



# BROCADE

July 20, 2000

T10/00-266 revision 1

To: John Lohmeyer, chairperson, T10  
From: Bob Snively  
Date: July 20, 2000  
Subject: Draft of Annex D, FCP-2 revision 5

This document contains a draft of Annex D to be included in FCP-2, revision 5, based on T10/00-137r5. Revision 1 adds the requested corrections discovered during the FCP-2 working group meeting of July 10, 2000.

Note that the complex cases with ambiguous results are not yet included, pending completion of the effort to resolve one particularly intractable corner case.

# Annex D Error detection and recovery action examples

(Informative) [Draft, based on T10/00-137r5]

## D.1 Introduction

This annex diagrams various error detection and recovery procedures for SCSI devices conforming to this profile.

Table D.1 - Diagram Drawing Conventions

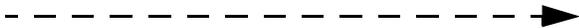
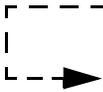
Drawing Convention	Meaning
	Acknowledged or Unacknowledged Frame
	Acknowledgement Frame
	Time-out value exceeded, caused transmission of IU or ELS
	IU or ELS received is processed to transmit IU or ELS
X	Frame lost or dropped
CI Continue ↓	Error detection complete. Operation continues with specified Error Recovery if continuously increasing sequence count prerequisites are met.
Continue ↓	Error detection complete. Operation continues with specified Error Recovery if continuously increasing sequence count prerequisites are not met.

