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

Carl Zeitler

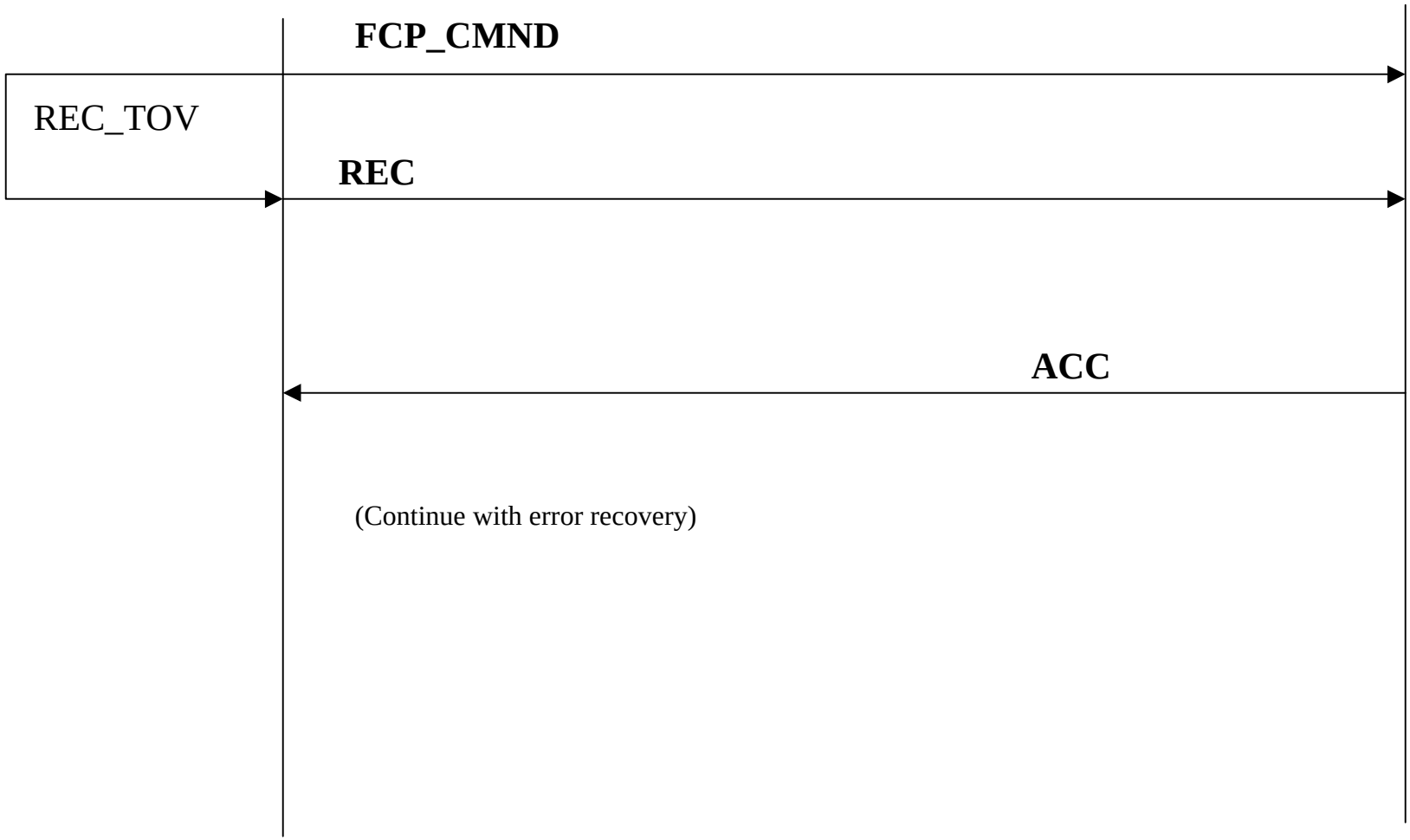
Compaq Computer Corporation

February 23, 2000

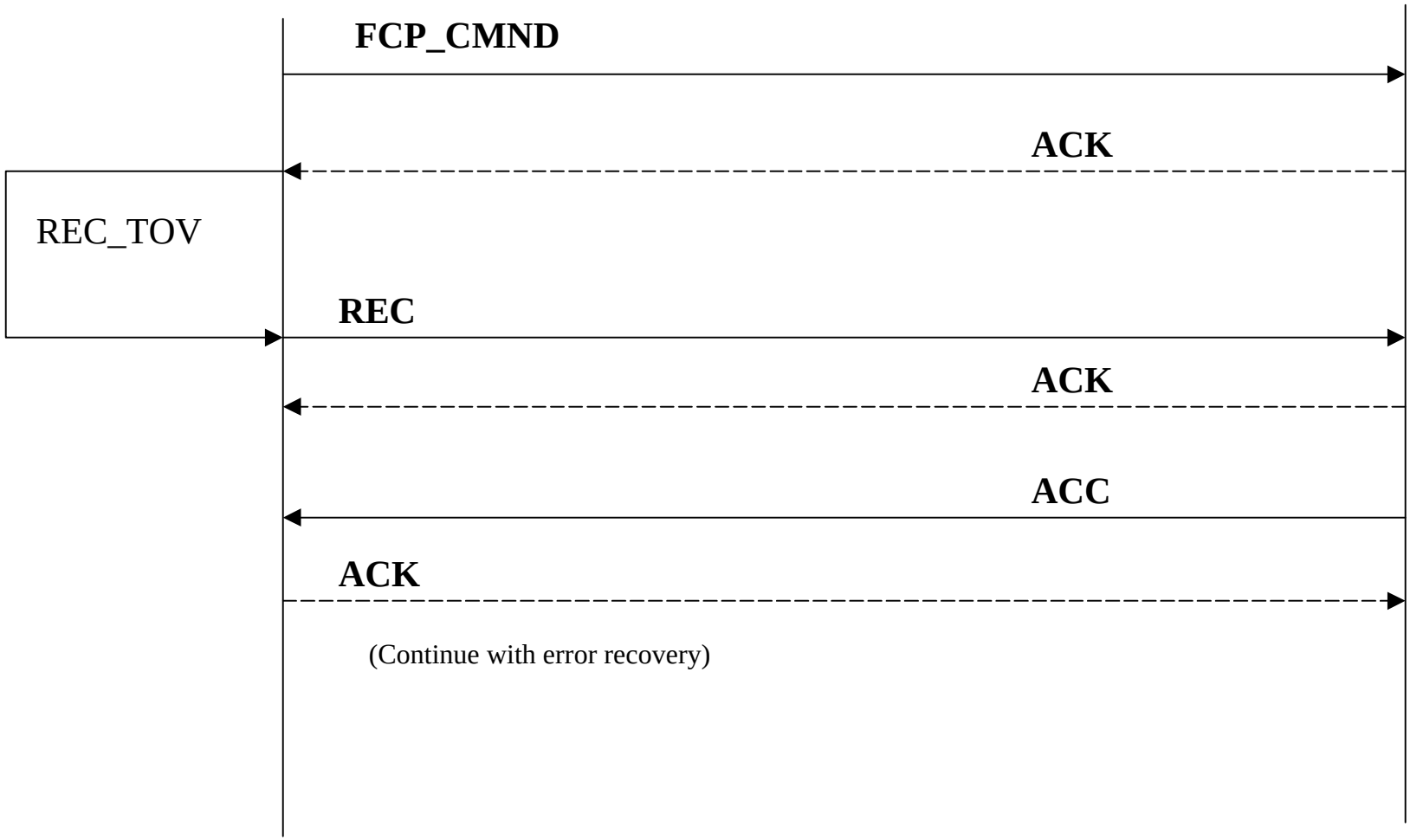
T10/00-137r1

Reference: T11/00-133r0

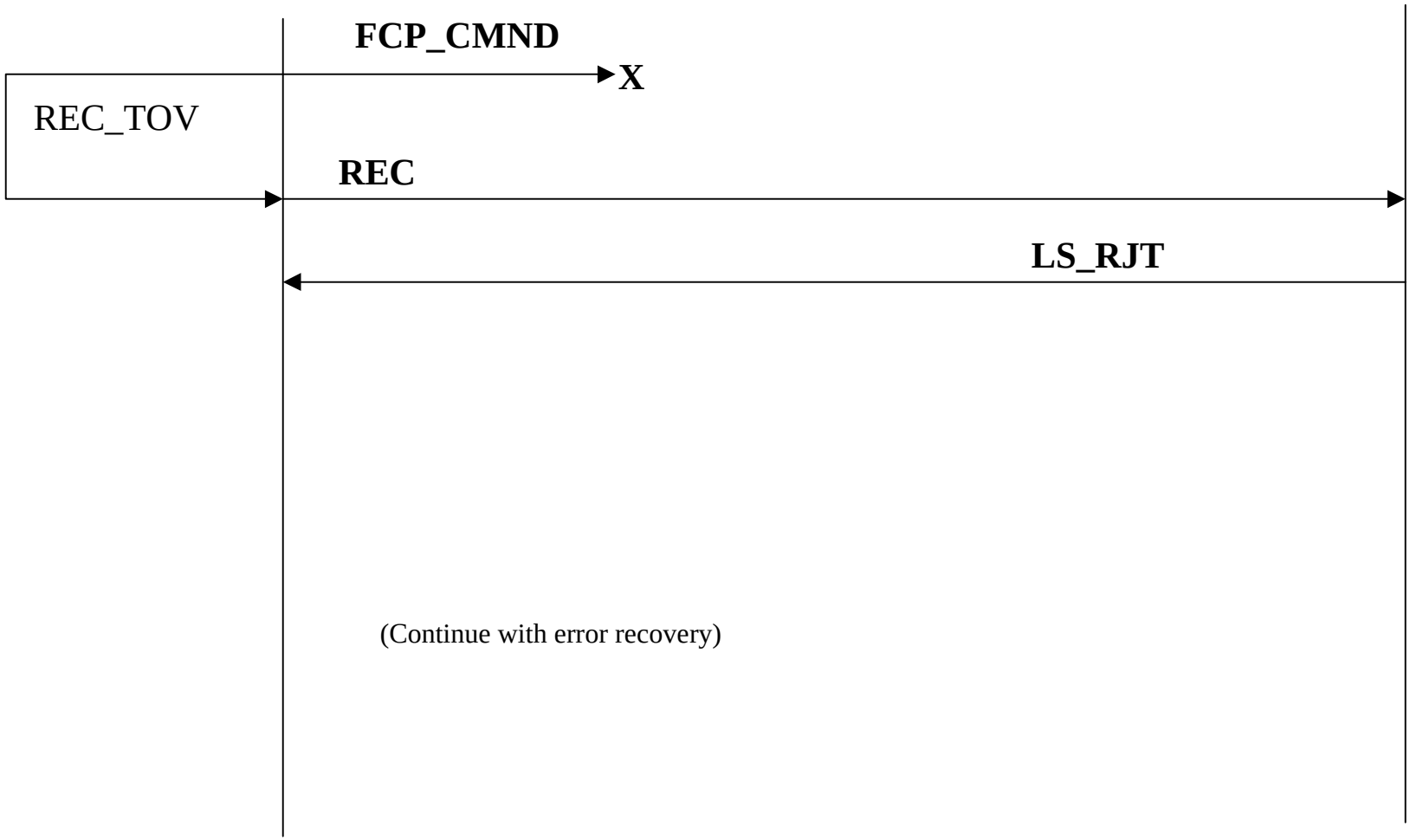
D.1 Class 3 Error Detection



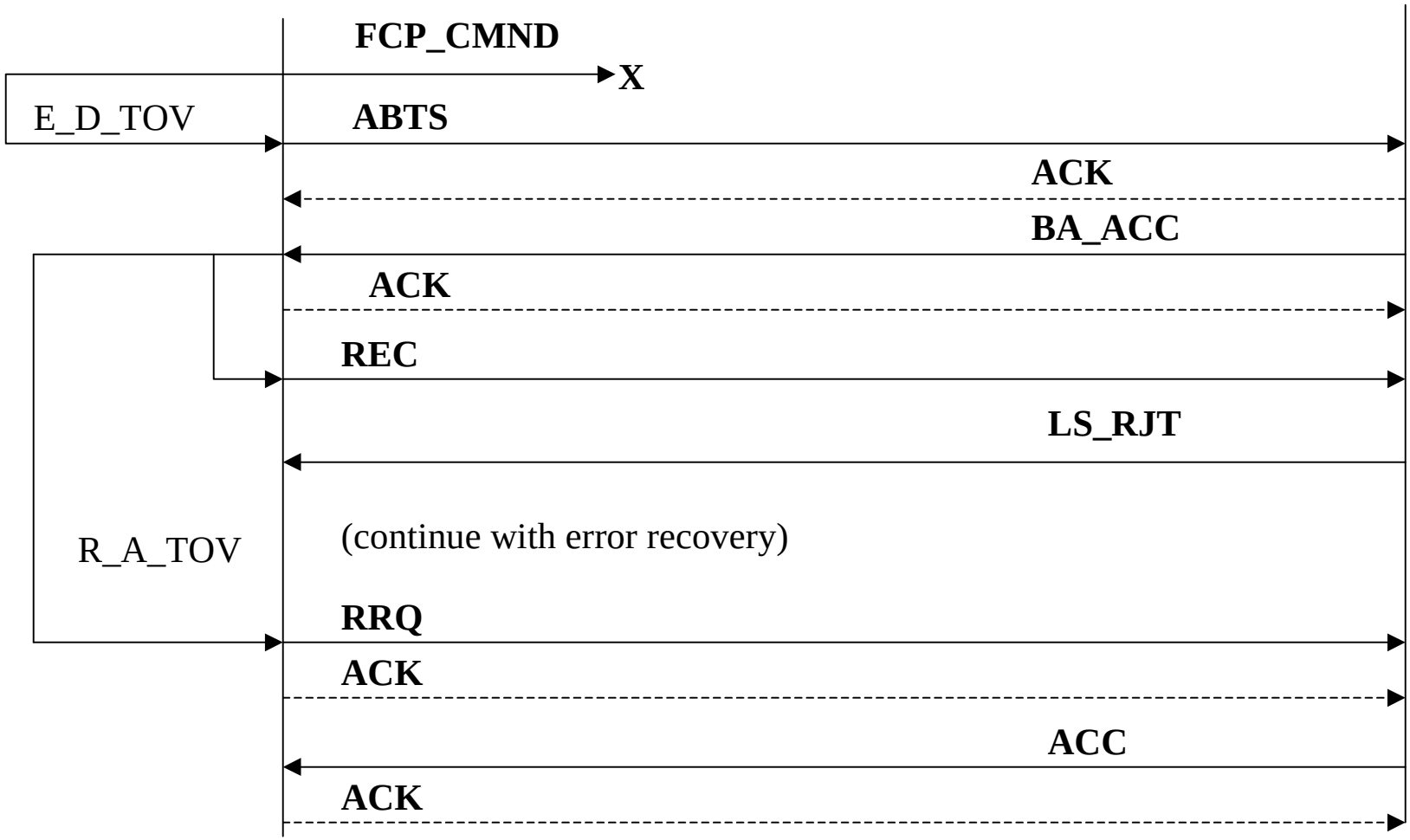
D.1 Class 2 Error Detection



D.2 Class 3 FCP_CMD Lost

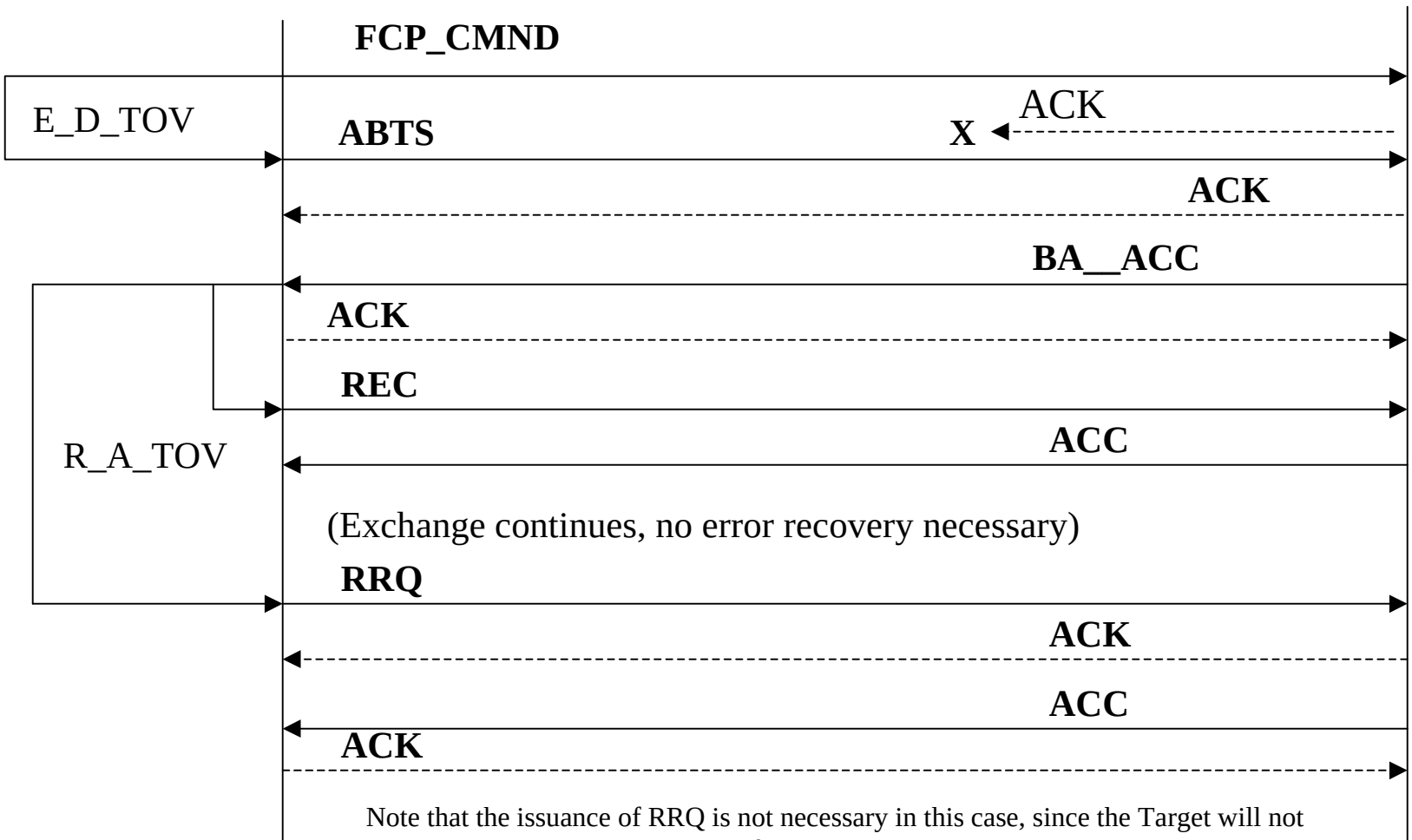


D.2 Class 2 FCP_CMD Lost



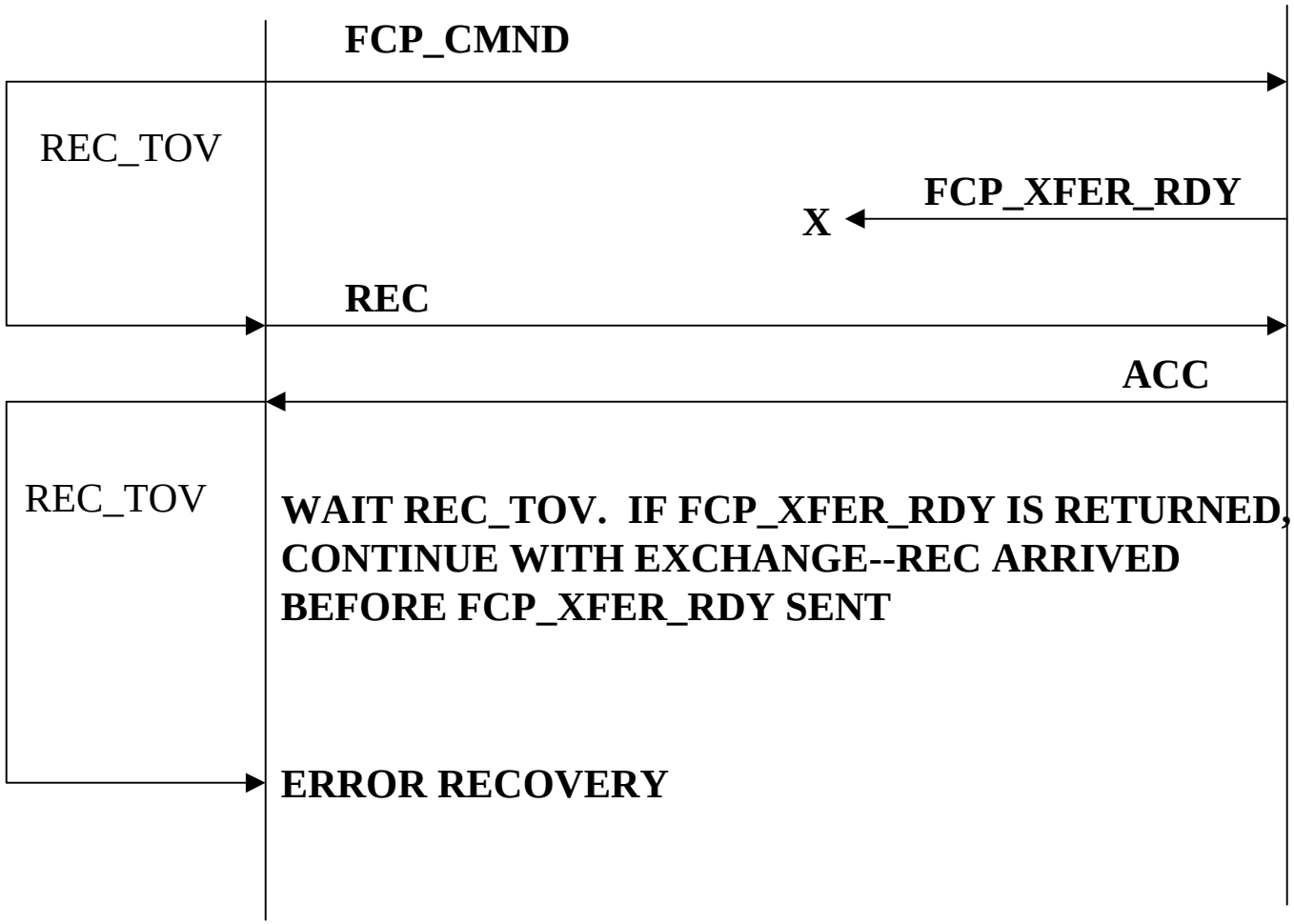
