason known to be test
- offline (10), --offline, applies only to Clause 37 Auto-Negotiation
- auto neg error (11) --Auto-Negotiation error, applies only to Clause 37 Auto-Negotiation
- PMD link fault (12) --PMD/PMD receive link fault
- WIS frame loss (13) --WIS loss of frame, applies only to 10GBASE-W
- WIS signal loss (14) --WIS loss of signal, applies only to 10GBASE-W
- PCS link fault (15) --PCS receive link fault
- excessive BER (16) --PCS Bit Error Ratio monitor reporting excessive error ratio
- DXS link fault (17) --DTE XS receive link fault, applies only to XAUI
- PXS link fault (18) --PHY XS transmit link fault, applies only to XAUI

Proposed Incident Codes for FC-BB-E

Excerpt from table 72 – Incident Code Values

- 01h **Implicit incident:** A condition, caused by an event known to have occurred within the incident port, has been recognized by the incident port. The condition affects the attached link in such a way that it may cause a link incident to be recognized by the connected port.
- 02h **Bit-error-rate threshold exceeded:** The incident port has detected that the Error Interval Count equals the Error Threshold (see FC-FS-2).
- 03h **Link Failure - Loss-of-Signal or synchronization:** The incident port has recognized a Loss-of-Synchronization condition, and it persisted for more than the R_T_TOV timeout period (see FC-FS-2).
- 04h **Link Failure - NOS recognized:** The NOS has been recognized by the incident port (see FC-FS-2)
- 05h **Link Failure - Primitive Sequence timeout:** The incident port has recognized either a Link-Reset-Protocol timeout (see FC-FS-2), or a timeout when timing for the appropriate response while in the LF1 State and after NOS is no longer recognized (see FC-FS-2).
- 06h **Link Failure - Invalid Primitive Sequence for port state:** The incident port recognized either a LR or LRR Primitive Sequence while in the OL3 State (see FC-FS-2).

Proposed Incident code values for FC-BB-E Table X

- 01h **Implicit incident:** A condition, caused by an event known to have occurred within the incident port, has been recognized by the incident port. The condition affects the attached link in such a way that it may cause a link incident to be recognized by the connected port.
- 02h **Bit-error-rate threshold exceeded:** The incident port has detected that the Error Interval Count equals the Error Threshold (see FC-FS-3) where Error Interval Count is based on Errored Blocks (see 802.3-2005 45.2.3.12.4)
- 03h **Link Failure - Loss-of-Signal** The aLoseMediaCounter has been incremented for entering an aMediaAvailable state indicating anything other than a remote fault, (see IEEE 802.3-2005 30.5.1.1.4 and 30.5.1.1.5).
- 04h **Link Failure – Remote Fault:** The aLoseMediaCounter has been incremented for an aMediaAvailable state being entered indicating a remote fault, (see IEEE 802.3-2005 30.5.1.1.4 and 30.5.1.1.5)..
- 05h **Link Failure – Virtual Link Failure** The incident port has recognized virtual link failure during the virtual link maintenance protocol.
- All Others **Reserved**

Proposal for FC-BB-5

- Add the following text (with editorial freedom and appropriate location)

Bit-Error-Rate Thresholding (see FC-FS-3) defines Error Intervals in terms of Fibre Channel invalid Transmission Words. An FC-BB-E device shall define an Error Interval as a time period during which one or more Errored Blocks (see IEEE-802.3-2005 **45.2.3.12.4**) are recognized.

The Link Incident Reporting procedure (see FC-LS-2 RLIR) defines link incidents and corresponding incident codes that are based on the Fibre Channel physical layer. A definition of link incidents and their respective incident codes are provided here based on IEEE 802.3 physical layer and FC-BB-E virtual link maintenance protocol.

Insert table X from slide 11 here.

The End

- **THANK YOU**