Figure D.1 - Lengthy FCP\_CMND or Lost ACK

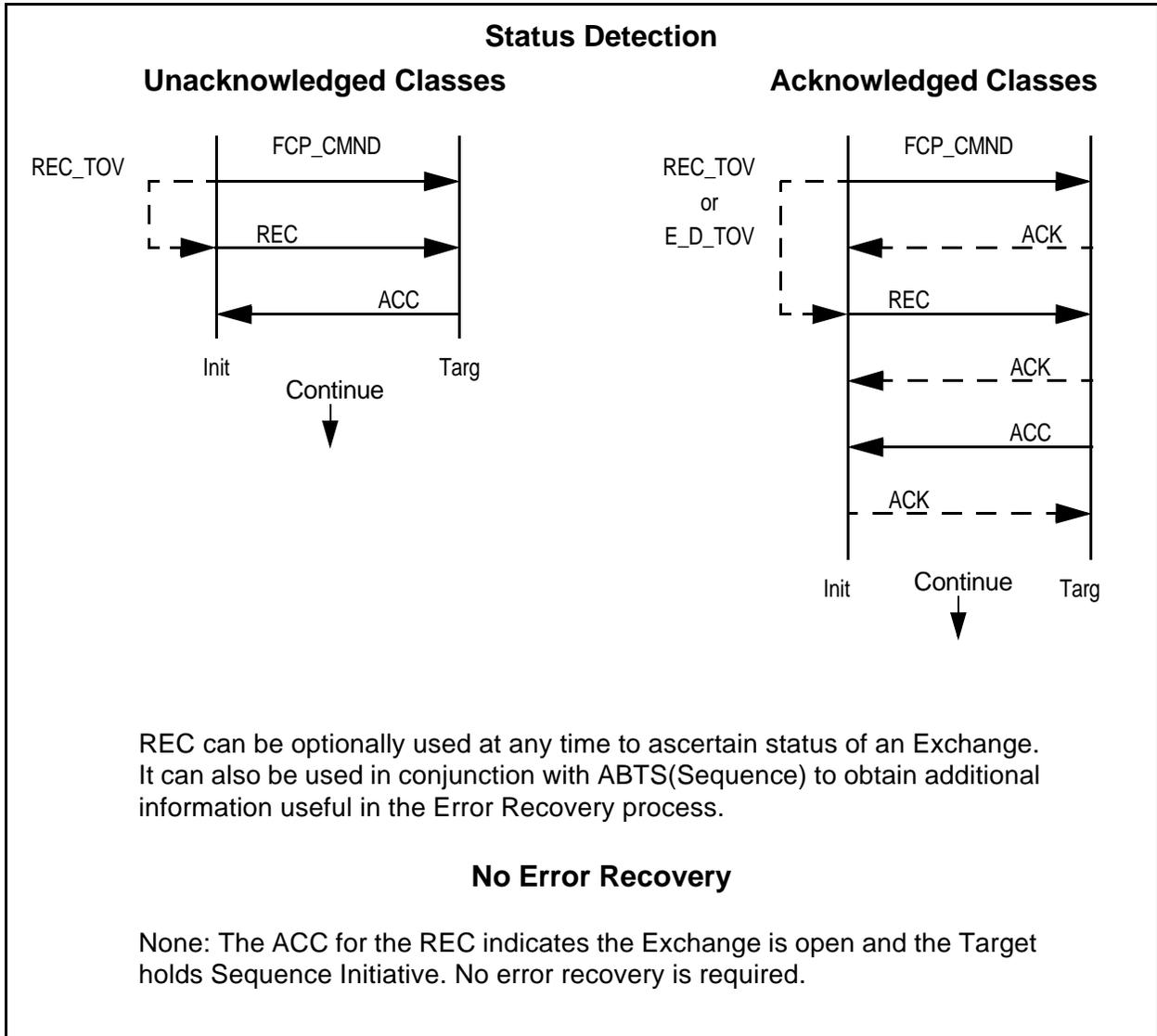


Figure D.2 - FCP\_CMND Lost, Unacknowledged Classes

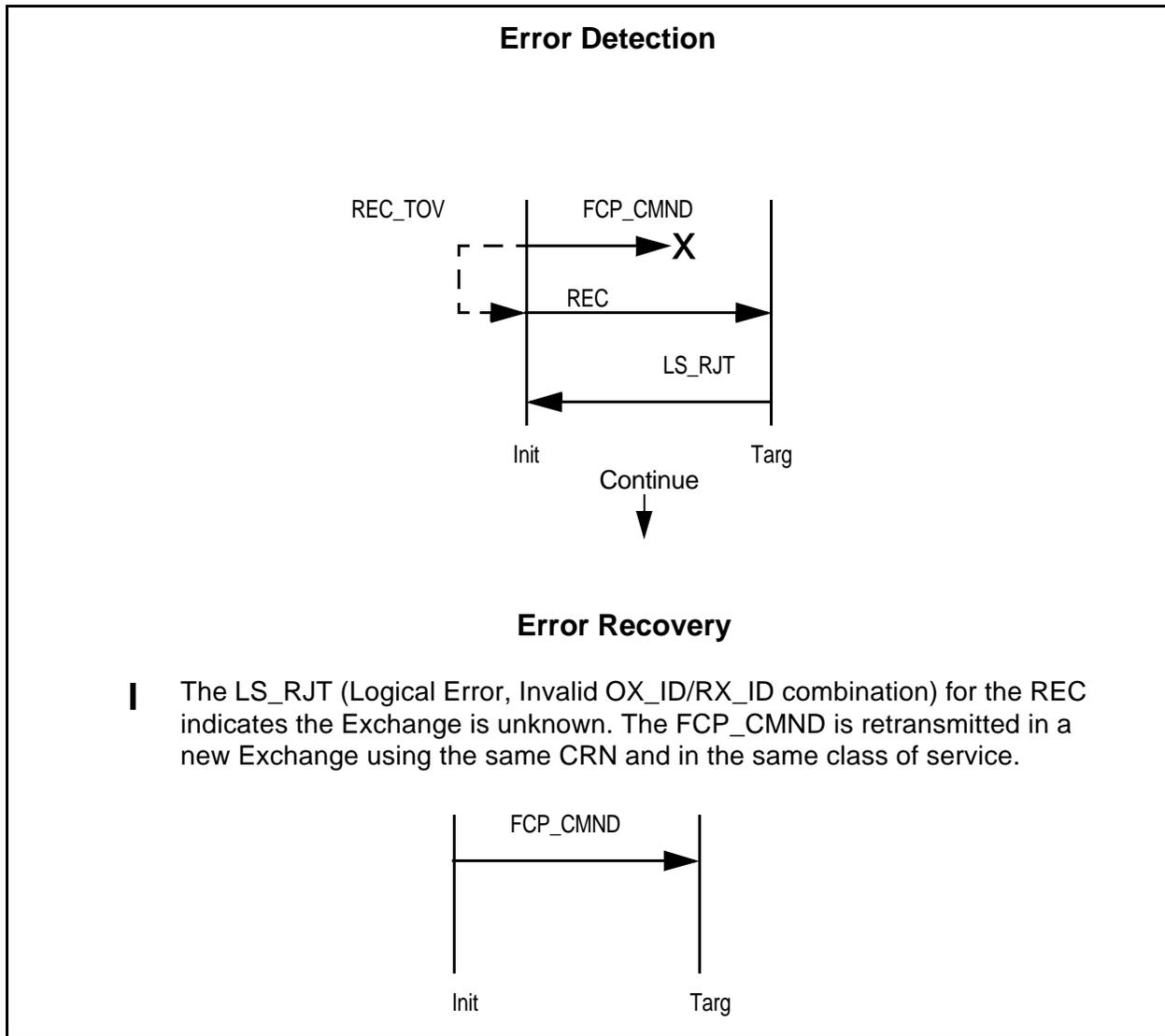


Figure D.3 - FCP\_CMND Lost, Acknowledged Classes

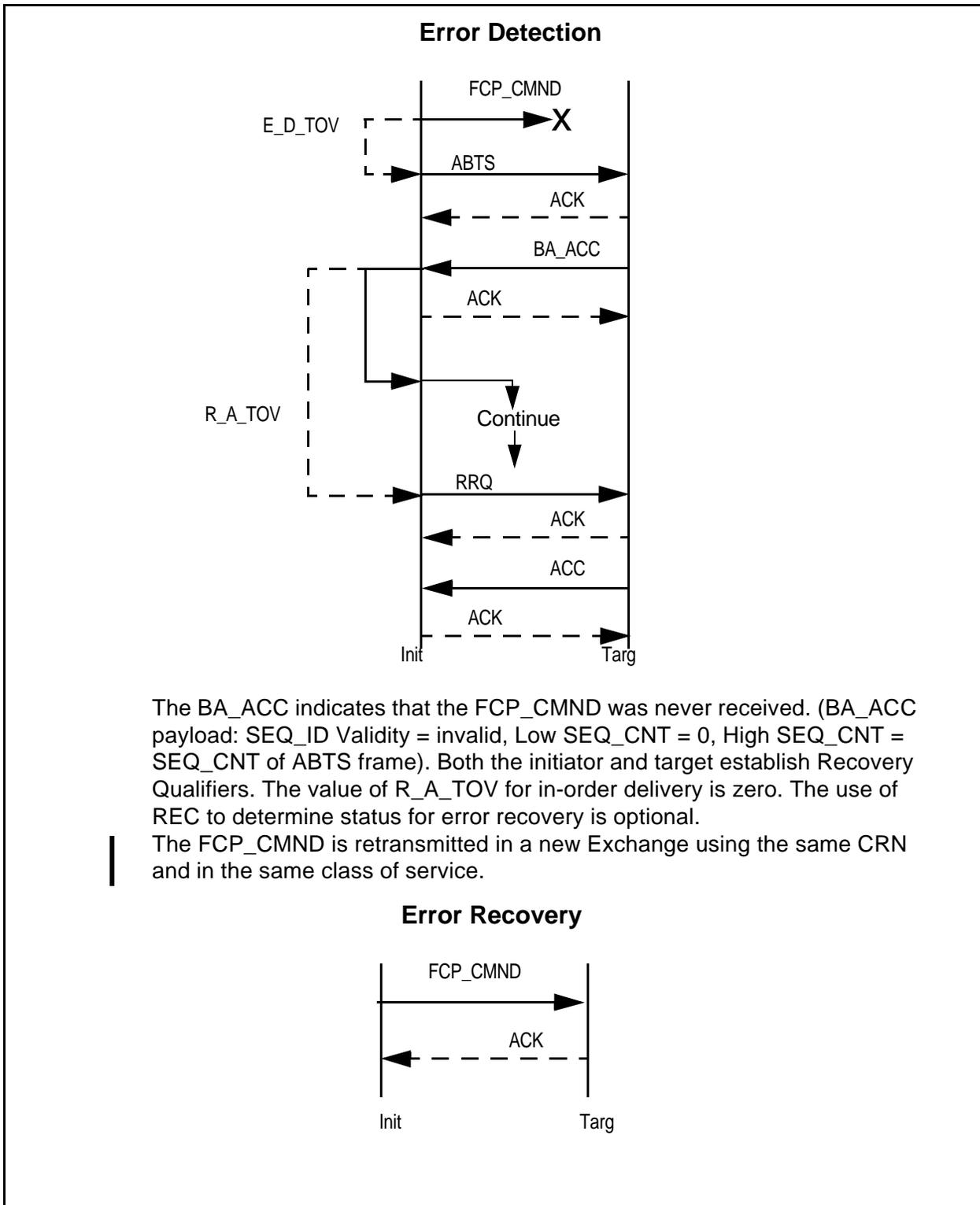
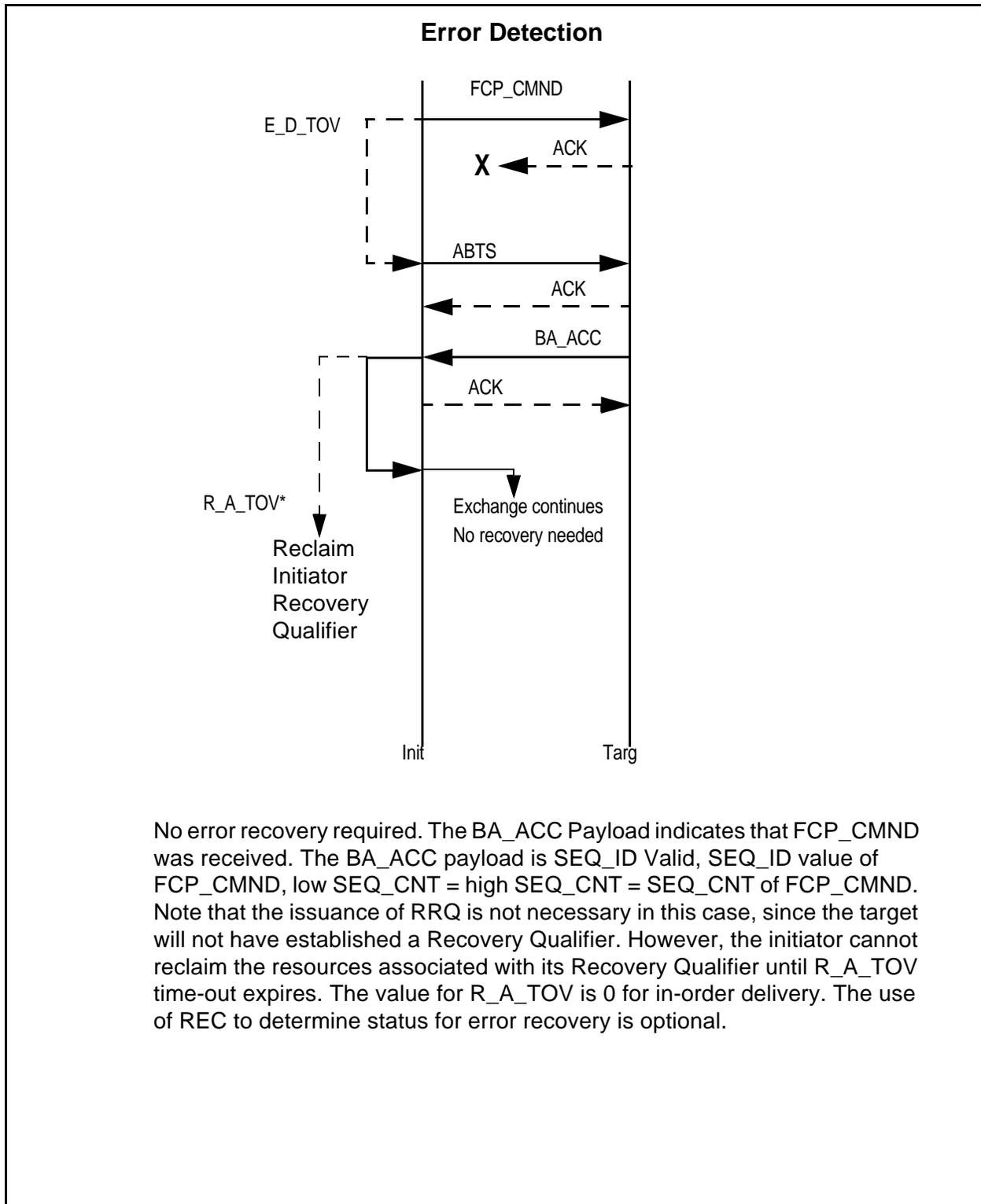


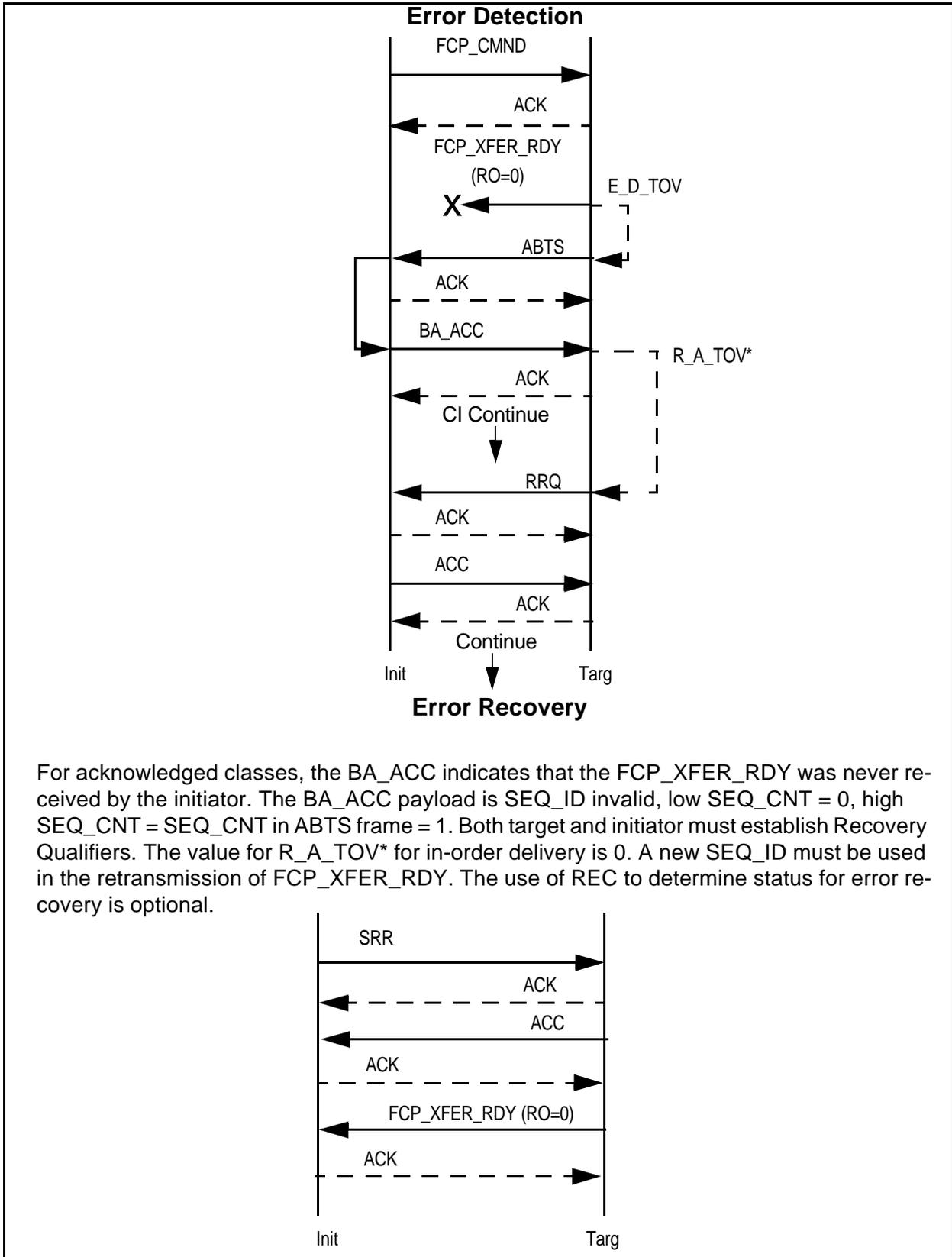
Figure D.4 - FCP\_CMND Acknowledgement Lost, Acknowledged Classes



No error recovery required. The BA\_ACC Payload indicates that FCP\_CMND was received. The BA\_ACC payload is SEQ\_ID Valid, SEQ\_ID value of FCP\_CMND, low SEQ\_CNT = high SEQ\_CNT = SEQ\_CNT of 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 R\_A\_TOV time-out expires. The value for R\_A\_TOV is 0 for in-order delivery. The use of REC to determine status for error recovery is optional.