Note: BA-ACC payload : SEQ_ID Validity = invalid, Low SEQ_CNT= 0, High SEQ_CNT= SEQ_CNT of ABTS frame. The ACKs for REC/LS_RJT are not shown.

D.2.1 Class 2 Lost ACK on FCP_CMND

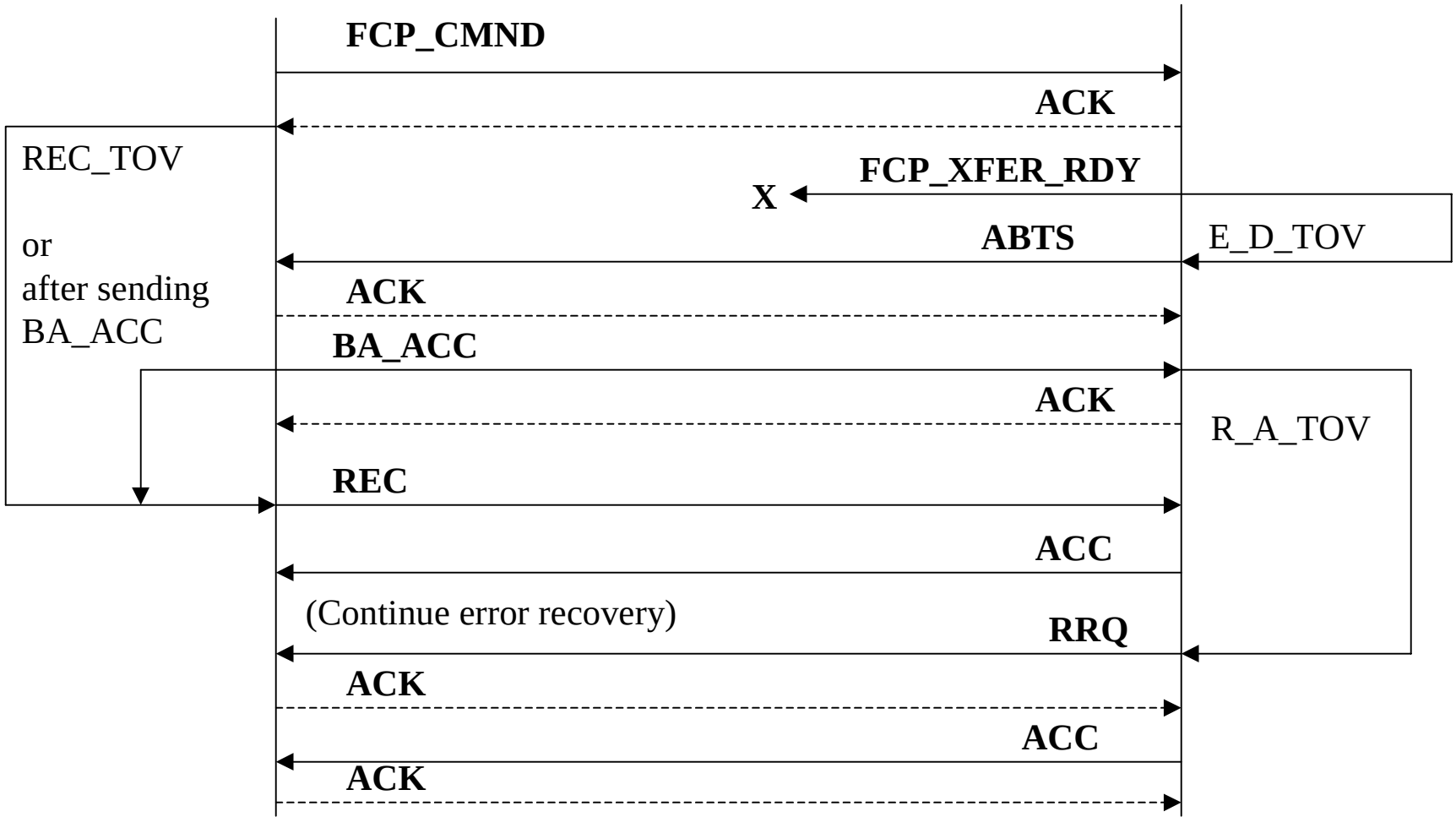


Note that the issuance of RRQ is not necessary in this case, since the Target will not have established a Recovery Qualifier. However, the Initiator cannot reclaim the resources associated with its Recovery Qualifier until the ACK is received (out of order) or the R_A_TOV time-out expires. The ACKs for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

