Ladder Diagrams for Error Recovery For FCP -2 Rev 04
Out-Of-Order Delivery- Annex D

Carl Zeitler
Compaq Computer Corporation
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Reference: T11/00-133r0
D.1 Class 3 Error Detection

(Continue with error recovery)
D.1 Class 2 Error Detection

(Continue with error recovery)
D.2 Class 3 FCP_CMD Lost

(Continue with error recovery)
D.2 Class 2 FCP_CMD Lost

Note: BA-ACC payload : SEQ_ID Validity = invalid, Low SEQ_CNT= 0, High SEQ_CNT= SEQ_CNT of ABTS frame. The ACKs for REC/LS_RJT are not shown.
D.2.1 Class 2 Lost ACK on FCP_CMND

(Exchange continues, no error recovery necessary)

Note that the issuance of RRQ is not necessary in this case, since the Target will not have established a Recovery Qualifier. However, the Initiator cannot reclaim the resources associated with its Recovery Qualifier until the ACK is received (out of order) or the R_A_TOV time-out expires. The ACKs for REC/ACC are not shown.
D.3 Class 3 FCP_XFER_RDY Lost

- **FCP_CMND**
  - REC_TOV
  - REC
  - ACC

**WAIT REC_TOV. IF FCP_XFER_RDY IS RETURNED, CONTINUE WITH EXCHANGE--REC ARRIVED BEFORE FCP_XFER_RDY SENT**

**ERROR RECOVERY**
D.3 Class 2 FCP_XFER_RDY Lost

Error Recovery Addition

A new SEQ_ID must be used in the retransmission of FCP_XFER_RDY. For Class 2, the SEQ_CNT value used must be one greater than the value used in the ABTS frame. The ACKs for REC/ACC are not shown.
D.4 Class 2 FCP_XFER_RDY Rcvd, ACK Lost

None:
The ACC returned for the REC indicates that the Initiator holds Sequence Initiative and the Exchange is open. No error recovery is required. Note: The Target may elect not to issue the RRQ since no Recovery Qualifier was established by the Initiator in this case. It must still let R_A_TOV expire before reclaiming the resources associated with its Recovery Qualifier. The ACKs for REC/ACC are not shown.
D.5 Class 3 FCP_RESP Lost, No FCP_CONF Req.

WAIT REC_TOV. IF FCP_RESP RECEIVED, COMPLETE THE EXCHANGE. OTHERWISE DO ERROR RECOVERY
D.5 Class 2 FCP_RESP Lost, No FCP_CONF Req.

Error Recovery Addition

A new SEQ_ID must be used in the retransmission of FCP_RESP. For Class 2, the SEQ_CNT value used must be one greater than the value used in the ABTS frame. The ACKs for REC/ACC are not shown.
D.6 Class 2 FCP_RESP Rcvd, ACK Lost

None:
The BA_RJT for the ABTS indicates the Exchange is unknown and therefore complete. No error recovery is required.
The Target must establish a Recovery Qualifier. The associated resources cannot be reused for a period of R_A_TOV or until the ACK to FCP_RESP is delivered (out of order). Note: The Target may elect not to issue the RRQ as no Recovery Qualifier was established by the initiator.
D.7 Class 3 Lost Write Data, Last Frame of Seq.

(Continue with error recovery)
D.7 Class 2 Lost Write Data, Last Frame of Seq.

Error Recovery Addition
New Sequence IDs shall be used for the retransmission of FCP_XFER_RDY and FCP_DATA. For Class 2, the starting Sequence count value used with the retransmission of FCP_DATA frames shall be one greater than the value used in ABTS. The ACKs for REC/ACC are not shown.
D.8 Cl 3, Lost Write Data, Not Last Fr. of Seq.

(Continue error recovery
D.8 Class 2  Lost Write Data, Not Last Frame of Seq.

Error Recovery Addition

New Sequence IDs shall be used for retransmission of FCP_XFER_RDY and FCP_DATA. For Class 2, the Sequence count value used with the retransmission of FCP_DATA shall be one greater than the value used in ABTS. Note that if all data frames arrive at the Target prior to the expiration of E_D_TOV, (out-of-order) then there is no error and no recovery is necessary. ACKs for REC/ACC are not shown.
D.9 Class 3 Lost Read Data, Last Frame of Seq.

IF FCP_DATA (seq=1, cnt=1) IS RECEIVED DURING REC_TOV, THEN COMPLETE THE EXCHANGE.

(Continue error recovery)
D.9 Class 2 Lost Read Data, Last Frame of Seq.

Error Recovery Addition

New Sequence IDs shall be used for retransmission of FCP_XFER_RDY and FCP_DATA. For Class 2, the Sequence count value used with the retransmission of FCP_DATA shall be one greater than the value used in ABTS. The ACKs for REC/ACC are not shown.
D.10 Class 3 Lost Read Data, Not Last Frame of Seq

IF FCP_DATA (seq=1, cnt=0, RO=0) IS RECEIVED WITHIN REC_TOV, THEN FINISH THE EXCHANGE.

(Continue error recovery)
D.10 Class 2 Lost Read Data, Not Last Frame of Seq

**Error Recovery Addition**

New Sequence IDs shall be used for retransmission of FCP_XFER_RDY and FCP_DATA. For Class 2, the Sequence count value used with the retransmission of FCP_DATA shall be one greater than the value used in ABTS. Note that if all data frames arrive at the initiator before E_D_TOV expires, then no recovery is required; a frame or frames arrived out-of-order. The ACKs for REC/ACC are not shown.
D.11 Class 2 ACK Lost on Read.