Figure D.6 - FCP\_XFER\_RDY Lost, Acknowledged Classes



For acknowledged classes, the BA\_ACC indicates that the FCP\_XFER\_RDY was never received by the initiator. The BA\_ACC payload is SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = SEQ\_CNT in ABTS frame = 1. Both target and initiator must establish Recovery Qualifiers. The value for R\_A\_TOV\* for in-order delivery is 0. A new SEQ\_ID must be used in the retransmission of FCP\_XFER\_RDY. The use of REC to determine status for error recovery is optional.

Figure D.7 - FCP\_XFER\_RDY Received, ACK Lost, Acknowledged Classes

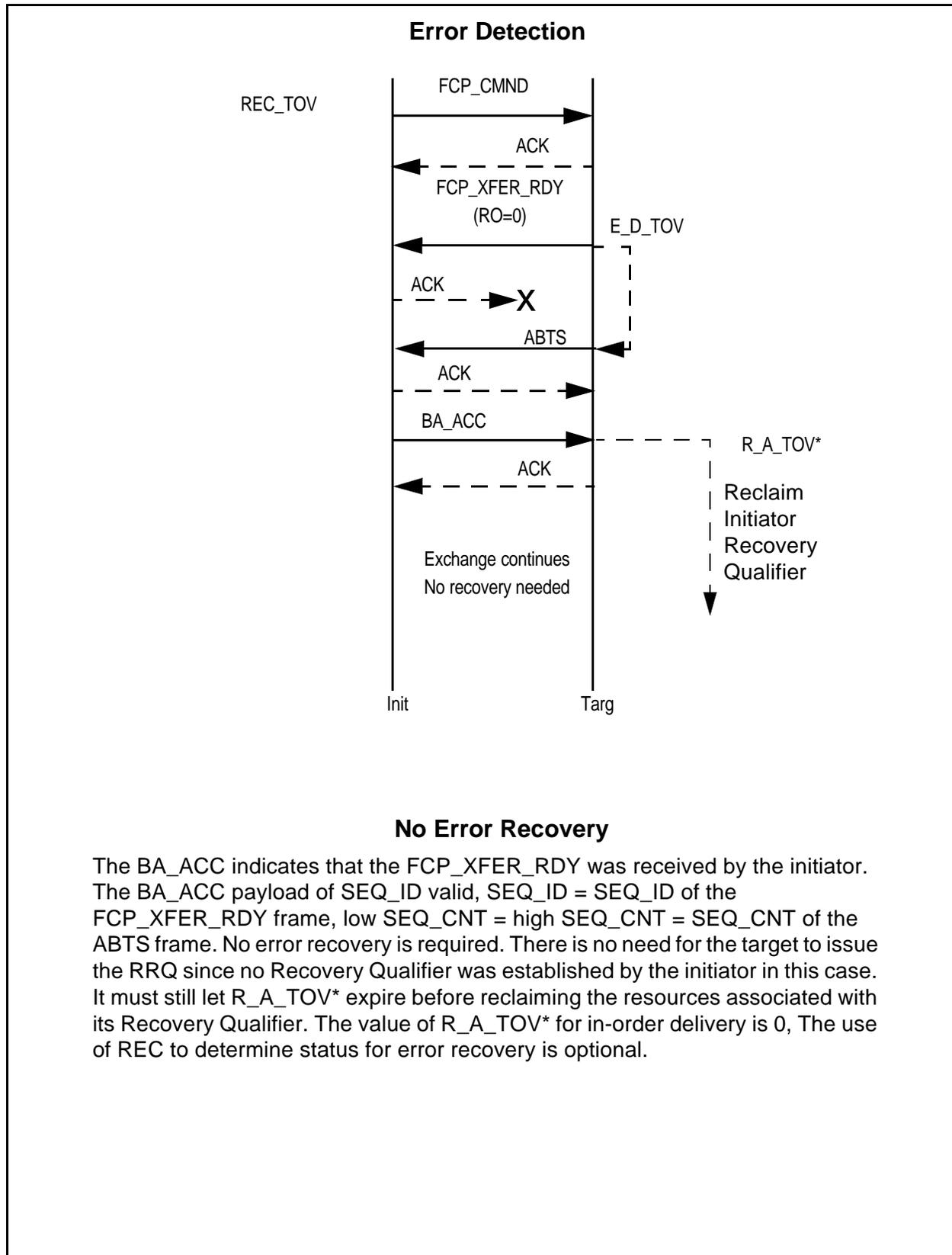


Figure D.8 - FCP\_RSP Lost, FCP\_CONF not requested, Unacknowledged Classes

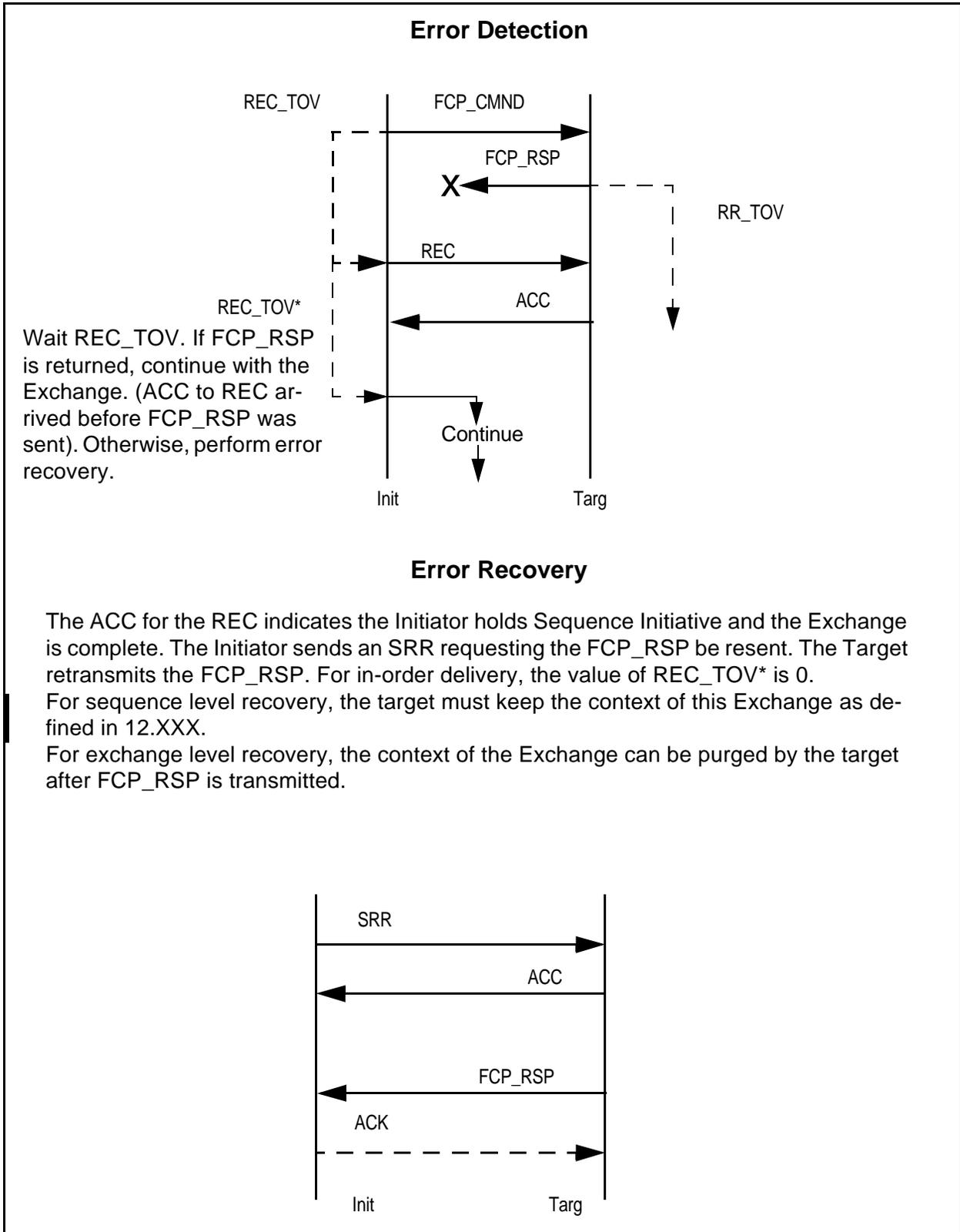


Figure D.9 - FCP\_RSP Lost, FCP\_CONF not requested, Acknowledged Classes

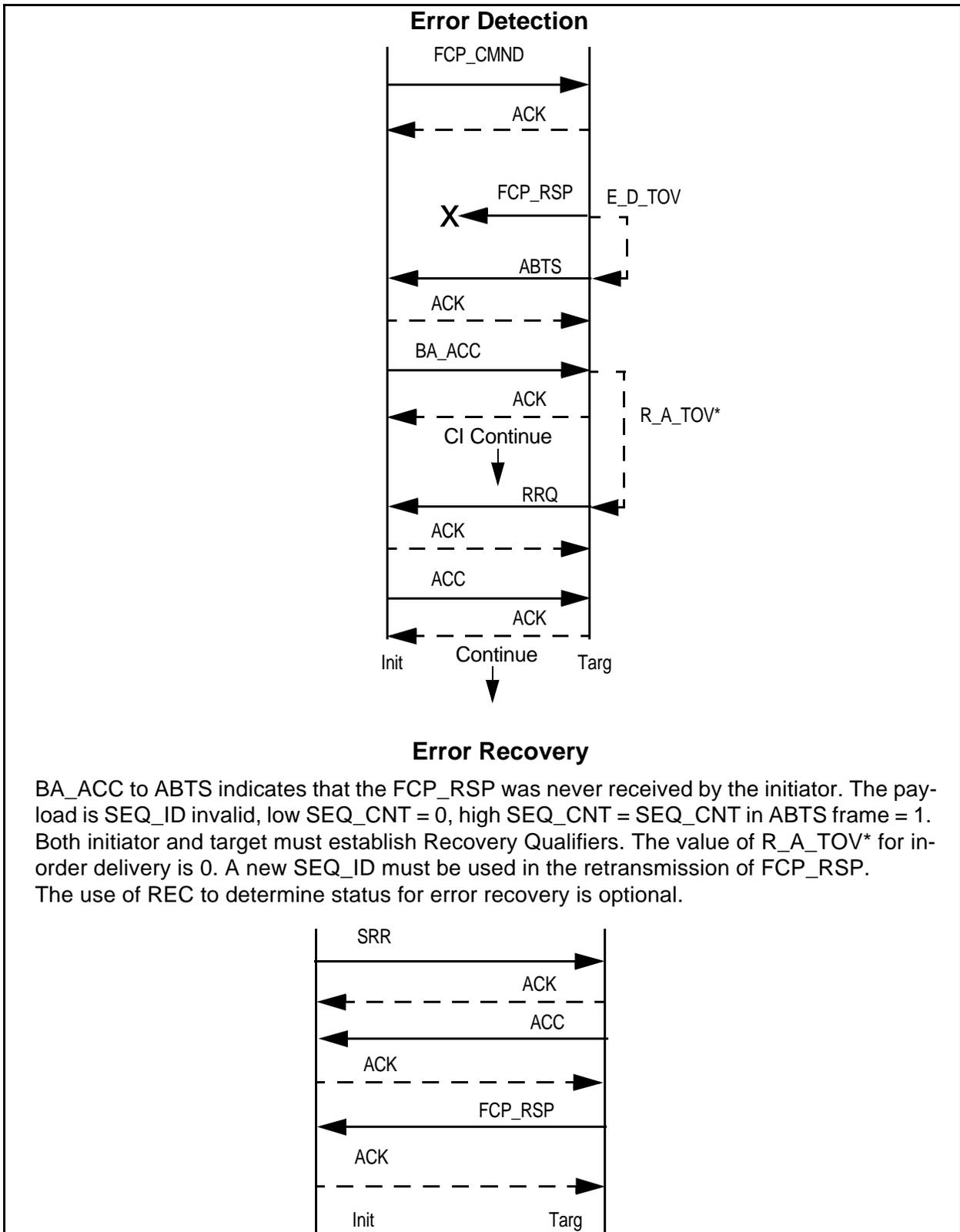
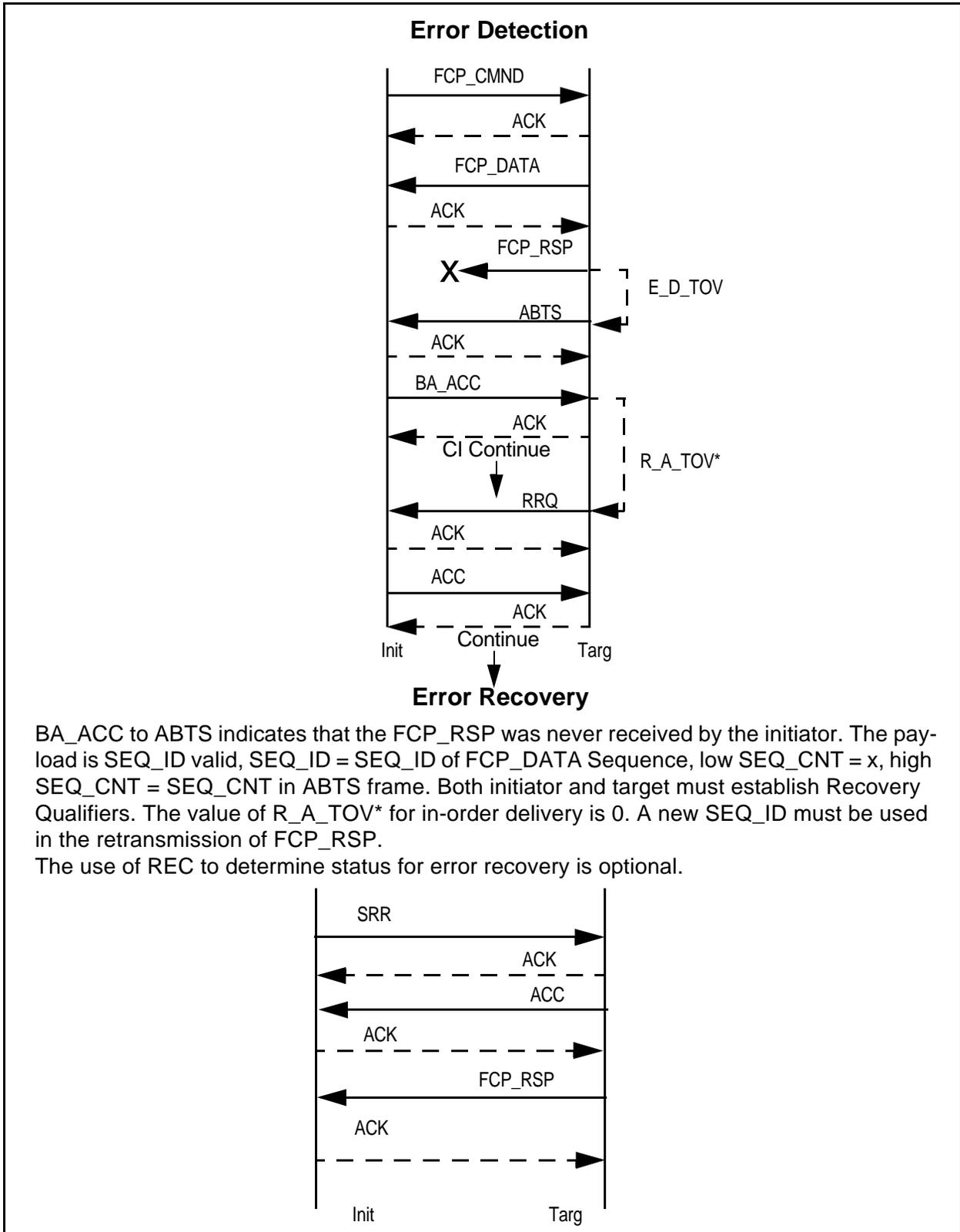


Figure D.10 - FCP\_RSP Lost after Read Command, FCP\_CONF not requested, Acknowledged Classes



BA\_ACC to ABTS indicates that the FCP\_RSP was never received by the initiator. The payload is SEQ\_ID valid, SEQ\_ID = SEQ\_ID of FCP\_DATA Sequence, low SEQ\_CNT = x, high SEQ\_CNT = SEQ\_CNT in ABTS frame. Both initiator and target must establish Recovery Qualifiers. The value of R\_A\_TOV\* for in-order delivery is 0. A new SEQ\_ID must be used in the retransmission of FCP\_RSP.

The use of REC to determine status for error recovery is optional.