D.3 Class 3 FCP_XFER_RDY Lost



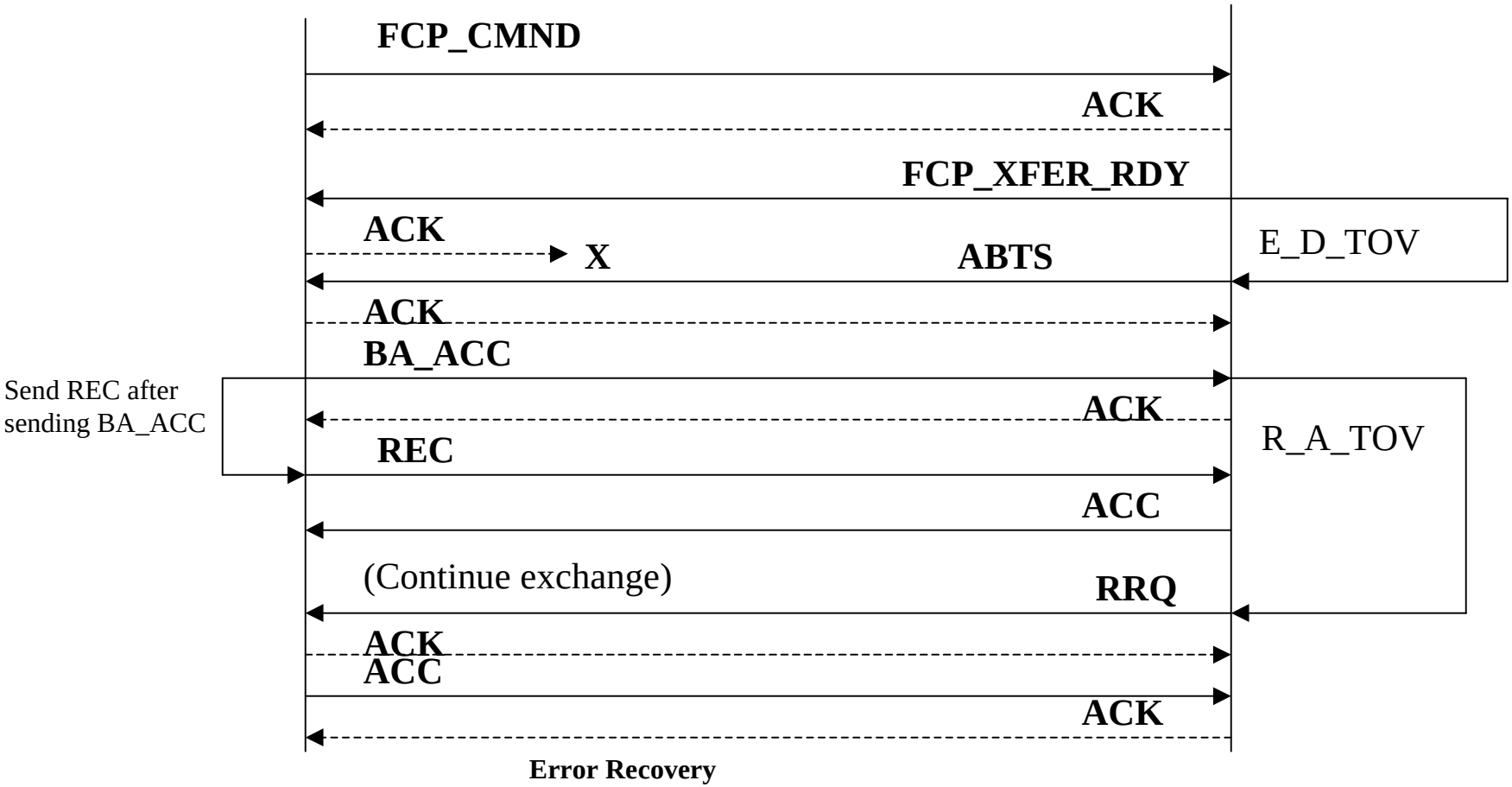
D.3 Class 2 FCP_XFER_RDY Lost



Error Recovery Addition

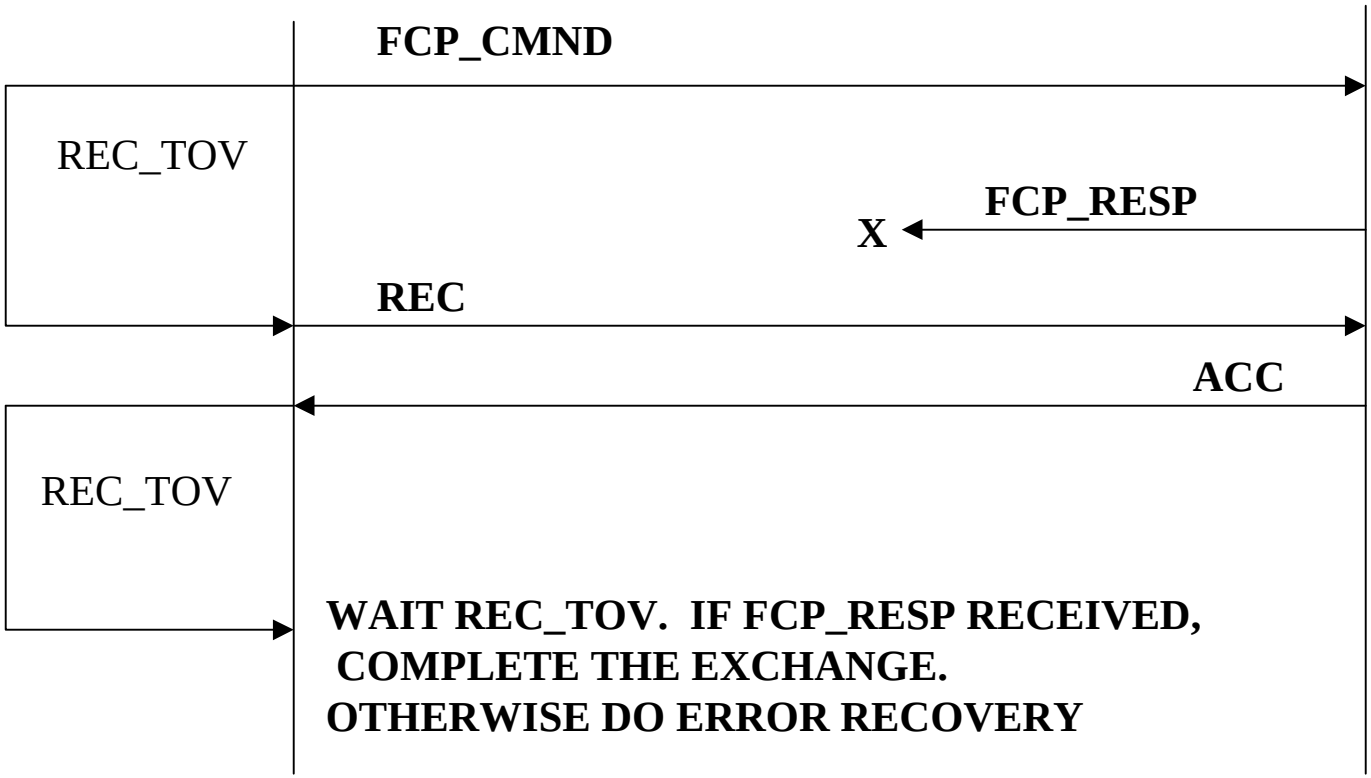
A new SEQ_ID must be used in the retransmission of FCP_XFER_RDY. For Class 2, the SEQ_CNT value used must be one greater than the value used in the ABTS frame. The ACKs for REC/ ACC are not shown.

D.4 Class 2 FCP_XFER_RDY Rcvd, ACK Lost

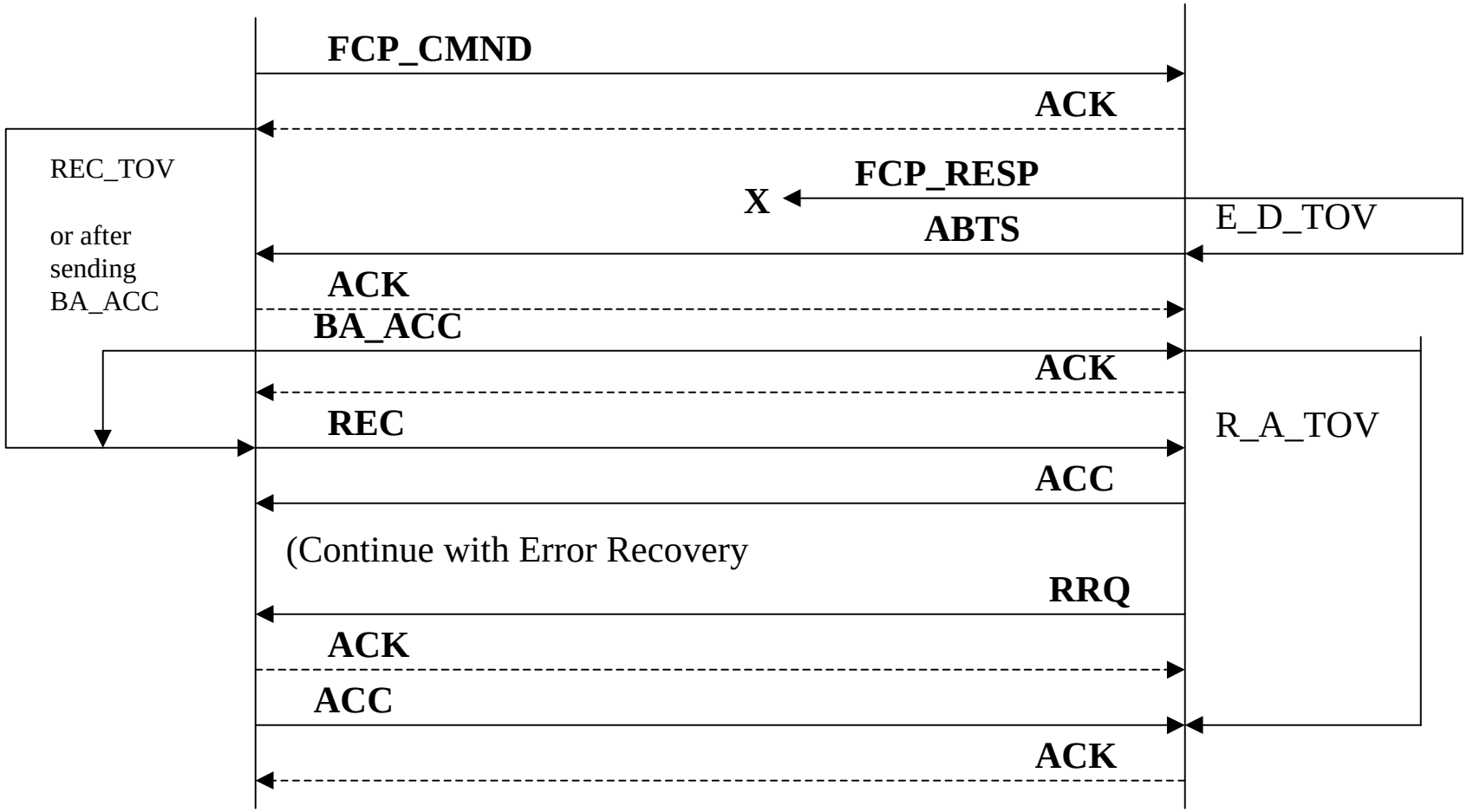


None:
The ACC returned for the REC indicates that the Initiator holds Sequence Initiative and the Exchange is open. No error recovery is required
Note: The Target may elect not to issue the RRQ since no Recovery Qualifier was established by the Initiator in this case. It must still let R_A_TOV expire 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.



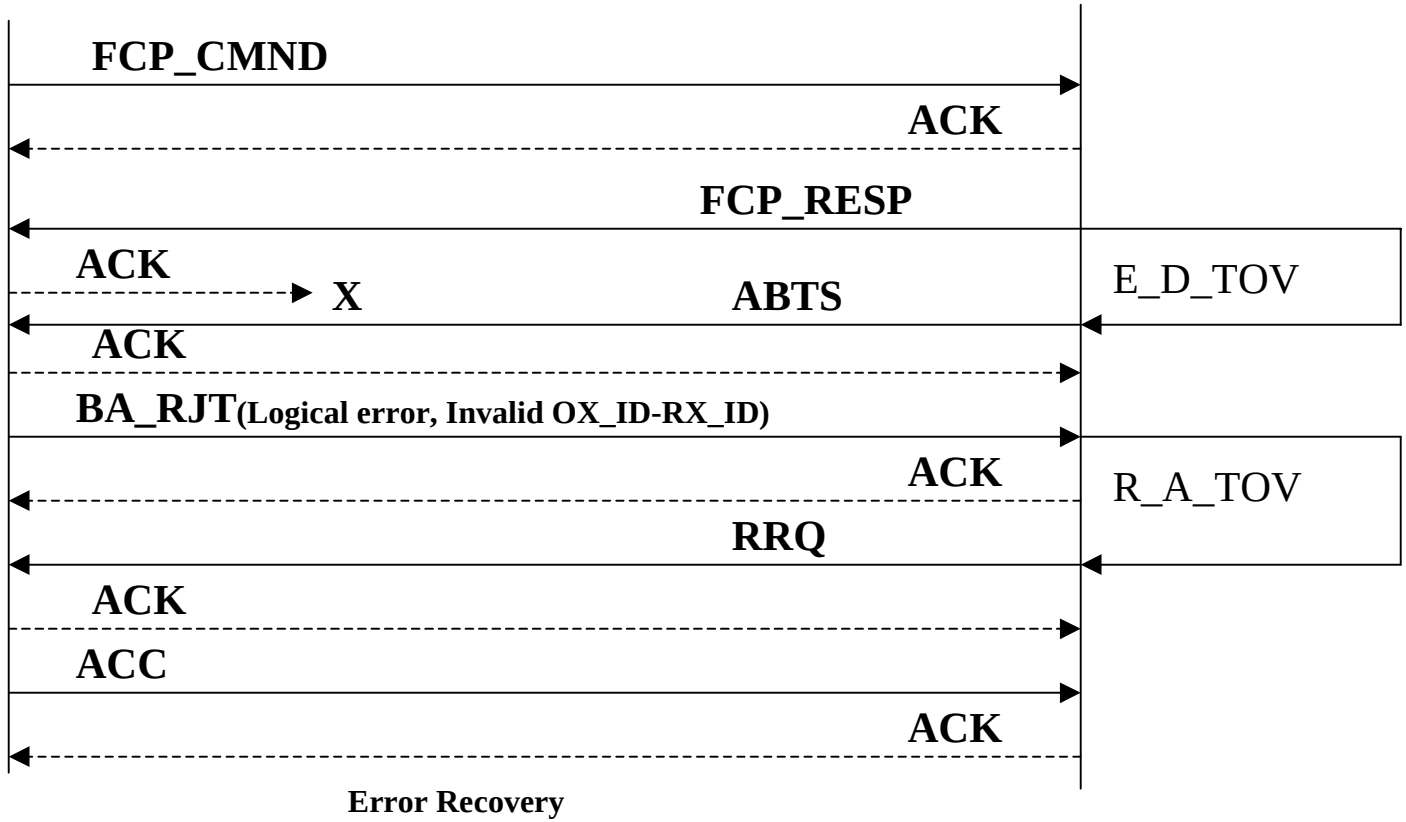
D.5 Class 2 FCP_RESP Lost, No FCP_CONF Req.



Error Recovery Addition

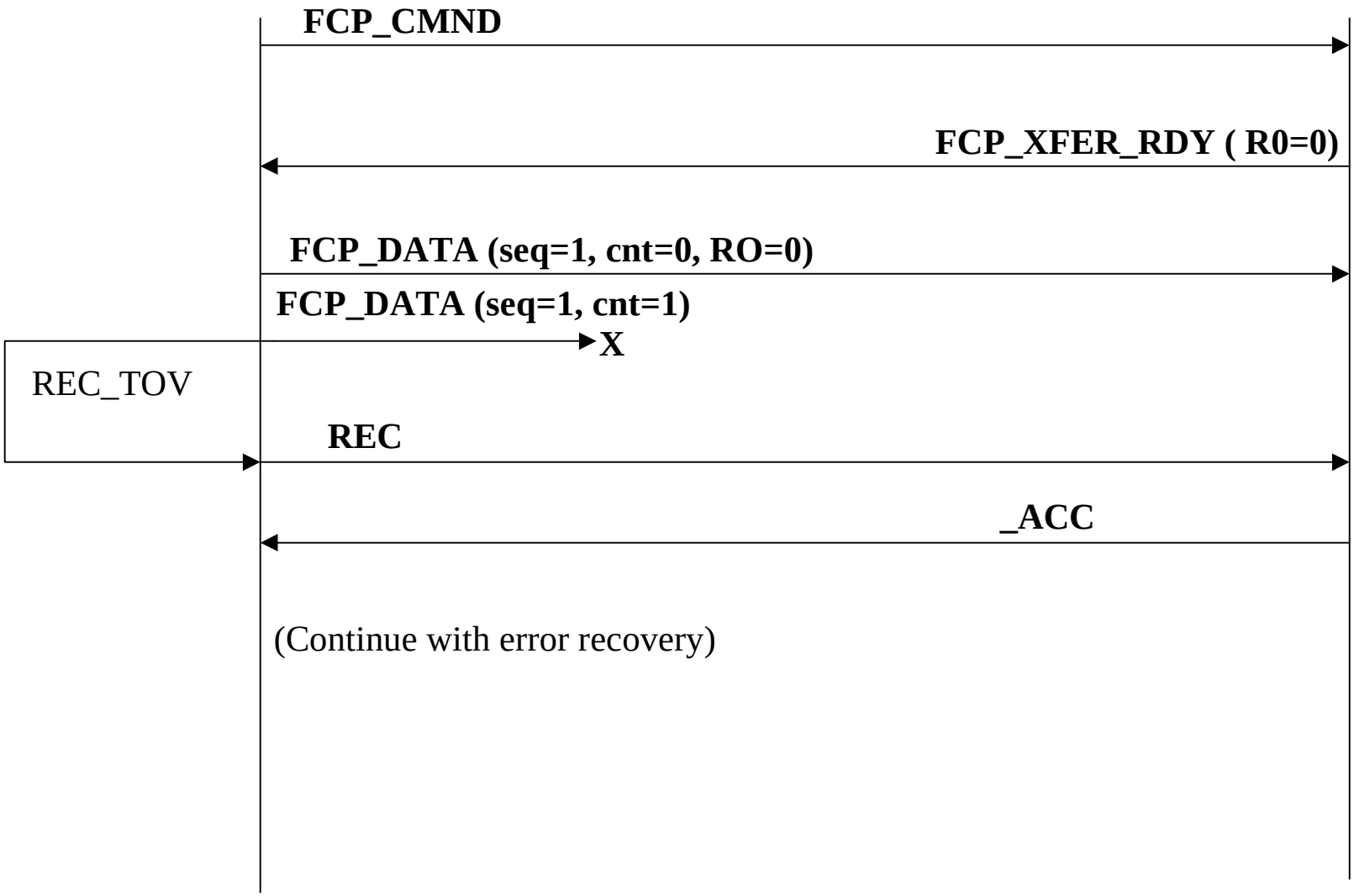
A new SEQ_ID must be used in the retransmission of FCP_RESP. For Class 2, the SEQ_CNT value used must be one greater than the value used in the ABTS frame. The ACKs for REC/ACC are not shown.