None:
The initiator has received the FCP_DATA frame or sequence. No error recovery is required.
Note: The BA_ACC indicates the FCP_DATA sequence was received, the Target continues the Exchange.
Note: The Target must establish its Recovery Qualifier. The resources associated with the Recovery Qualifier can be reclaimed on receipt of the ACK(out of order) or after R_A_TOV. The issuance of RRQ is optional as no Recovery Qualifier was established by the Initiator in this case.
D.12a Class 2  ACK Lost on Write

None: The Target received the FCP_DATA sequence. No error recovery is required.
Note: The BA_ACC indicates the data sequence was received, the Target and Initiator continue the Exchange. The Initiator must establish its Recovery Qualifier. The resources associated with the Recovery Qualifier can be reclaimed on receipt of the ACK (out of order) or after R_A_TOV. The issuance of the RRQ is optional as no Recovery Qualifier was established by the Target. FCP_RESP can be received at any time after FCP_DATA(seq1, cnt1 has been sent, but prior to the expiration of R_A_TOV.
D.12b Class 2  ACK Lost on Write

Error Recovery

None: The Target received the FCP_DATA sequence. No error recovery is required.

Note: The BA_ACC indicates the data sequence was received, the Target and Initiator continue the Exchange. The Initiator must establish its Recovery Qualifier. The resources associated with the Recovery Qualifier can be reclaimed on receipt of the ACK (out of order) or after R_A_TOV. The issuance of the RRQ is optional as no Recovery Qualifier was established by the Target. FCP_RESP can be received at any time after FCP_DATA(seq1, cnt1 has been sent, but prior to the expiration of R_A_TOV.
D.1 Class 3 FCP_CONF Lost

None.
LS-RJT indicates that the Initiator received FCP_RESP and sent FCP_CONF. The RX_ID used by the Target must be retired for another R_A_TOV to prevent possible aliasing. This insures that if FCP_CONF is received after LS_RJT, it is discarded as there is no context for it (OX_ID-RX_ID).
The ACC to the REC indicates that the Initiator has received the FCP_RESP and that the initiator is in the process of returning FCP_CONF or is hung. The RX_ID must not be reused for an additional R_A_TOV after receipt of the ACC to prevent aliasing. Other resources associated with the exchange in the Target can be released. If FCP_CONF is received after the ACC, the Target discards it since there is no context for it (OX_ID-RX_ID).
BA_ACC payload indicates that FCP_CONF was not received (Low SEQ_CNT not equal to High SEQ_CNT value of the ABTS)

* Second FCP_CONF must be sent with a different SEQ_ID. The SEQ_CNT value used in the retransmission of FCP_CONF must be one greater than the value used in the ABTS frame.
D.??? Class 2 ACK Lost on FCP_CONF

Error Recovery

None:
The Initiator must establish a Recovery Qualifier on receipt of the BA_RJT. The resources associated with the Recovery Qualifier can be retired on the receipt of the ACK (out of order) or when R_A_TOV Time-out has expired. Note that the issuance of RRQ is optional as no Recovery Qualifier was established by the Target.
D.13 Cl 3, REC or REC Response Lost

Since REC does not change any state, it can be reissued unconditionally.

Change E_D_TOV in the text to 2 * R_A_TOV to agree with the text in 12.6.2.
D.13a  Class  2, REC Lost

The second REC is issued using a new Exchange.
D.13b  Class 2, REC Response Lost

Note: The second REC is issued using a new Exchange. Since REC does not change any state, it can be reissued unconditionally.
Change E_D_TOV in the text to 2 * R_A_Tov to agree with the text in 12.6.3.
D.14b  Class 3, SRR Response Lost

2 * R_A_TOV

R_A_TOV

SRR

ABTS

BA_ACC

SRR

LS_RJT(FCP_RJT)

RRQ

ACC

Note: BA_ACC Payload: SEQ_ID Validity = invalid, Low SEQ_CNT=0, High SEQ_CNT = SEQ_CNT of ABTS. FCP_RJT is returned since the original Exchange has been restarted by the Target per the Payload of the SRR. The original Exchange is in process, or it has completed and no context for it (OX_ID-RX_ID) remains.

Change E_D_TOV in the text to 2 * R_A_TOV to agree with the text in 12.6.3
Note: The second SRR is issued using a new Exchange.
Since this is an ABTS on a new Exchange, a Recovery Qualifier must be established by the Target. BA-ACC indicates Invalid SEQ_ID, low SEQ_CNT= 0 and high SEQ_CNT = SEQ_CNT of the ABTS.
D.14d  Class 2, SRR Response Lost

Note: The BA_ACC payload indicates SEQ_ID invalid, low SEQ_CNT=0 and high SEQ_CNT=SEQ_CNT of the ABTS, which indicates that the ACC for SRR was not received and will be discarded if it is received. The ACC for SRR is issued with a new SEQ_ID and a SEQ_CNT one greater than used in the ABTS.
Use of REC in Class 2

- Note that the use of REC is not really required in Class 2. The response obtained from issuing ABTS is adequate to determine the payload of SRR to restart the Exchange.