Figure D.11 - FCP\_RSP Received, ACK Lost, Acknowledged Classes, Example 1

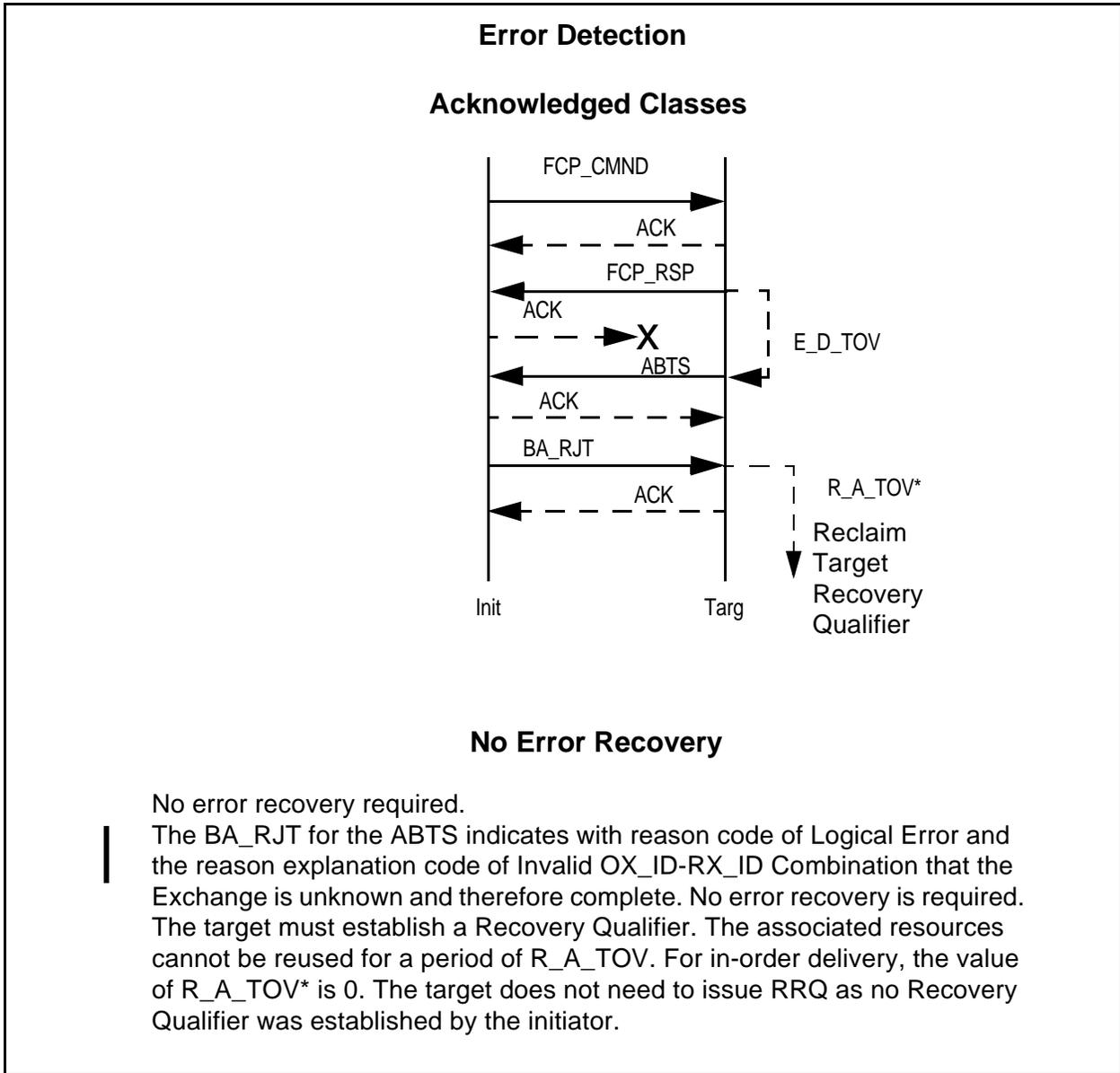


Figure D.12 - FCP\_RSP Received, ACK Lost, Acknowledged Classes, Example 2

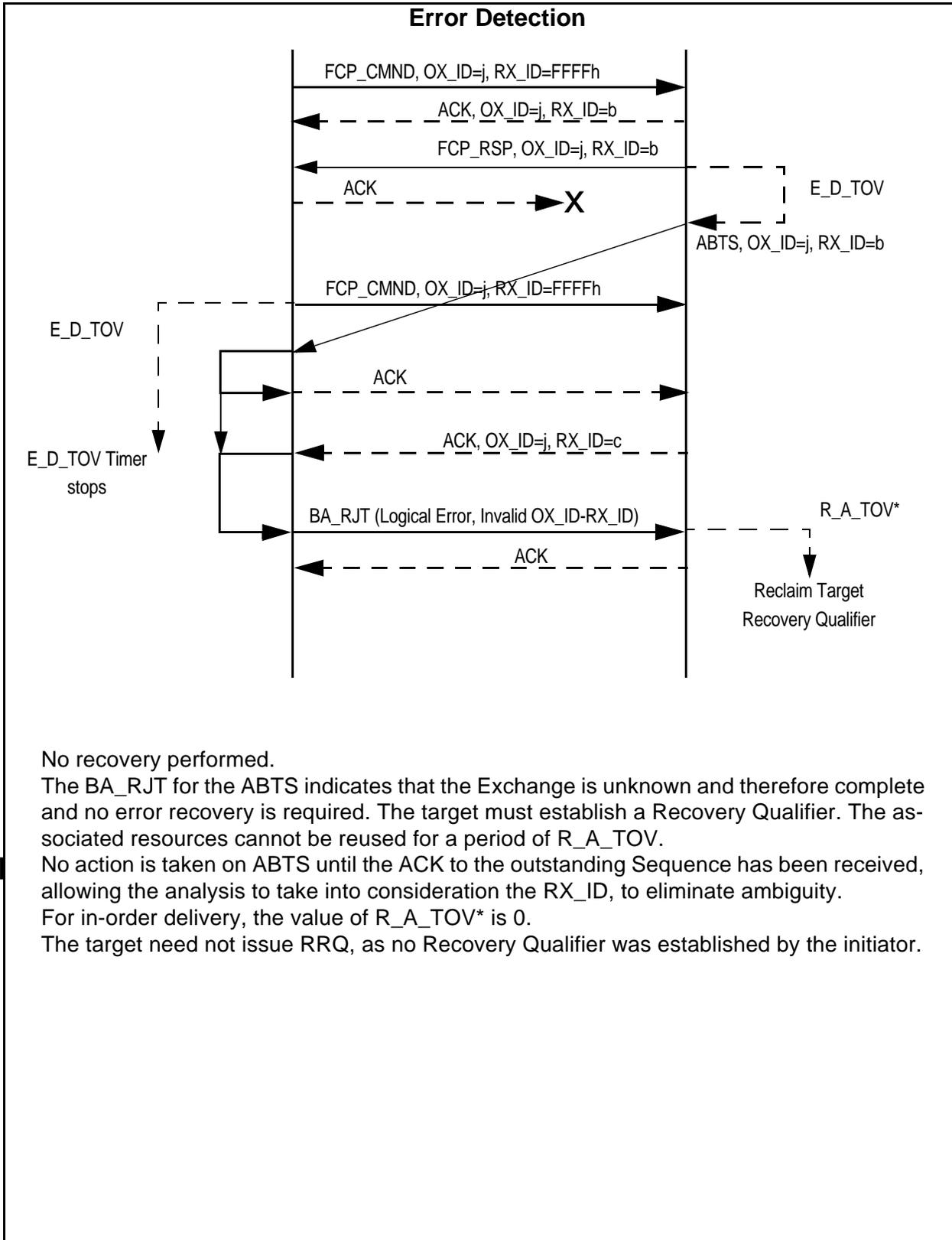


Figure D.13 - Lost Write Data, Last Frame of Sequence, Unacknowledged Classes

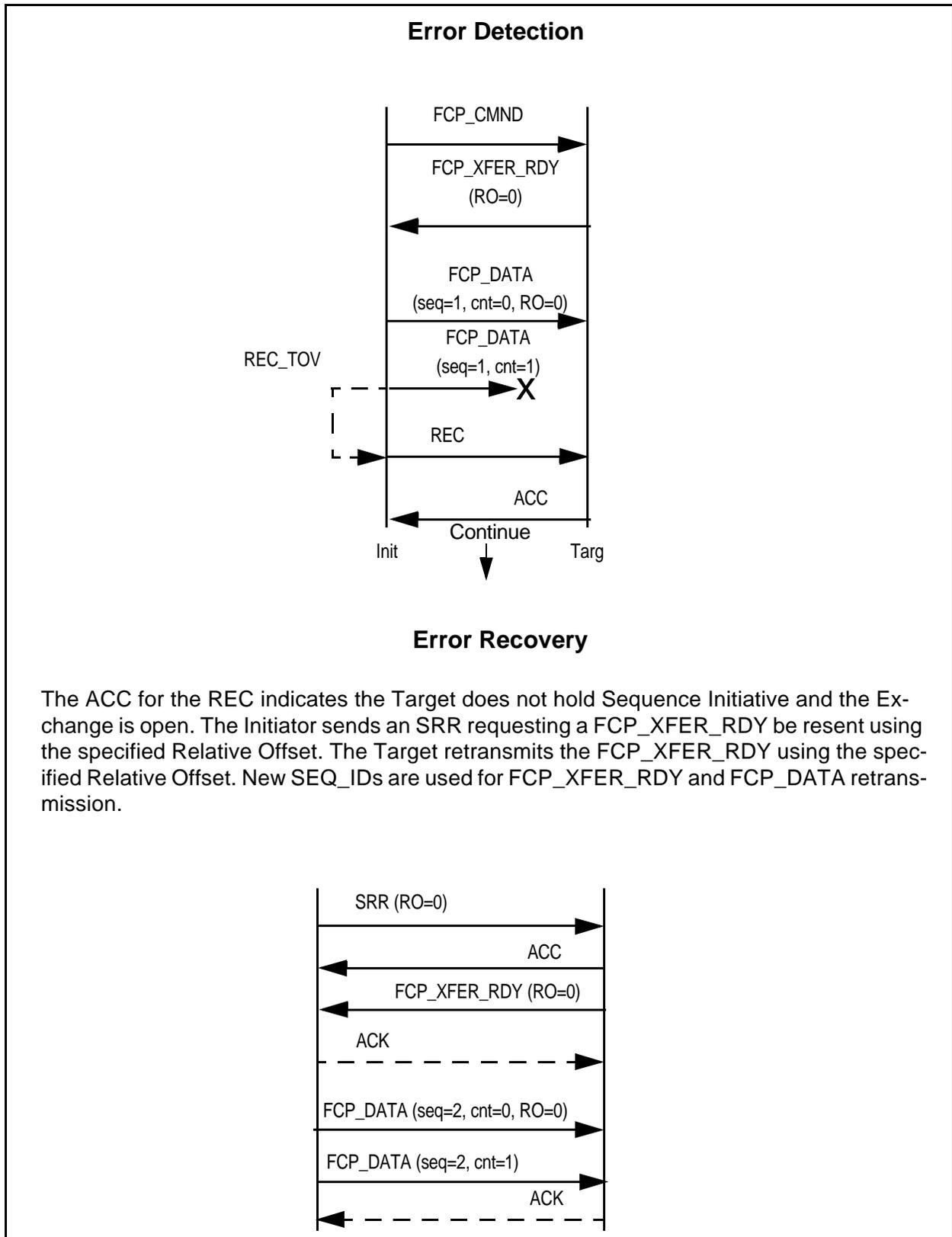


Figure D.14 - Lost Write Data, Last Frame of Sequence, Acknowledged Classes

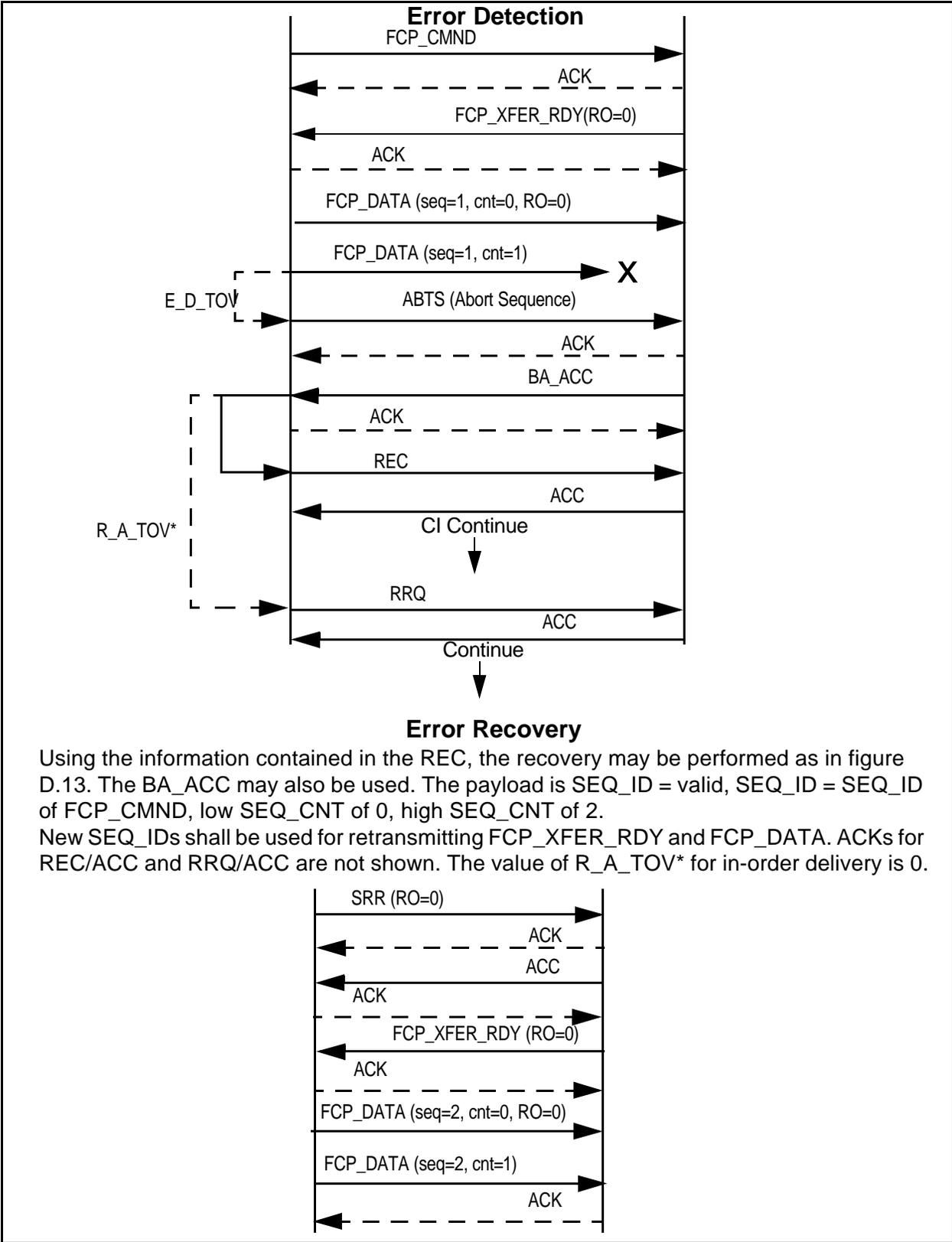


Figure D.15 - Lost Write Data, Not Last Frame of Sequence, Unacknowledged Classes