D.6 Class 2 FCP_RESP Rcvd, ACK Lost

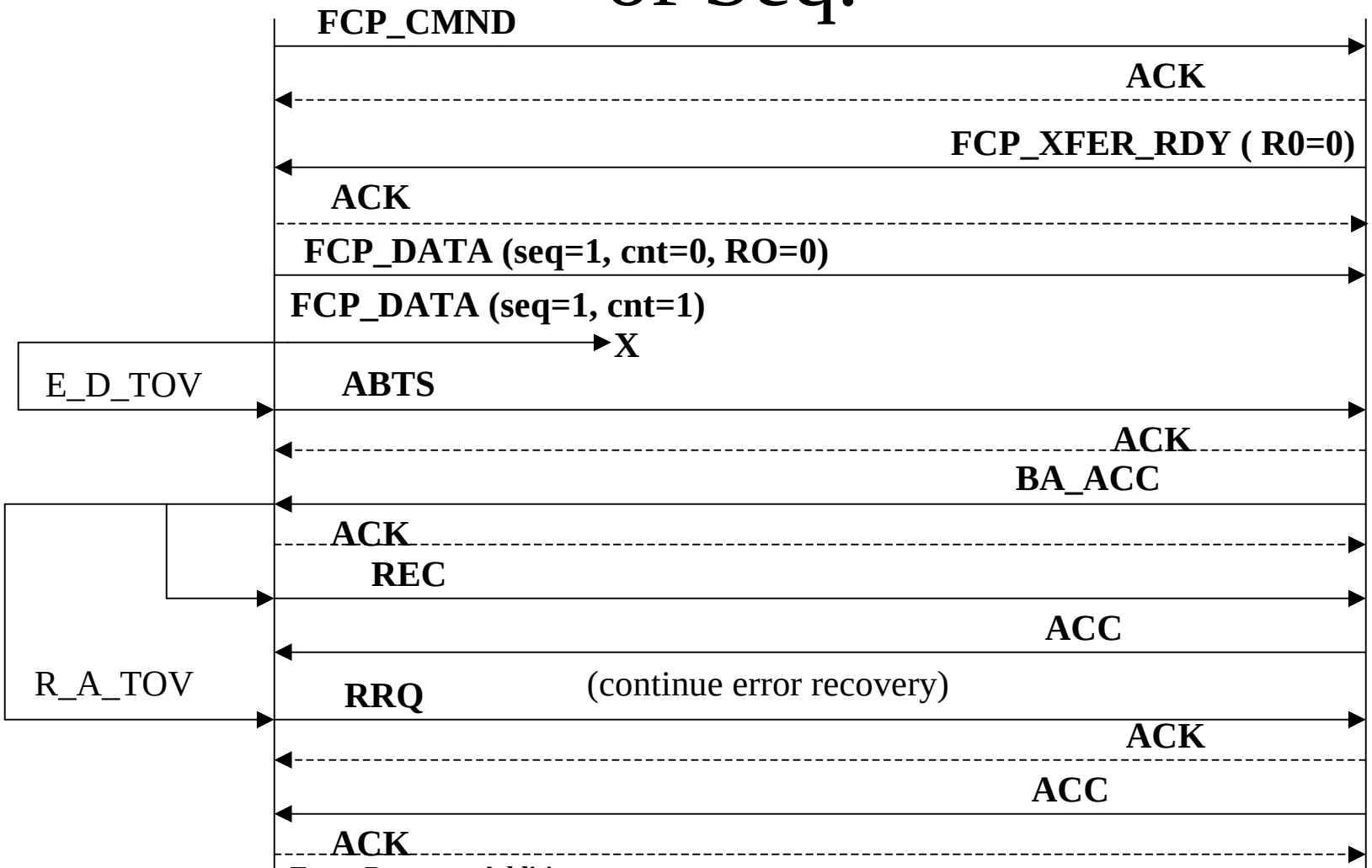


None:
The BA_RJT for the ABTS indicates the Exchange is unknown and therefore complete.
No error recovery is required.
The Target must establish a Recovery Qualifier. The associated resources cannot be reused for a period of R_A_TOV or until the ACK to FCP_RESP is delivered (out of order).
Note: The 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.



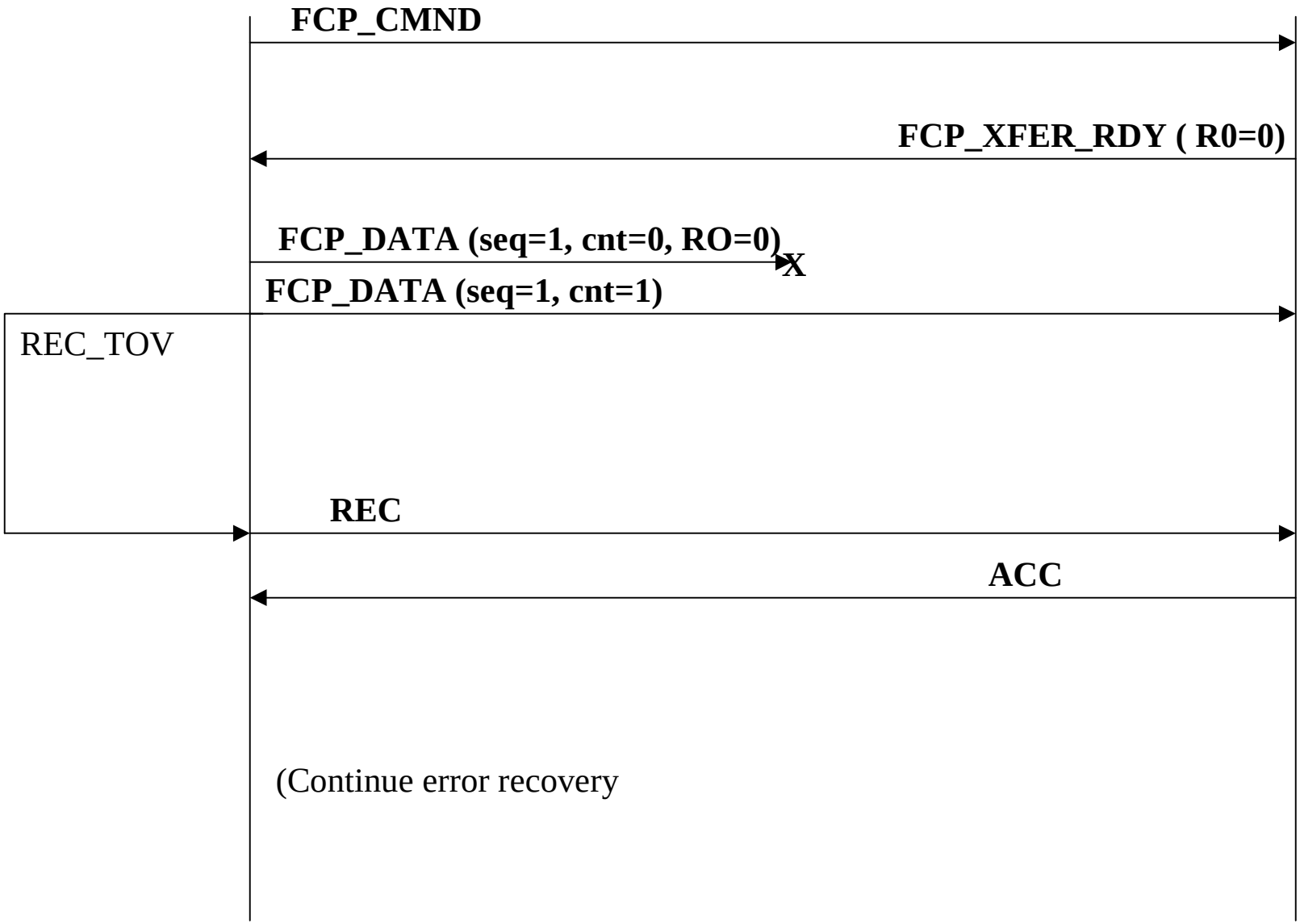
D.7 Class 2 Lost Write Data, Last Frame of Seq.



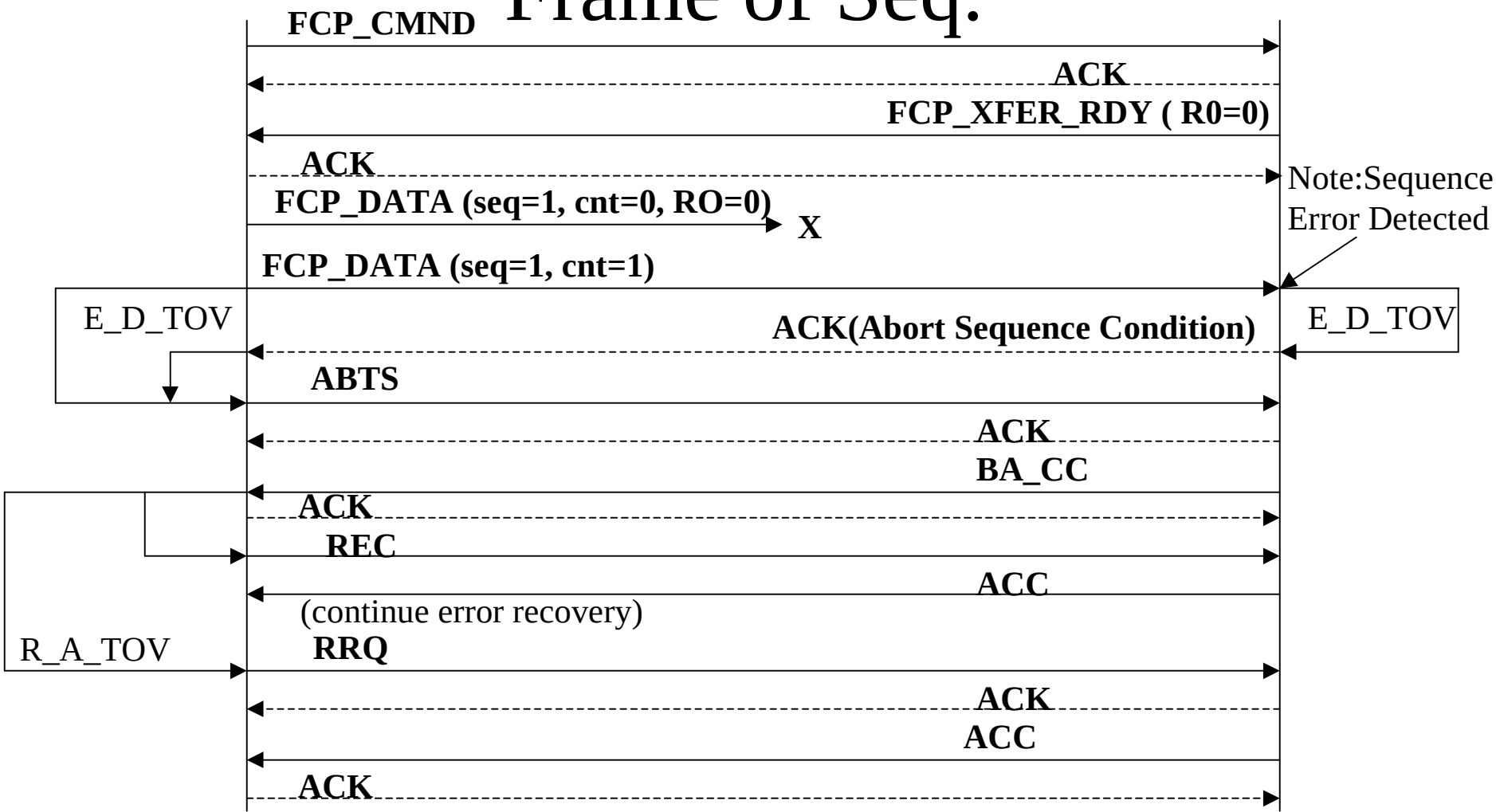
Error Recovery Addition

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.



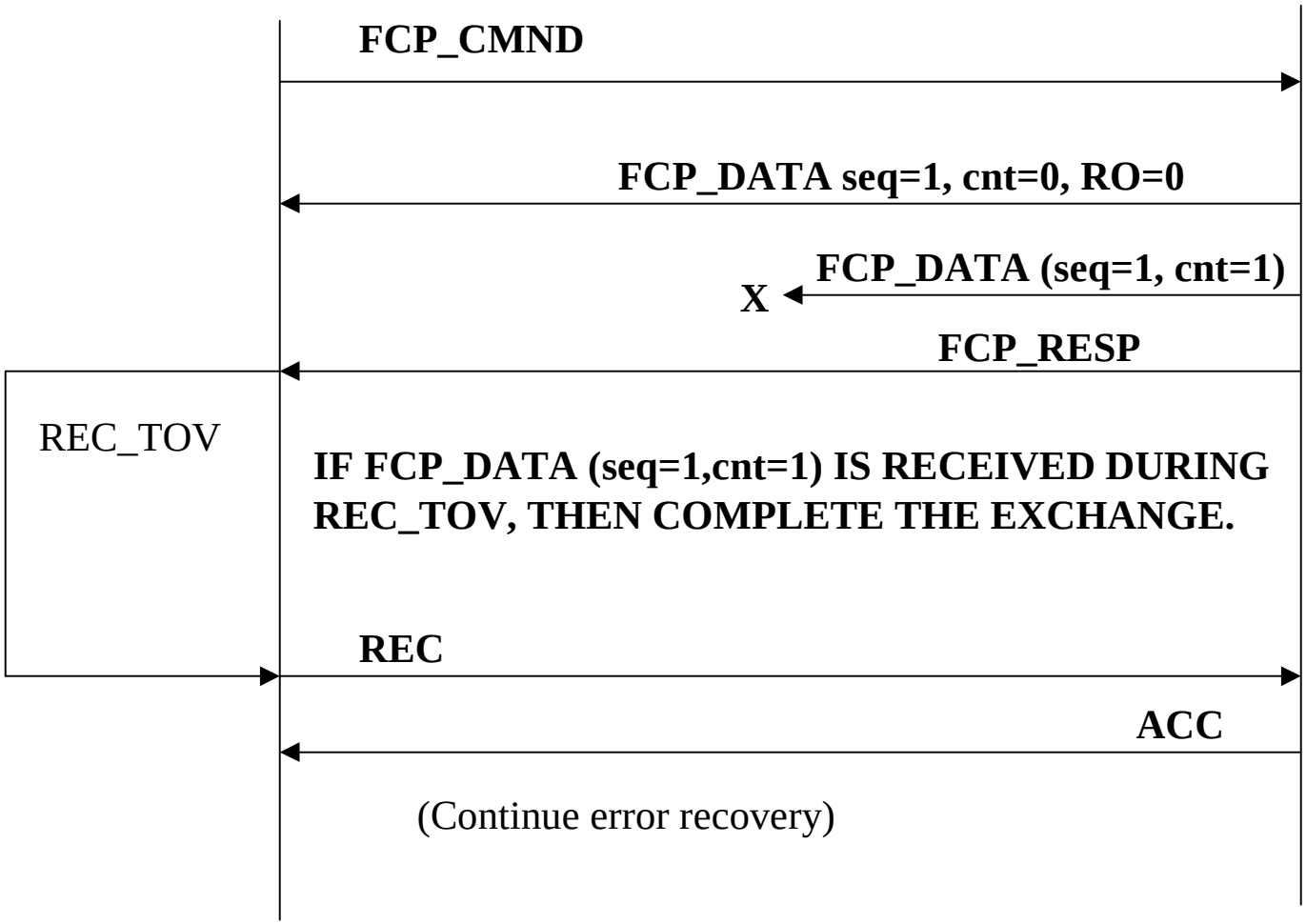
D.8 Class 2 Lost Write Data, Not Last Frame of Seq.