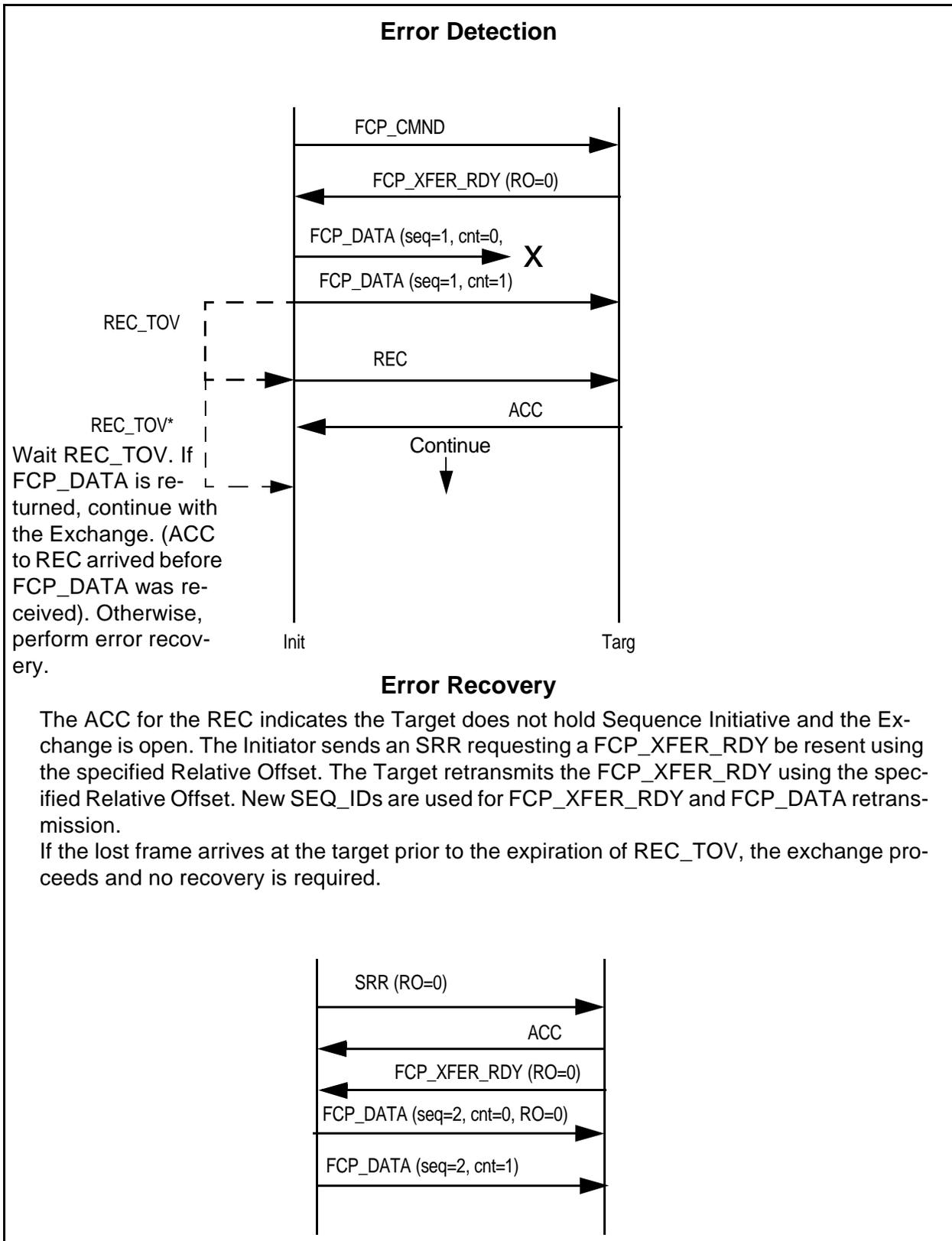


Figure D.16 - Lost Write Data, Not Last Frame of Sequence, Acknowledged Classes

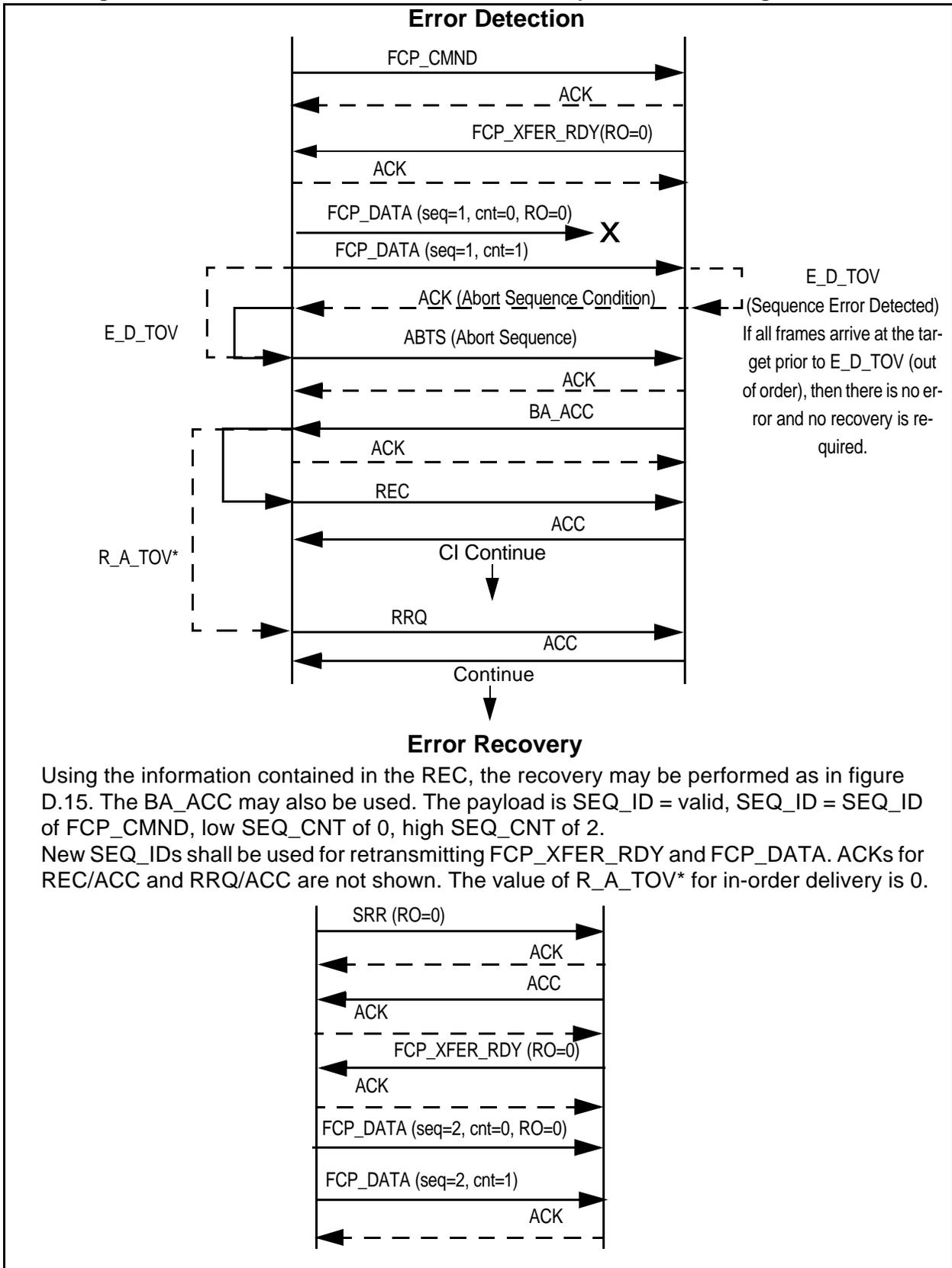
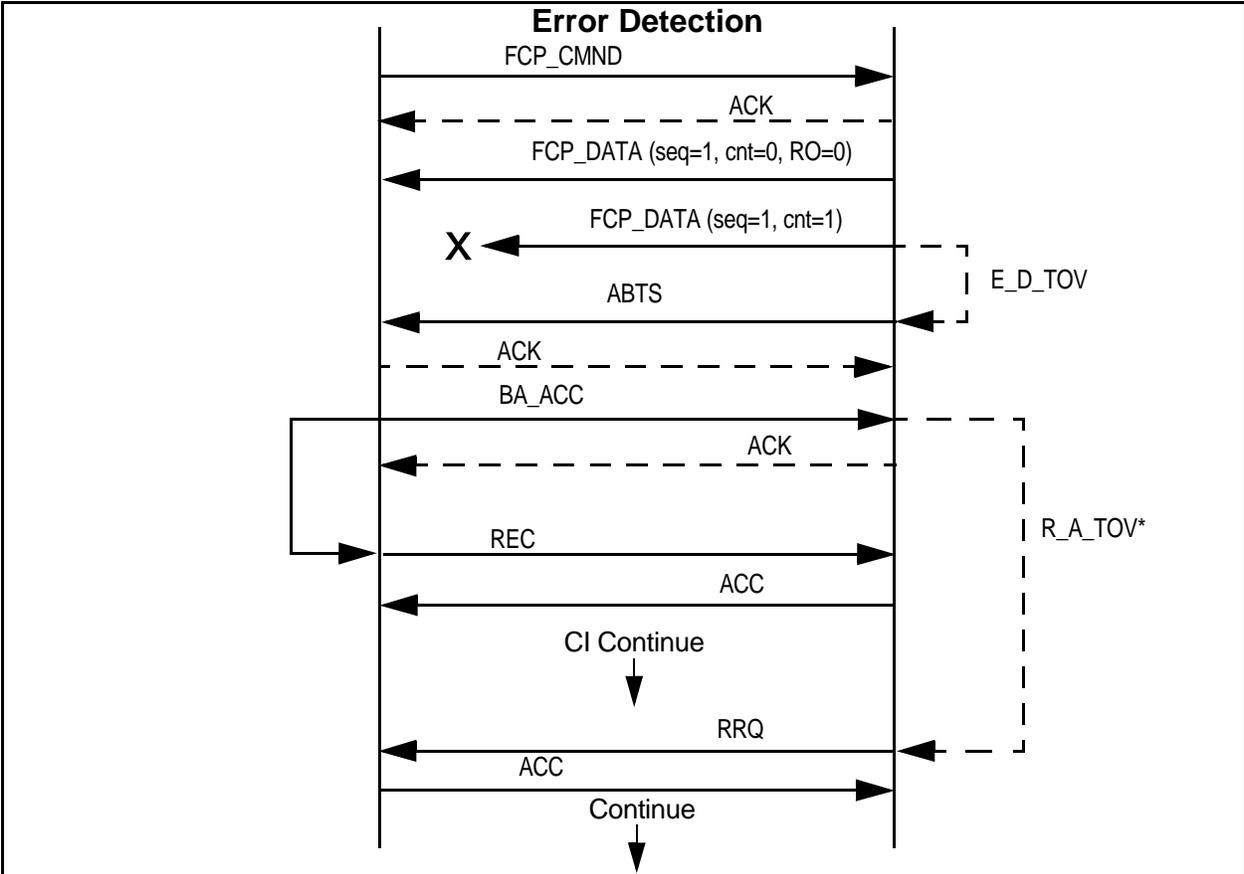




Figure D.18 - Lost Read Data, Last Frame of Sequence, Acknowledged Classes



**Error Recovery**

Using the information contained in the REC, the recovery may be performed as in figure D.17. The BA\_ACC may also be used because it indicates that the FCP\_DATA sequence was not completely received. The payload is SEQ\_ID = invalid, low SEQ\_CNT of 0, high SEQ\_CNT of ABTS frame. New SEQ\_IDs shall be used for retransmitting FCP\_DATA. ACKs for REC/ACC and RRQ/ACC are not shown. The value of R\_A\_TOV\* for in-order delivery is 0.

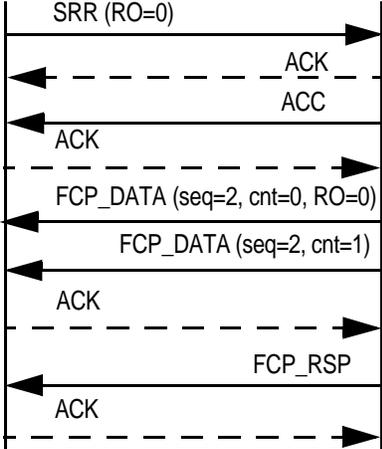


Figure D.19 - Lost Read Data, Not Last Frame of Sequence, Unacknowledged Classes

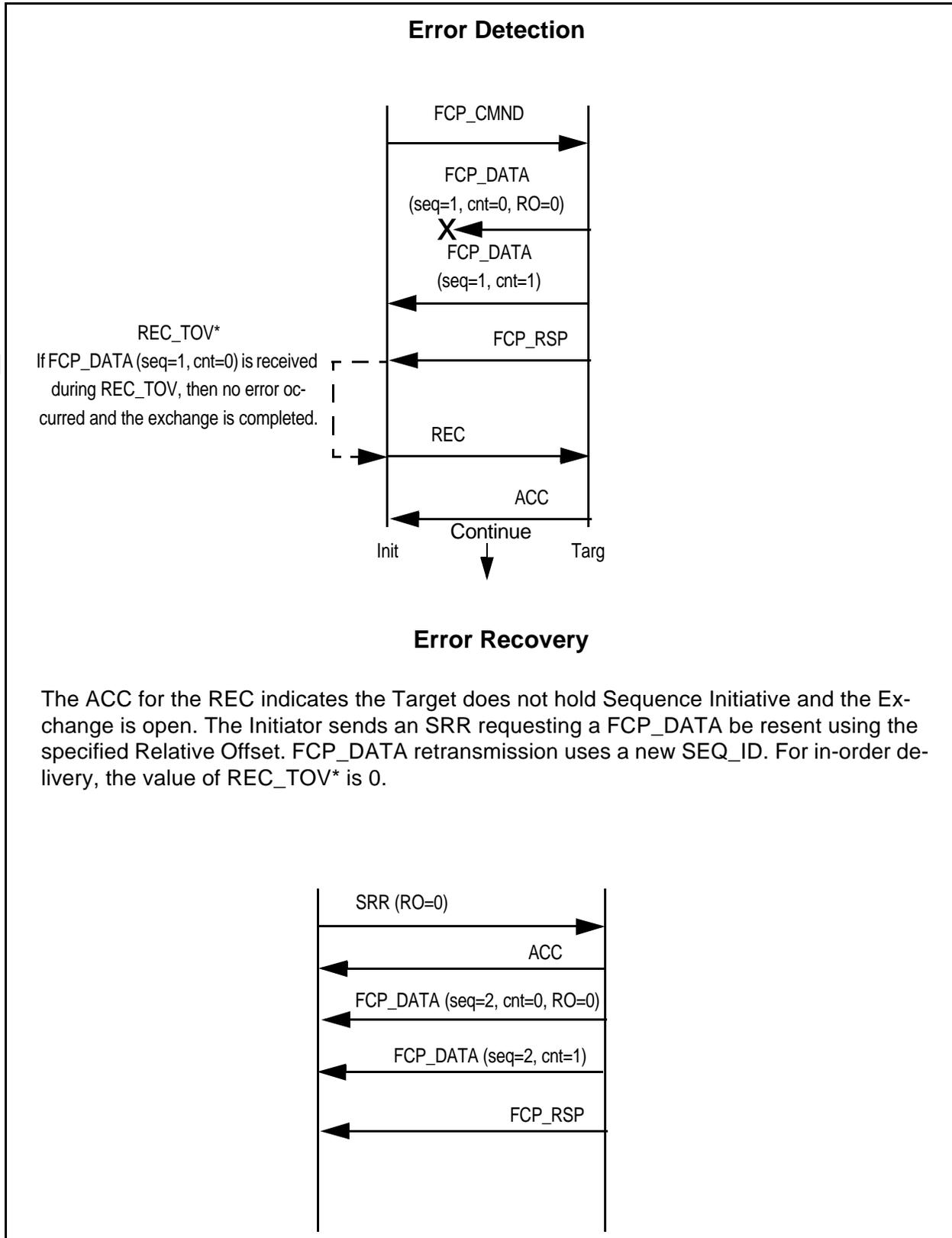


Figure D.20 - Lost Read Data, Not Last Frame of Sequence, Acknowledged Classes

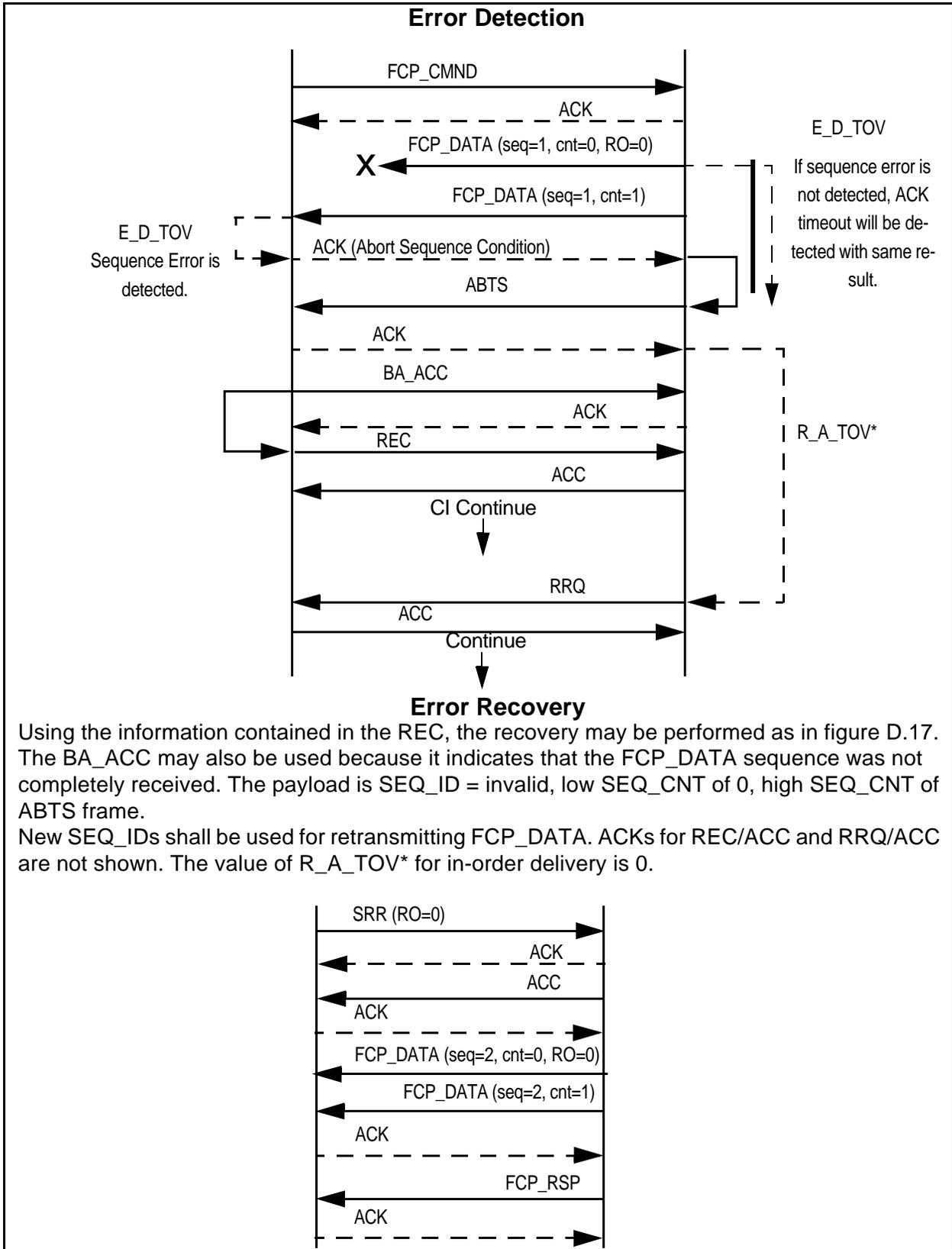


Figure D.21 - ACK Lost on Read (Acknowledged Classes)