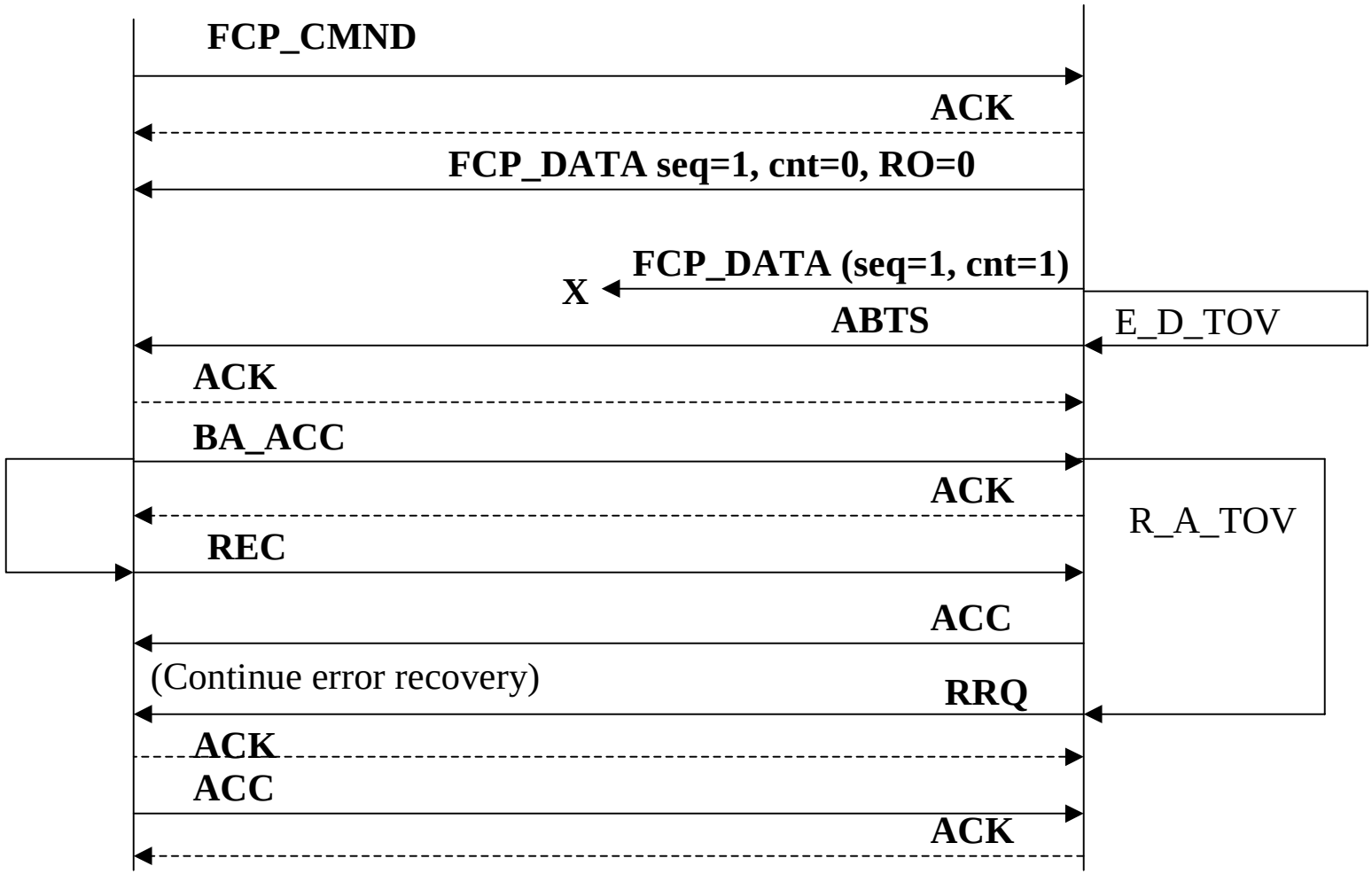
Error Recovery Addition

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 then 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.



D.9 Class 2 Lost Read Data, Last Frame of Seq.

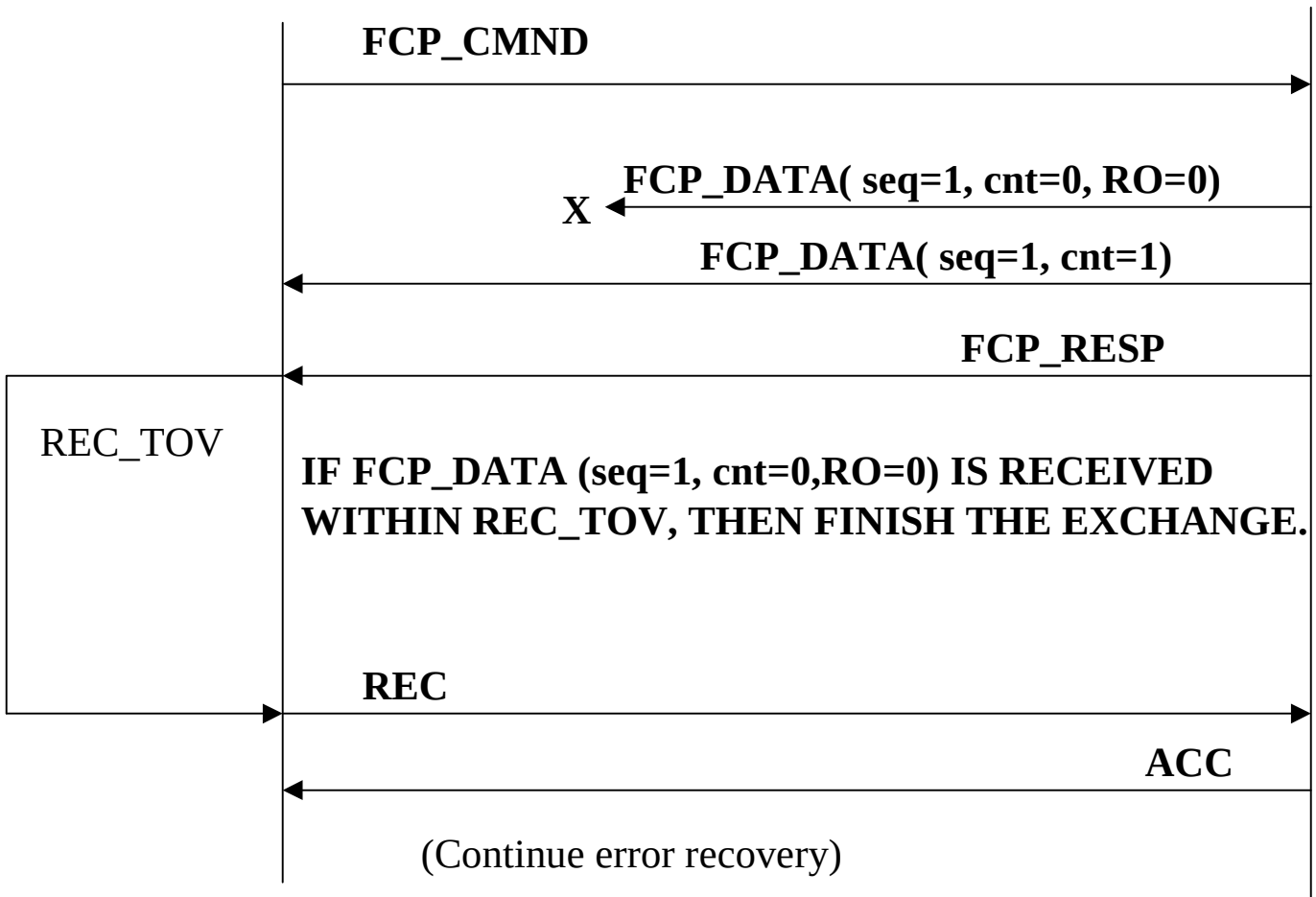


Error Recovery Addition

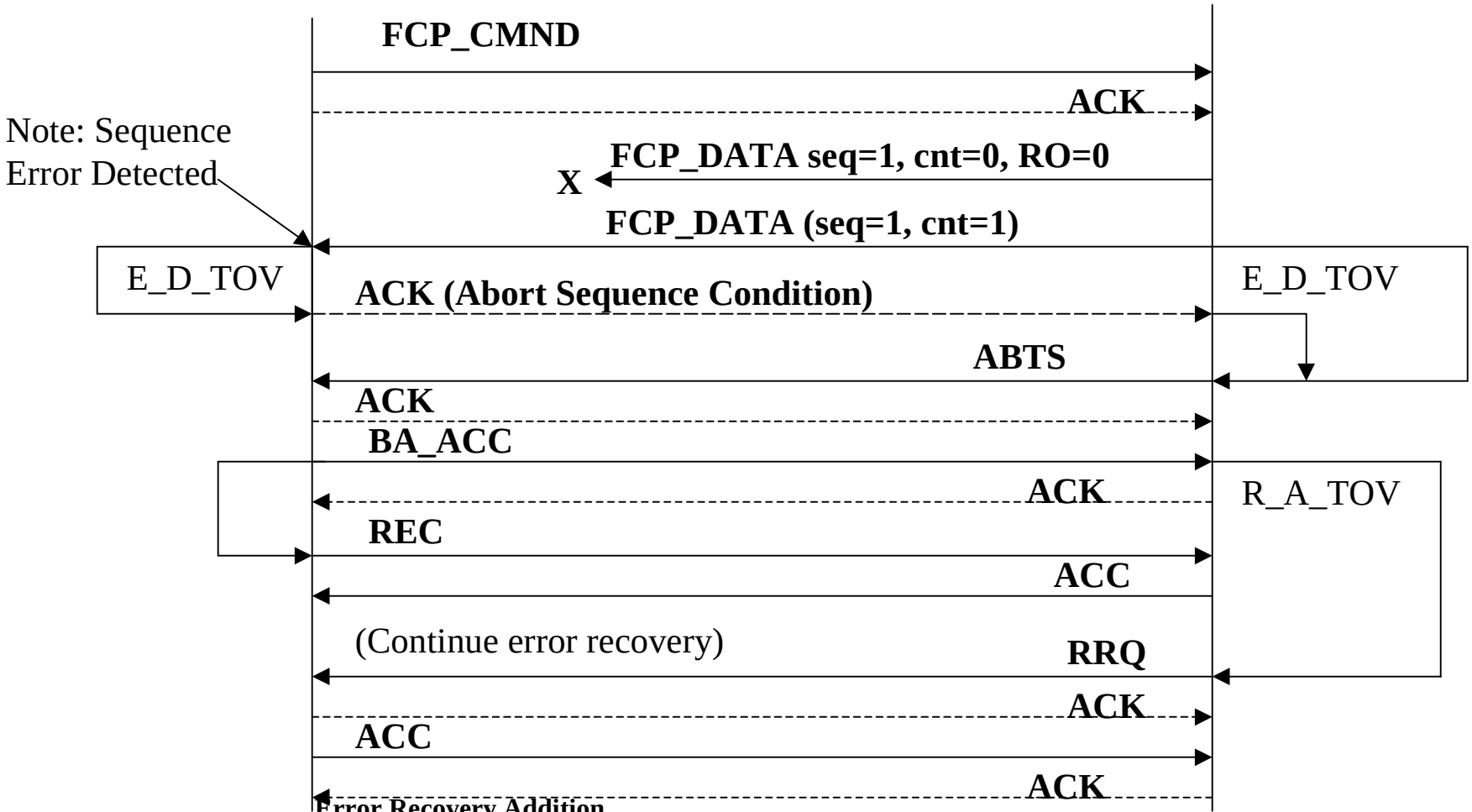
New Sequence IDs shall be used for retransmission of FCP_XFER_RDY and FCP_DATA.

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



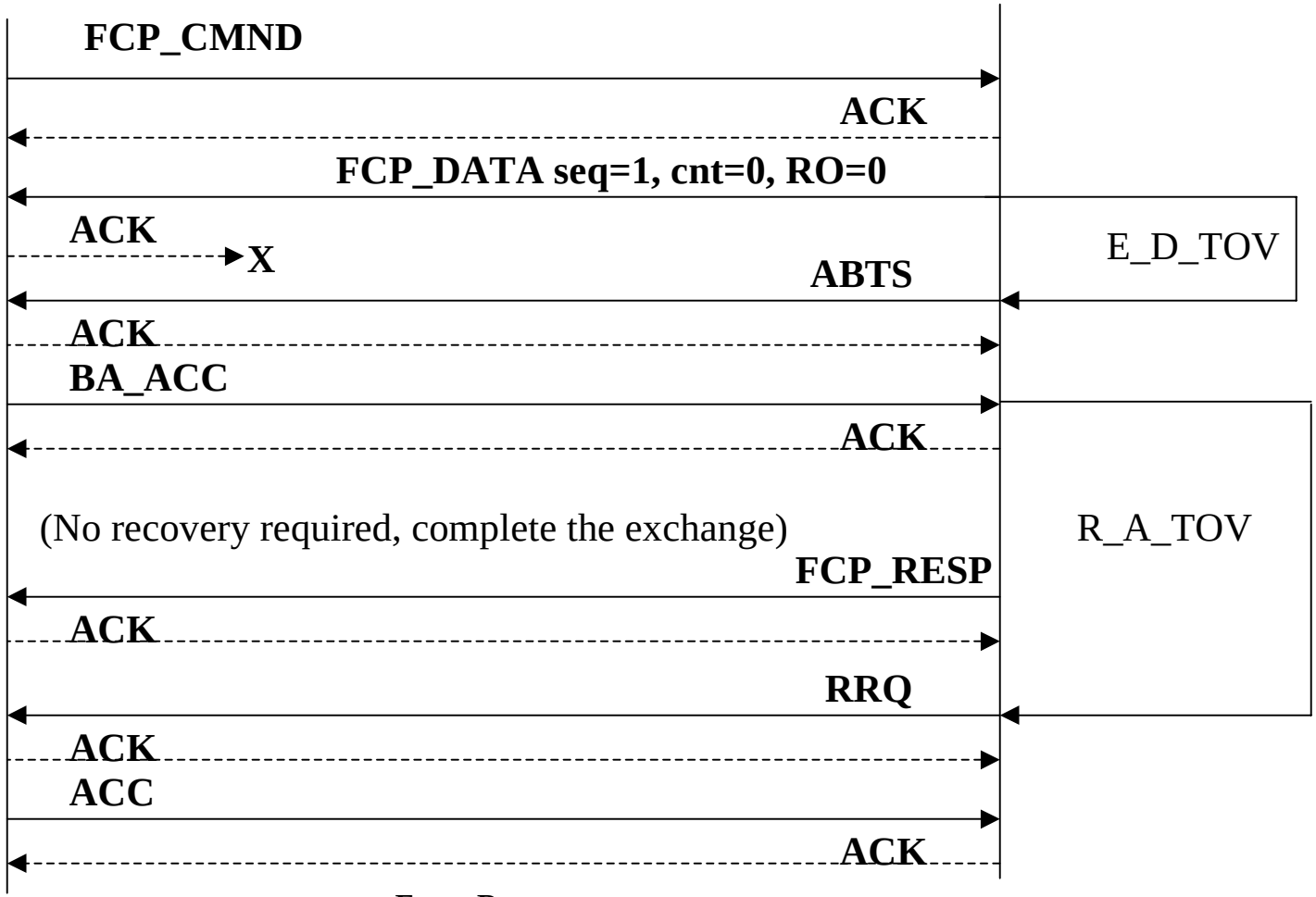
D.10 Class 2 Lost Read Data, Not Last Frame of Seq



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.

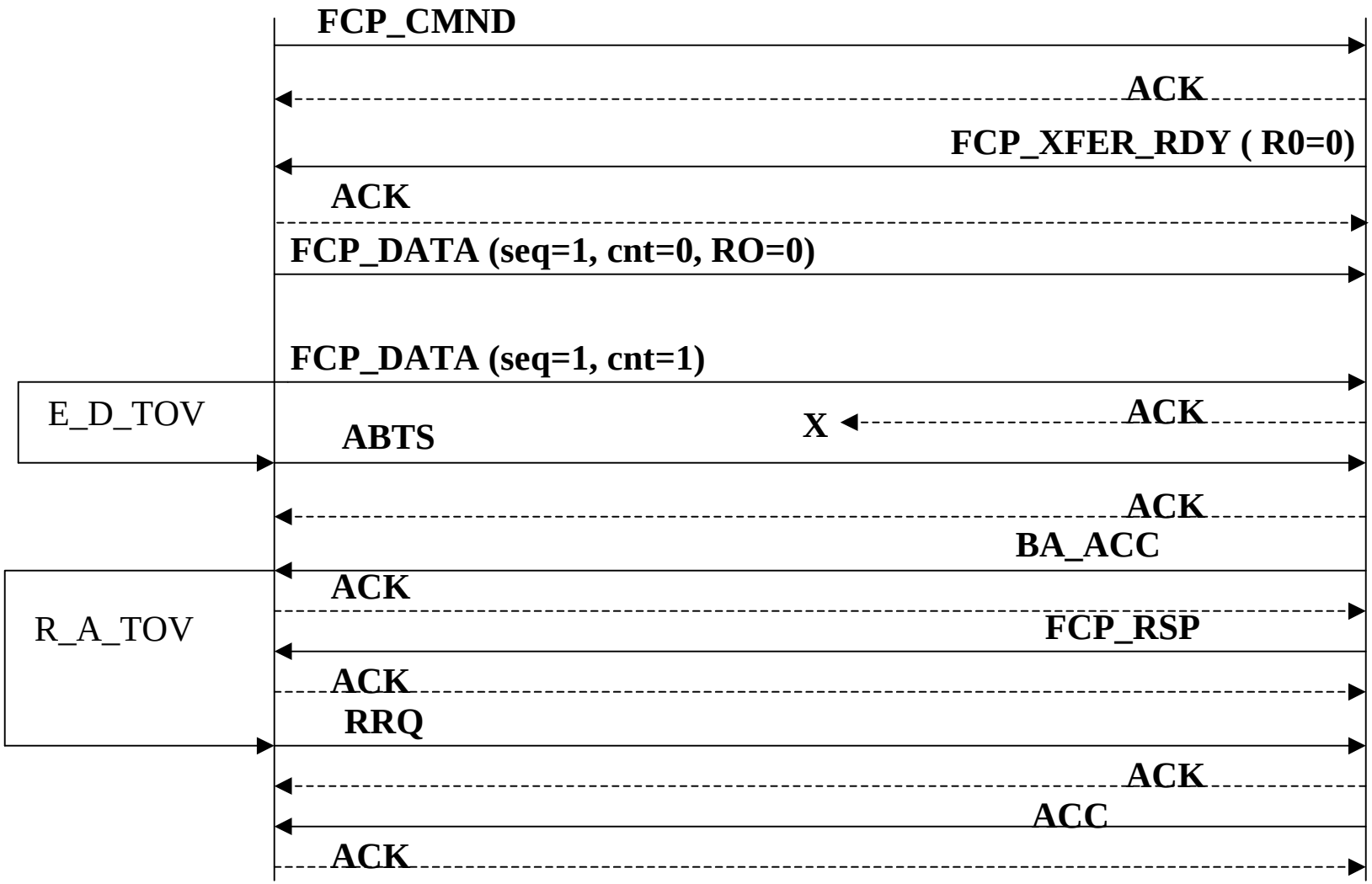
D.11 Class 2 ACK Lost on Read.



Error Recovery

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

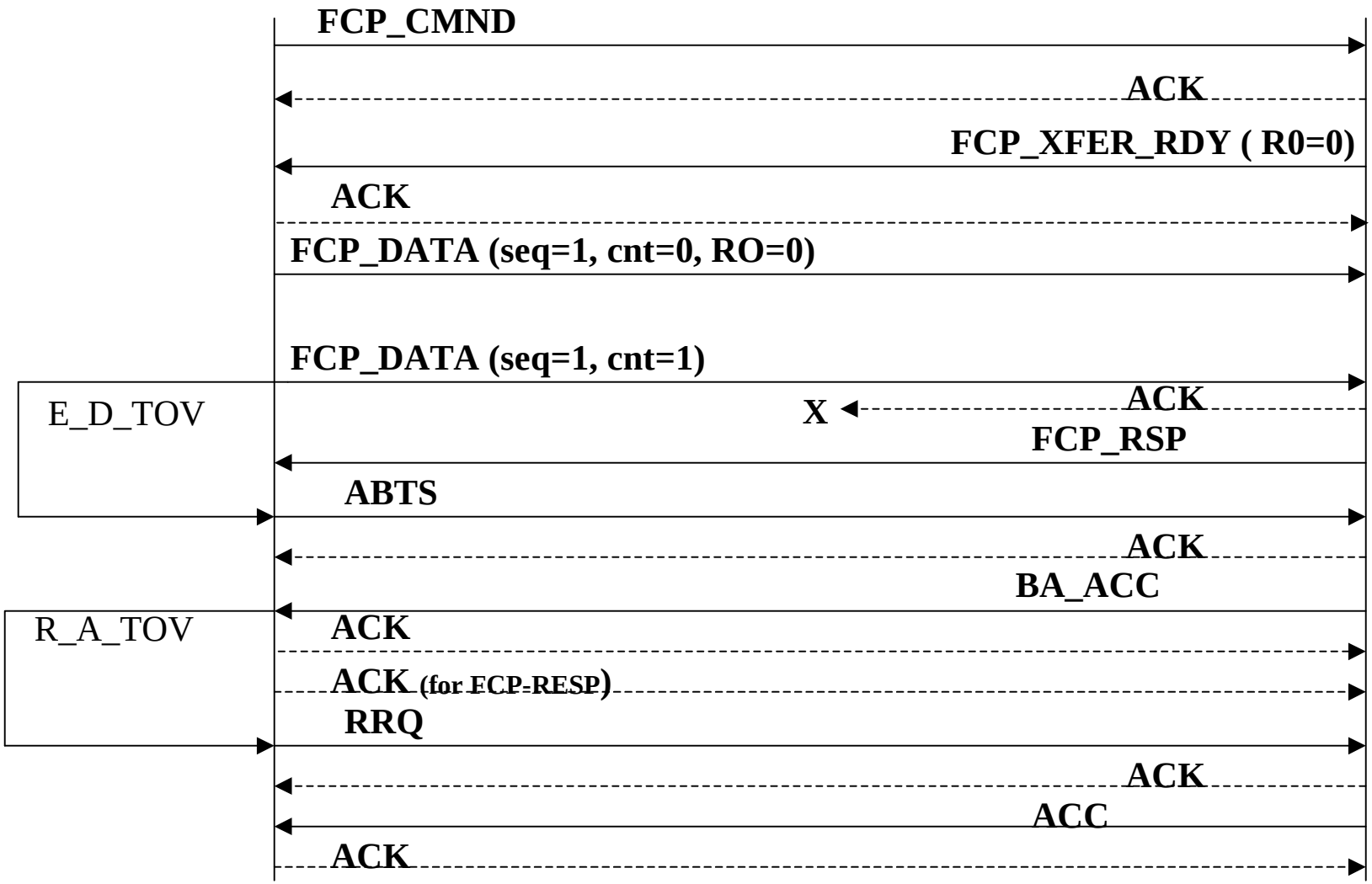


Error Recovery

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.12b Class 2 ACK Lost on Write

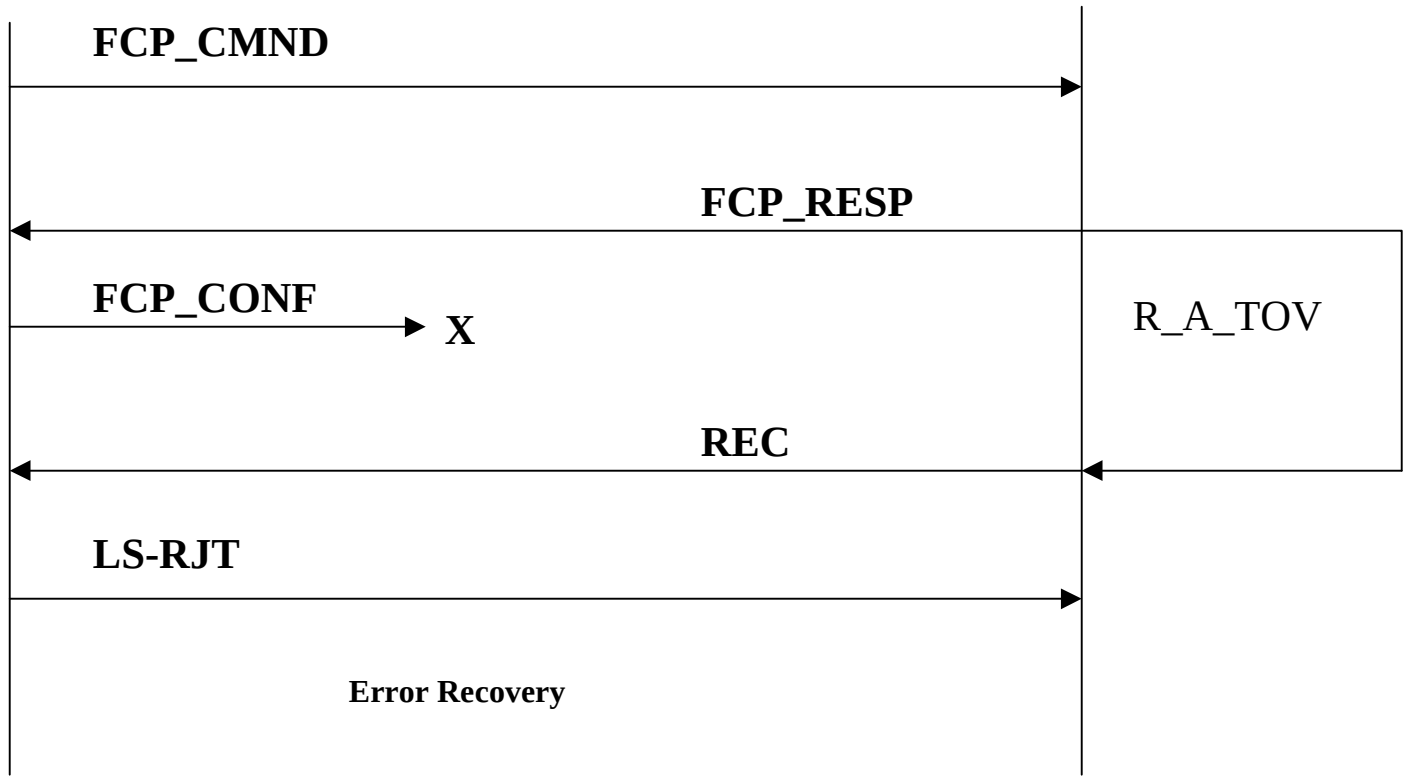


Error Recovery

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

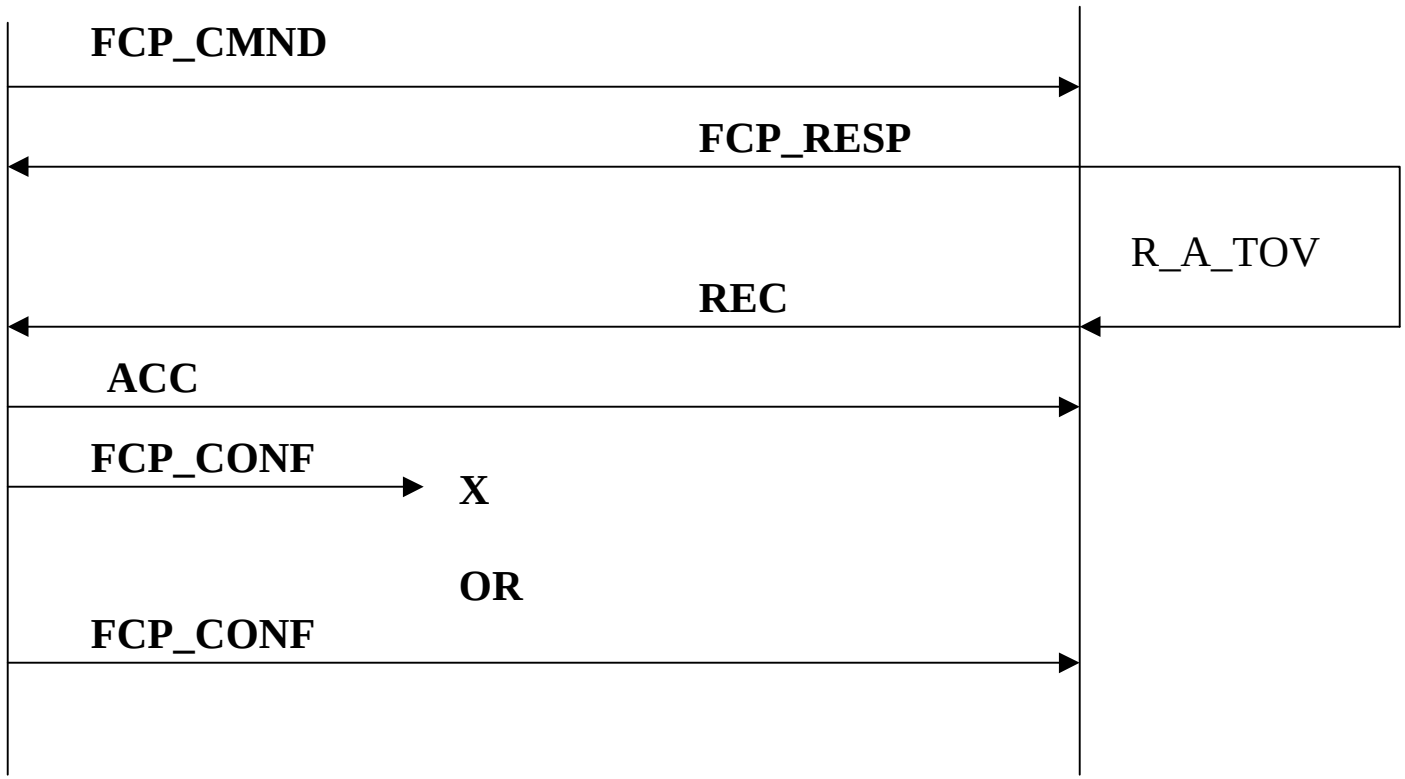
Note: The BA_ACC indicates the data sequence was received, the Target and Initiator continue the Exchange. The Initiator must establish its Recovery Qualifier. The resources associated with the Recovery Qualifier can be reclaimed on receipt of the ACK (out of order) or after R_A_TOV. The issuance of 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).

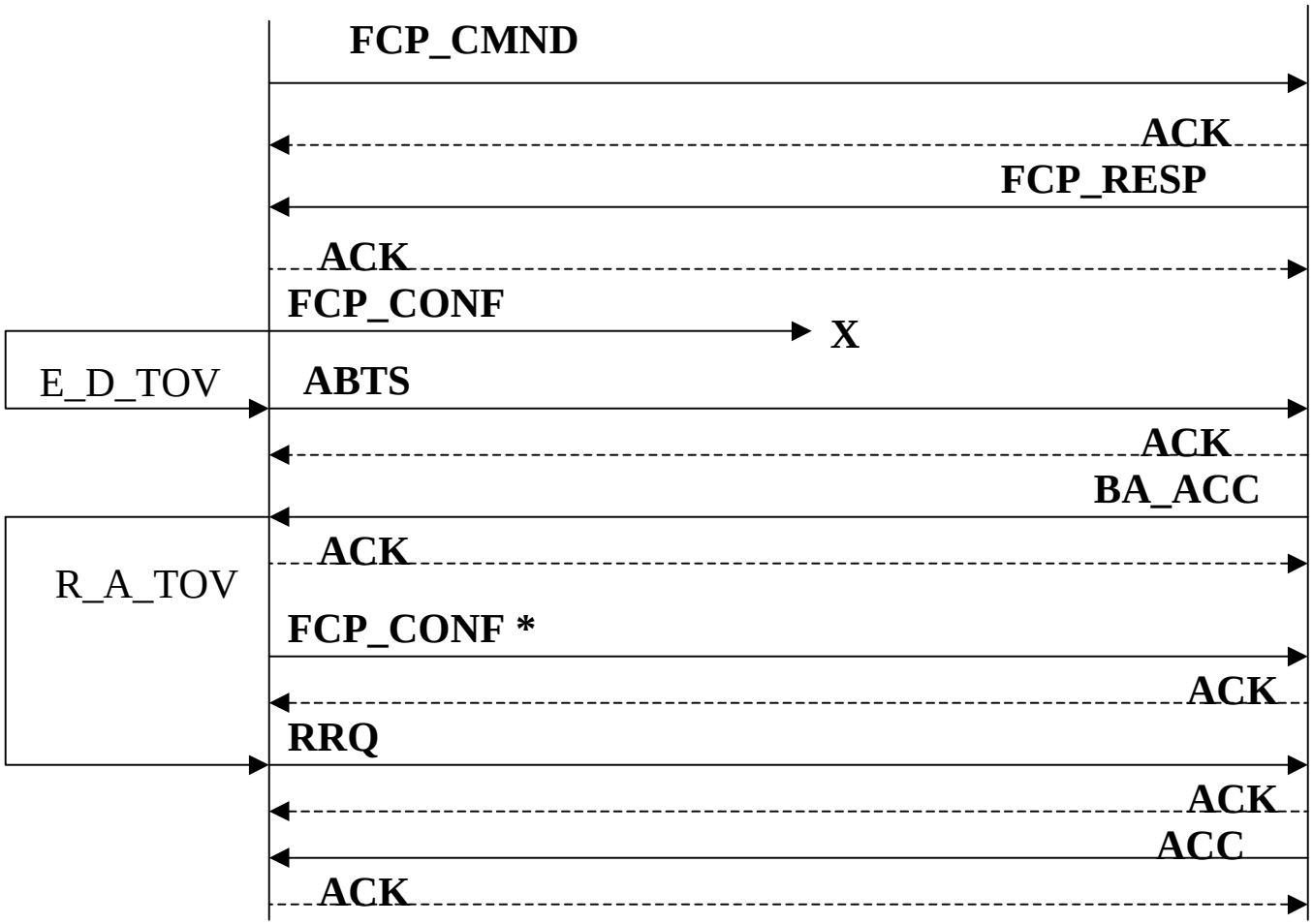
D.?2 Class 3 FCP_CONF Delayed and Lost



Error Recovery

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 resused 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).

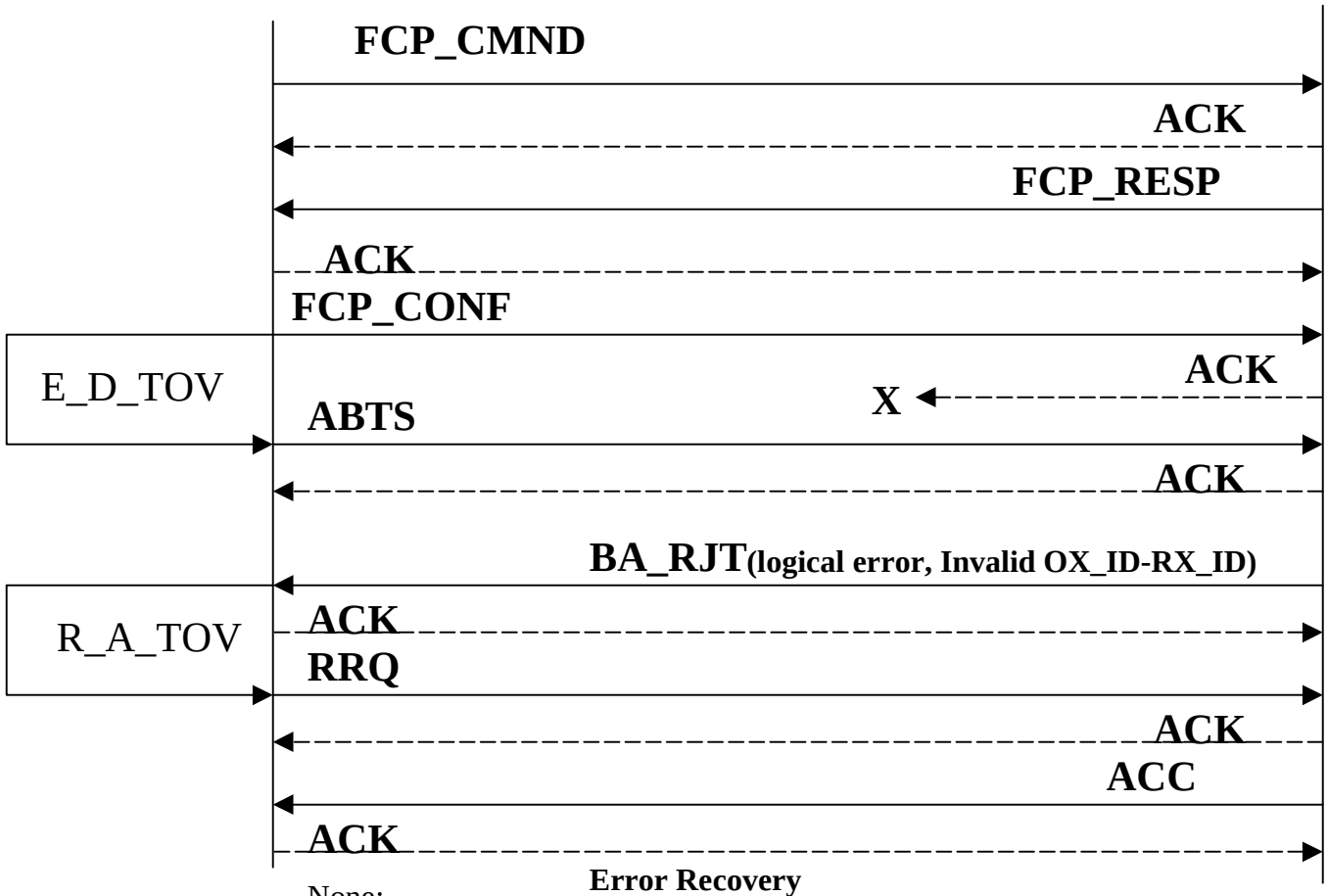
D.?? Class 2 FCP_CONF Lost



BA_ACC payload indicates that FCP_CONF was not received (Low SEQ_CNT not equal to High SEQ_CNT value of the ABTS)

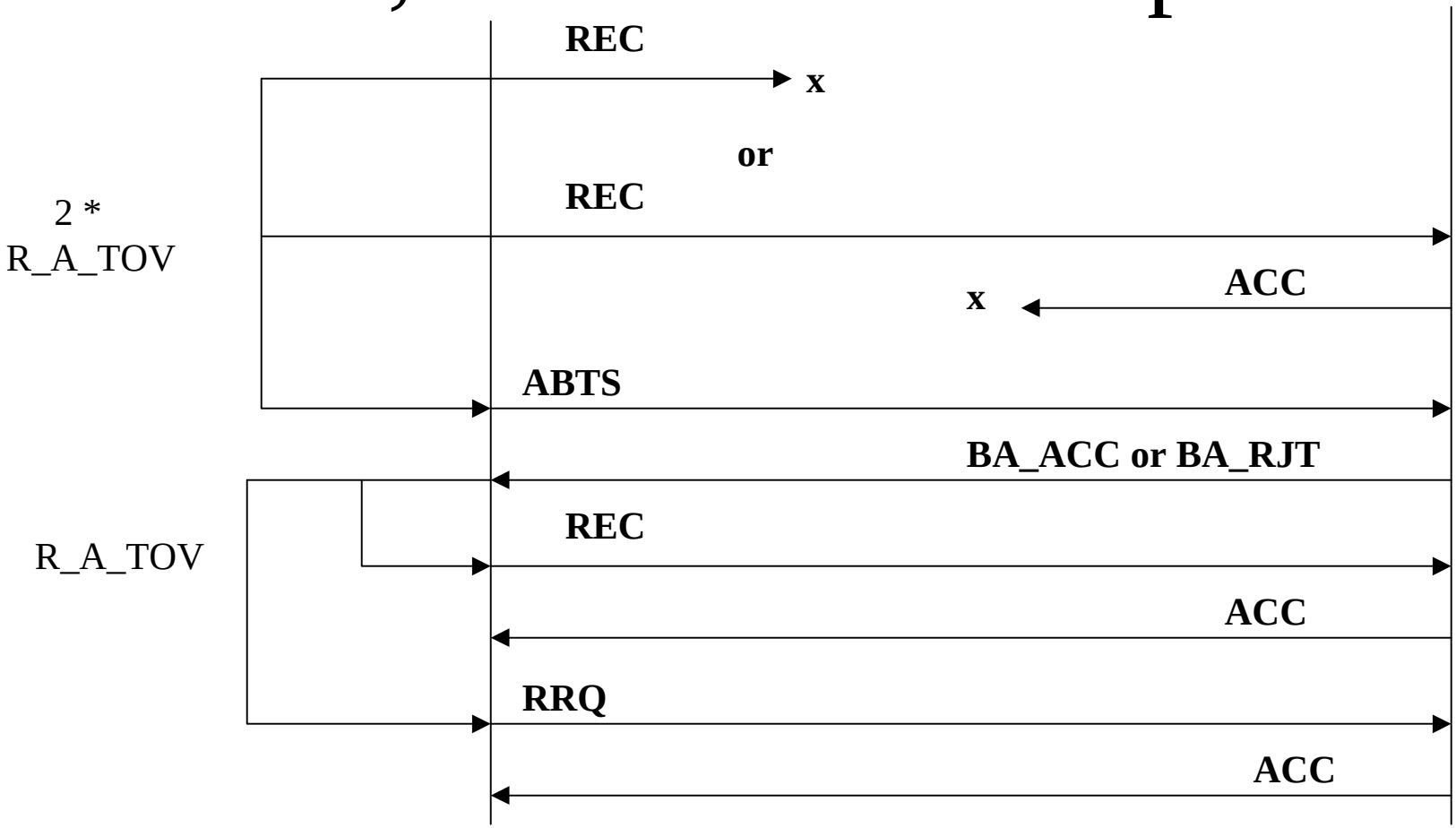
* Second FCP_CONF must be sent with a different SEQ_ID. The SEQ_CNT value used in the retransmission of FCP_CONF must be one greater than the value used in the ABTS frame.

D.??? Class 2 ACK Lost on FCP_CONF



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.

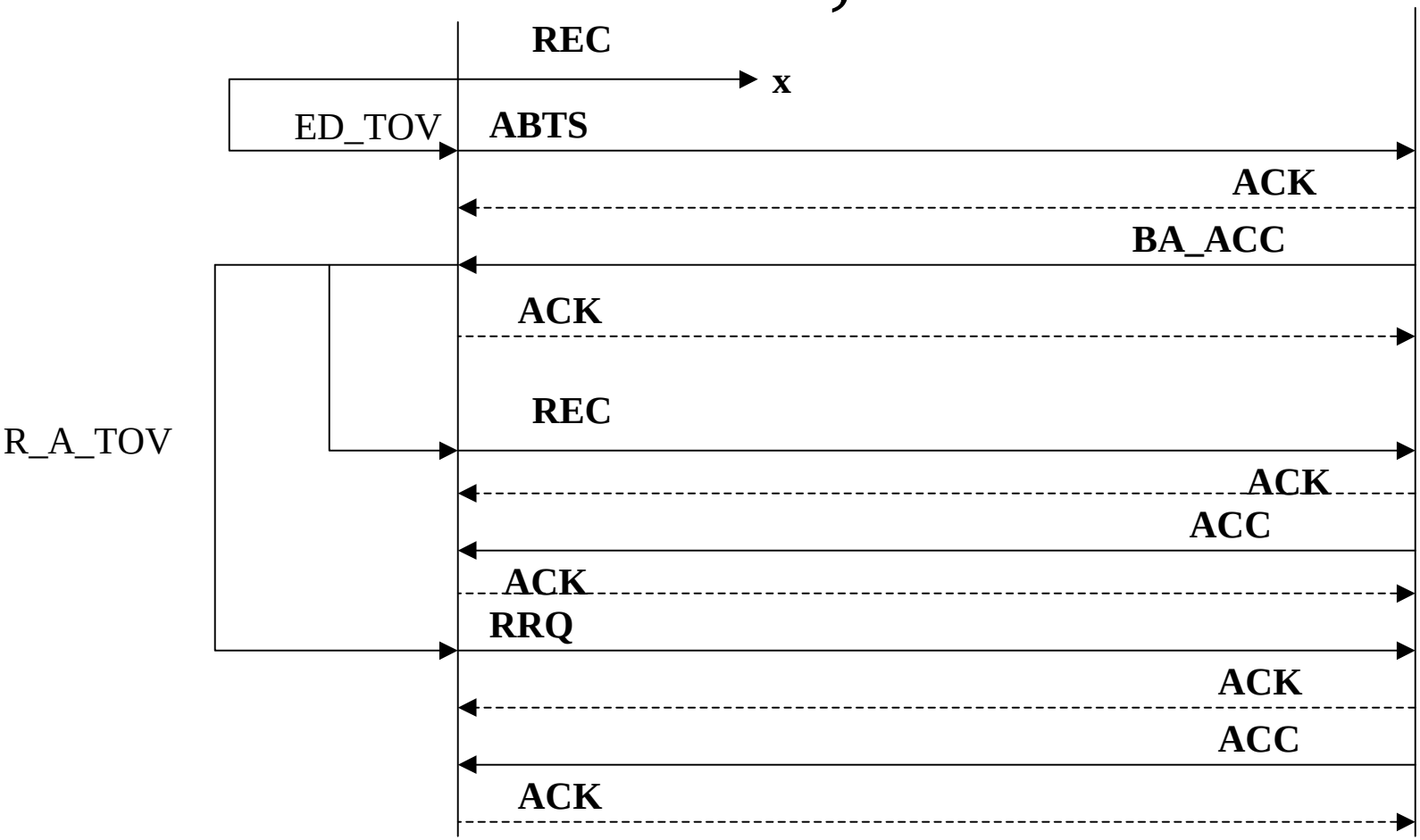
D.13 Cl 3,REC or REC Response Lost



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

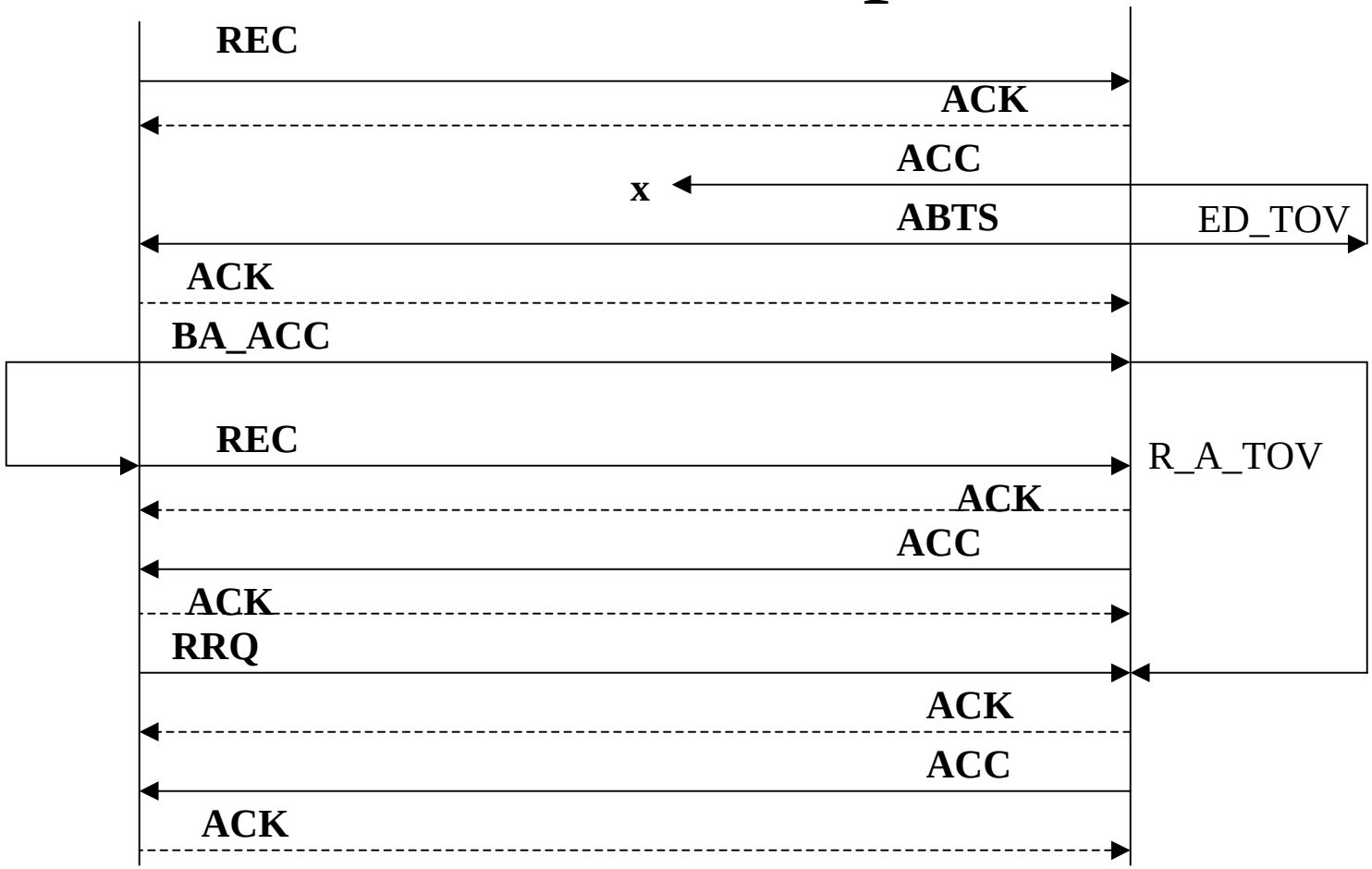
Change E_D_TOV in the text to 2 * R_A_TOV to agree with the text in 12.6.2

D.13a Class 2, REC Lost



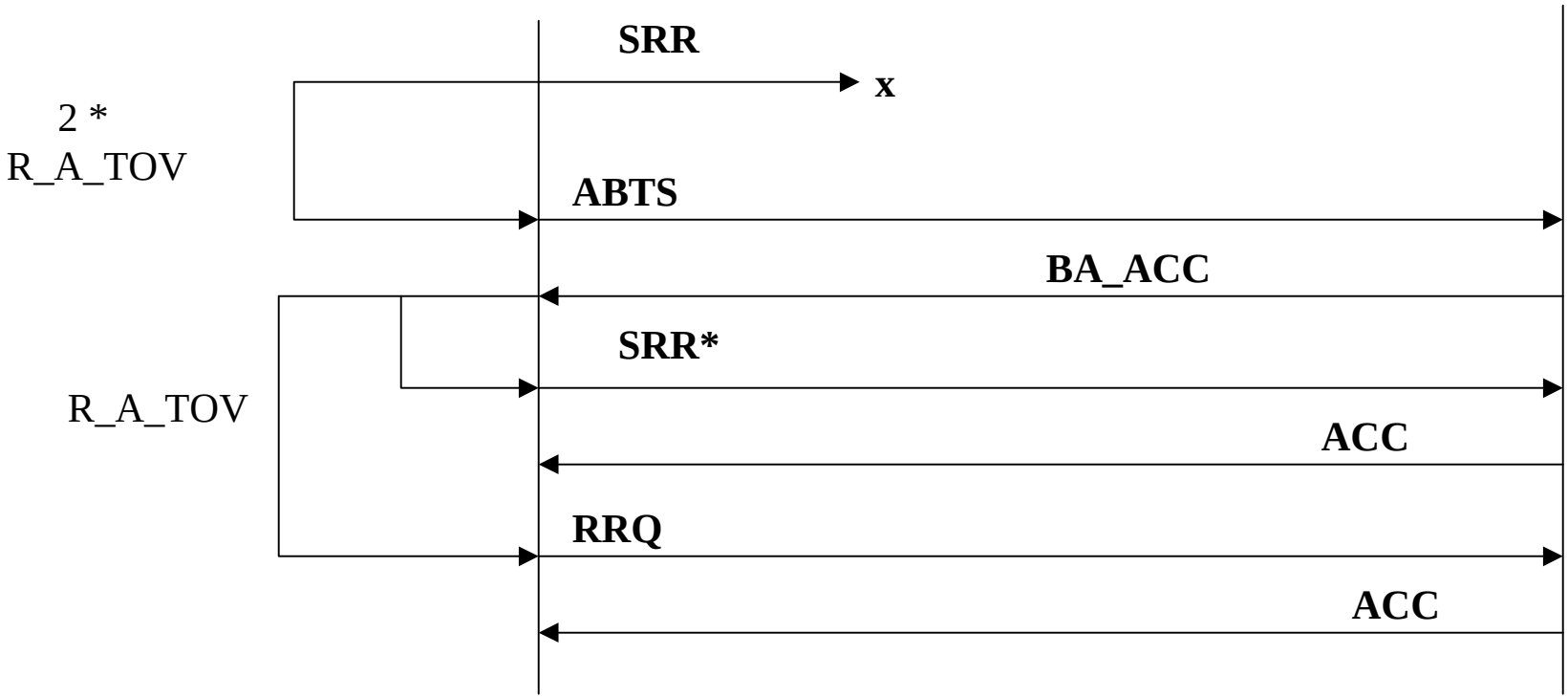
The second REC is issued using a new Exchange.

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.

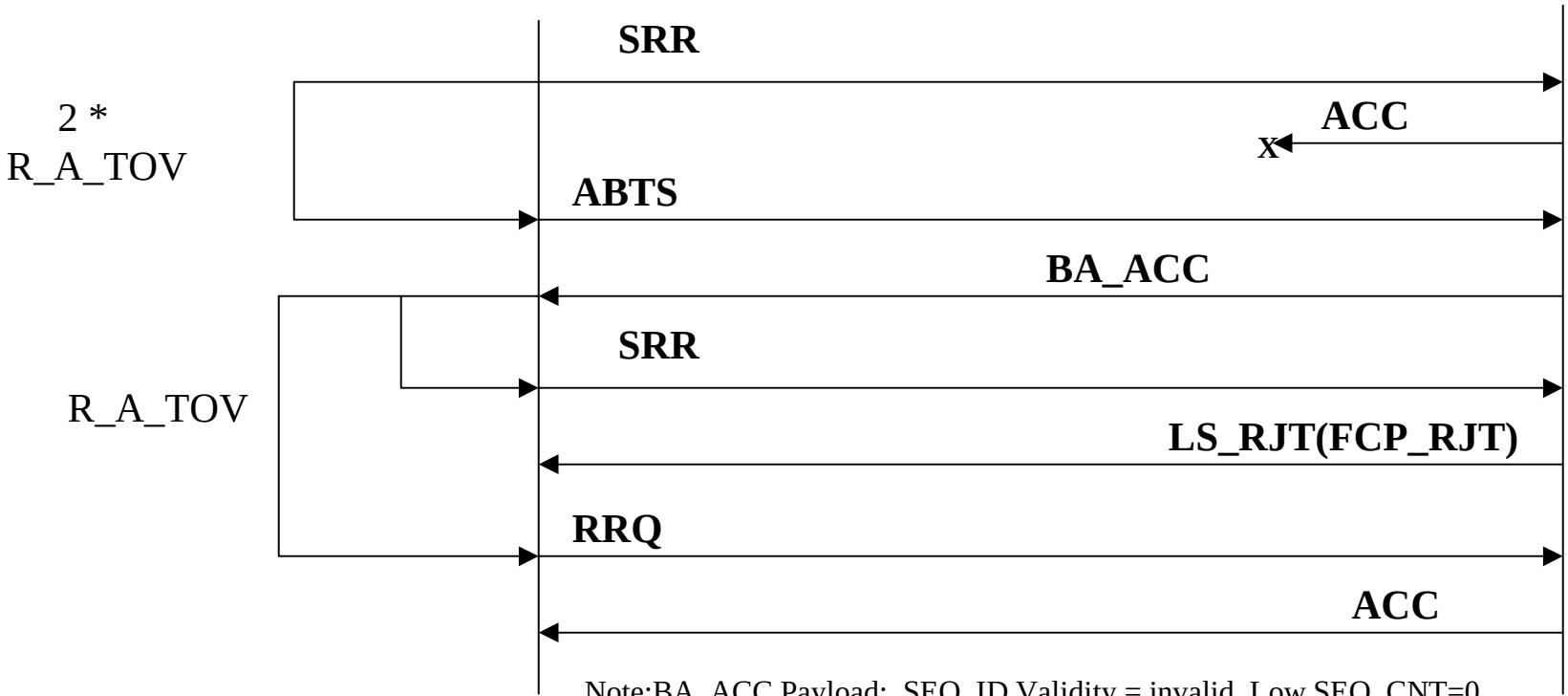
D.14a Class 3, SRR Lost



Note: BA_ACC Payload: SEQ_ID Validity = invalid, Low SEQ_CNT=x'0000', High SEQ_CNT =SEQ_CNT of ABTS. SRR* is issued in a new Exchange. The Target restarts the original Exchange per the SRR* Payload.

Change E_D_TOV in the text to 2 * R_A_Tov to agree with the text in 12.6.3

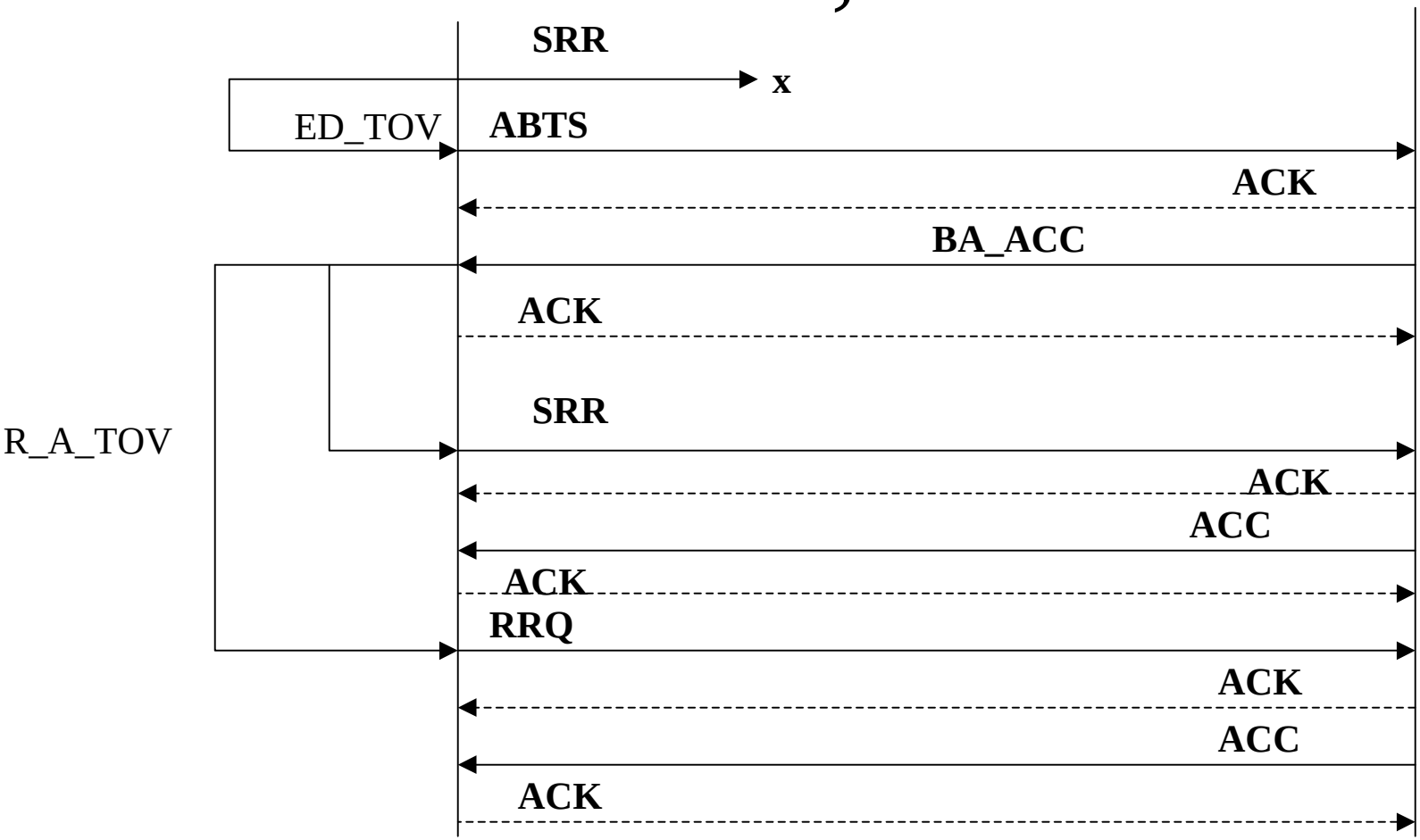
D.14b Class 3, SRR Response Lost



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 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.

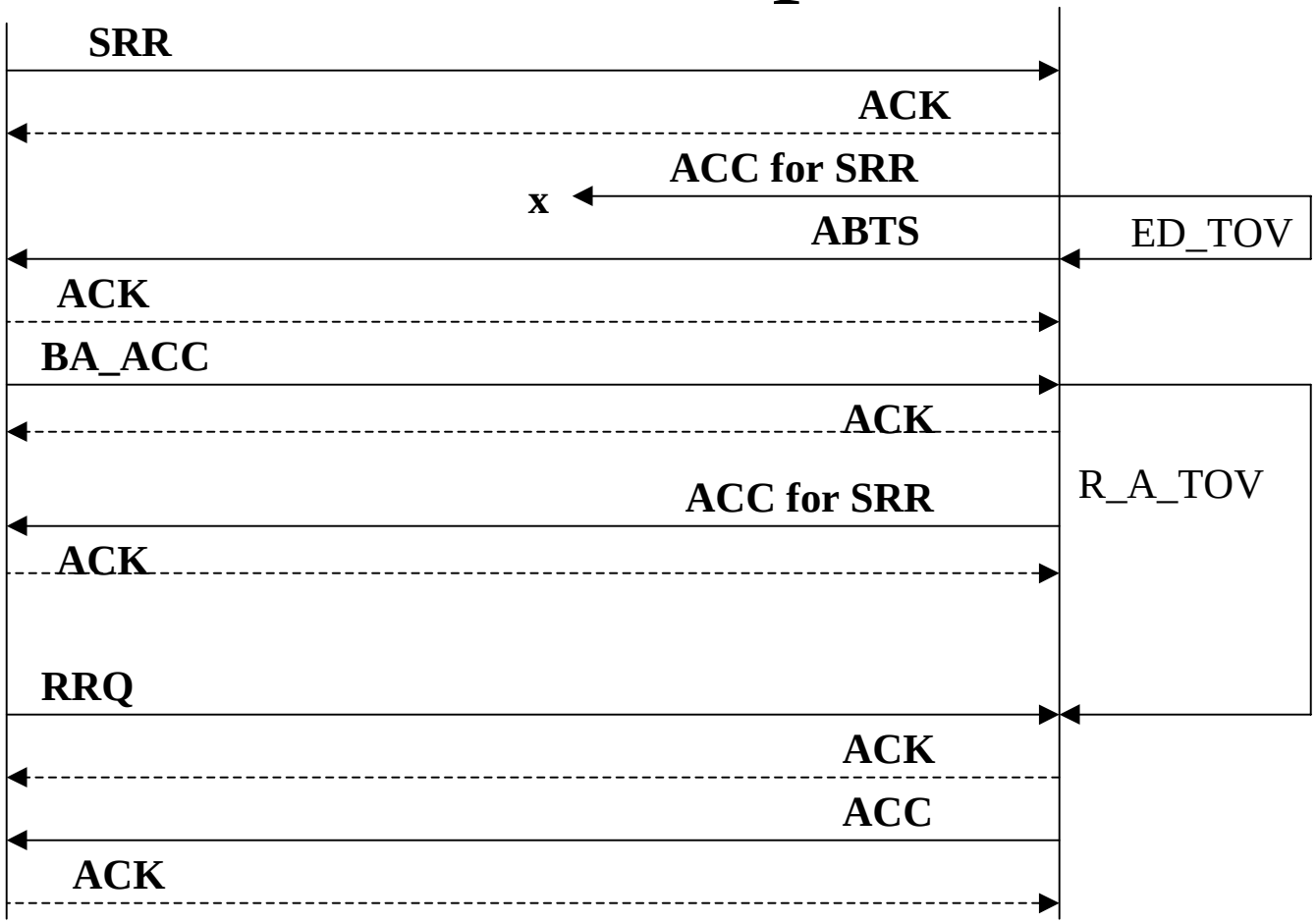
Change E_D_TOV in the text to 2 * R_A_TOV to agree with the text in 12.6.3

D.14c Class 2, SRR Lost



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.