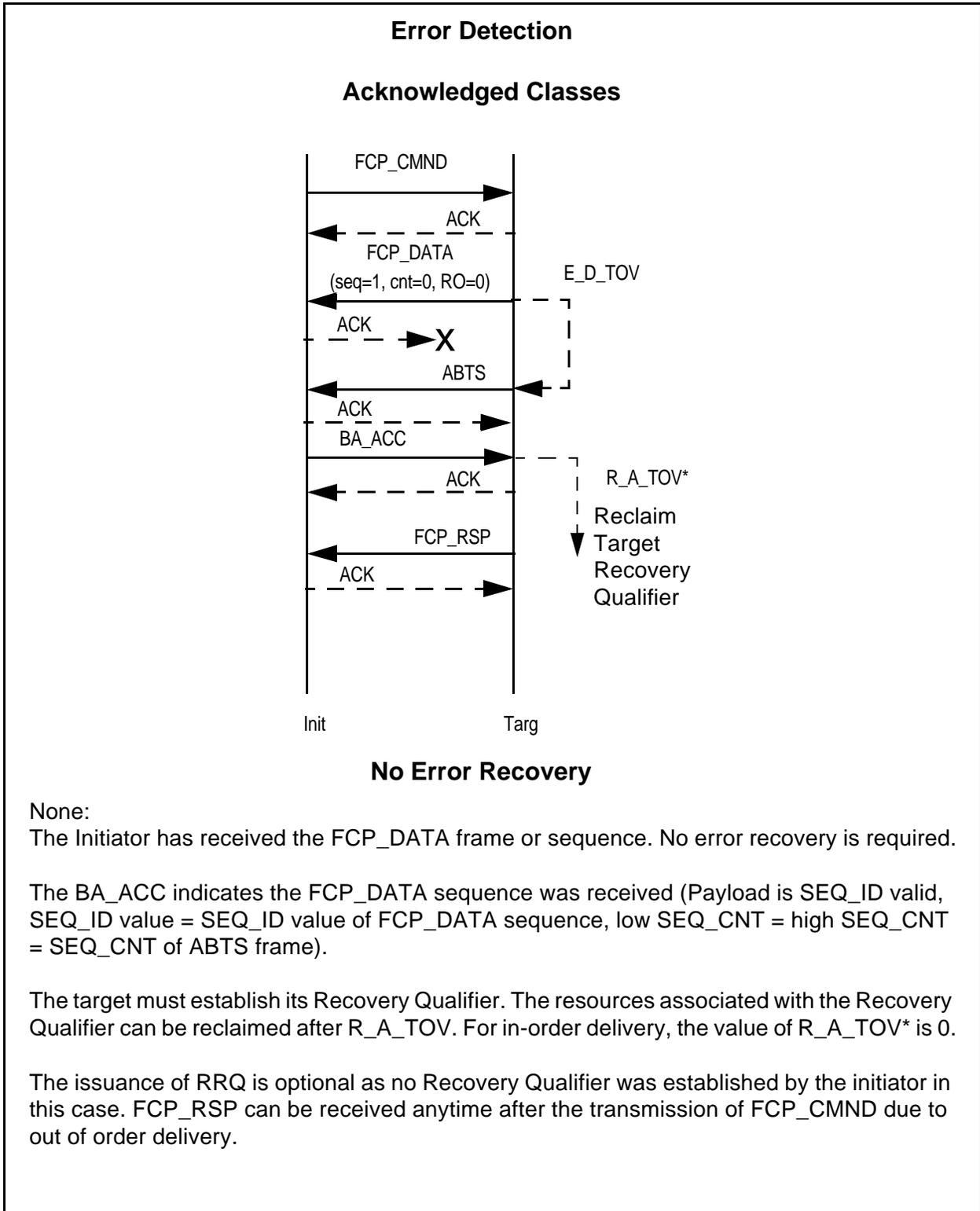


Figure D.22 - ACK Lost on Write (Acknowledged Classes)

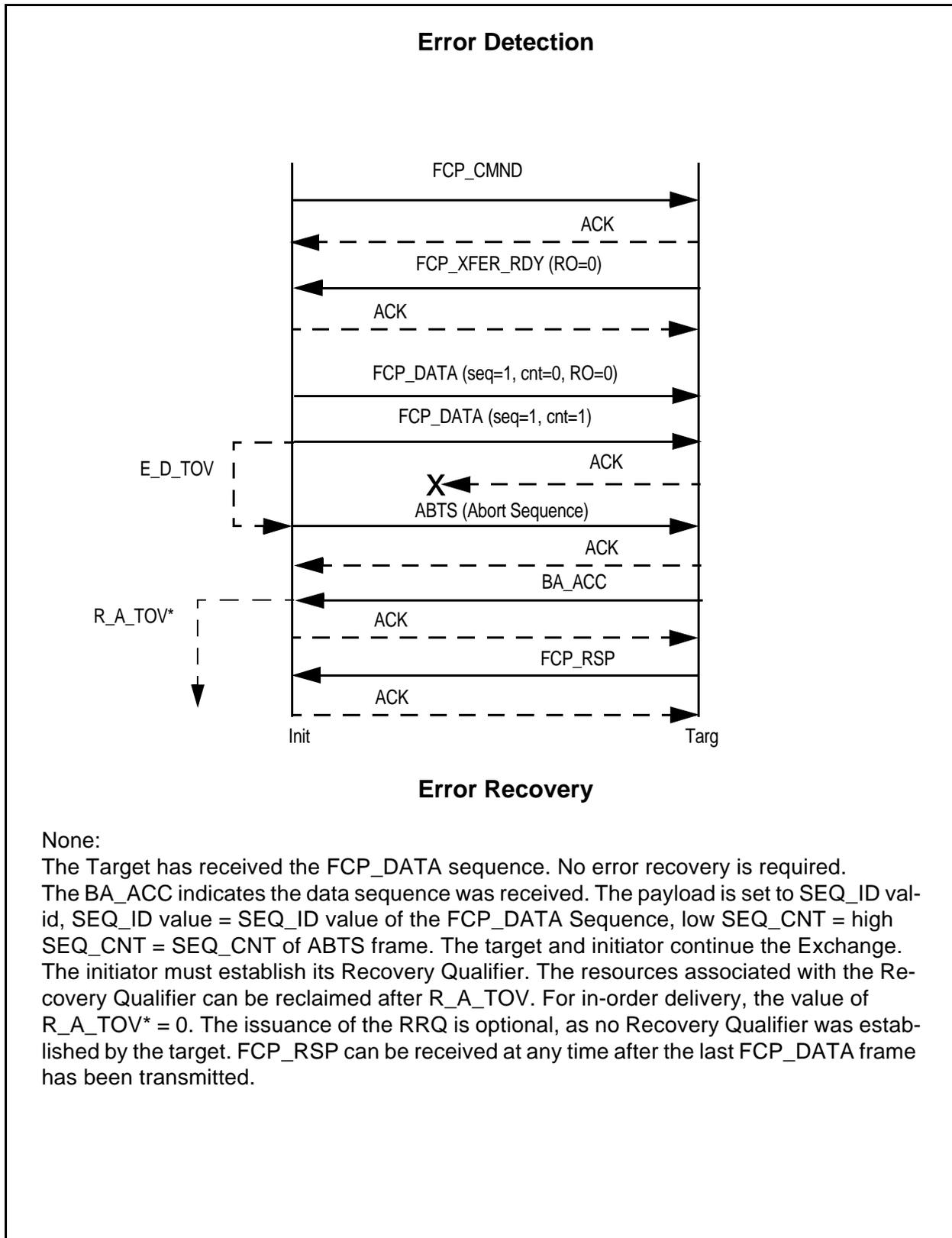


Figure D.23 - FCP\_CONF Lost, Unacknowledged Classes

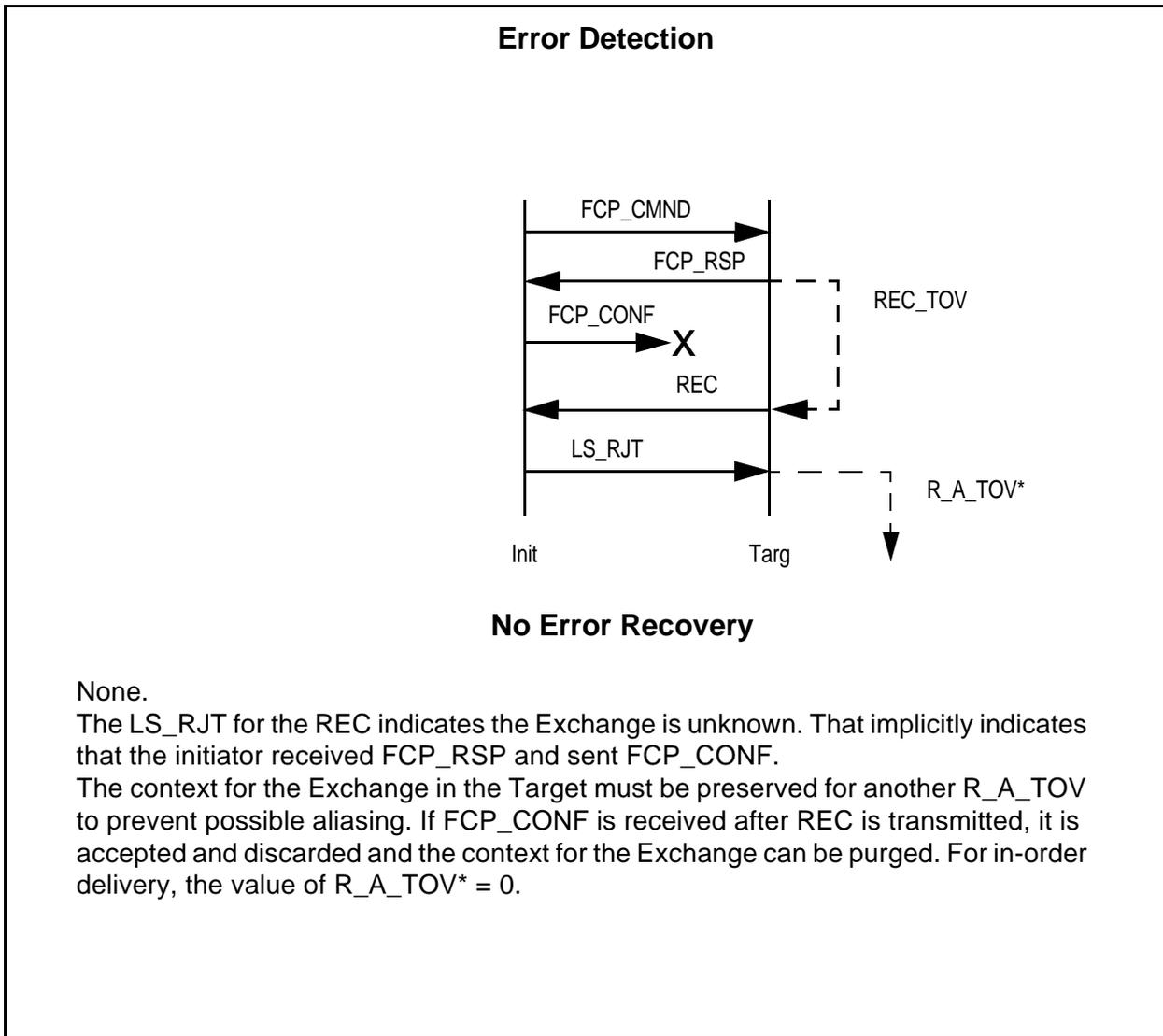


Figure D.24 - FCP\_CONF Lost, Acknowledged Classes

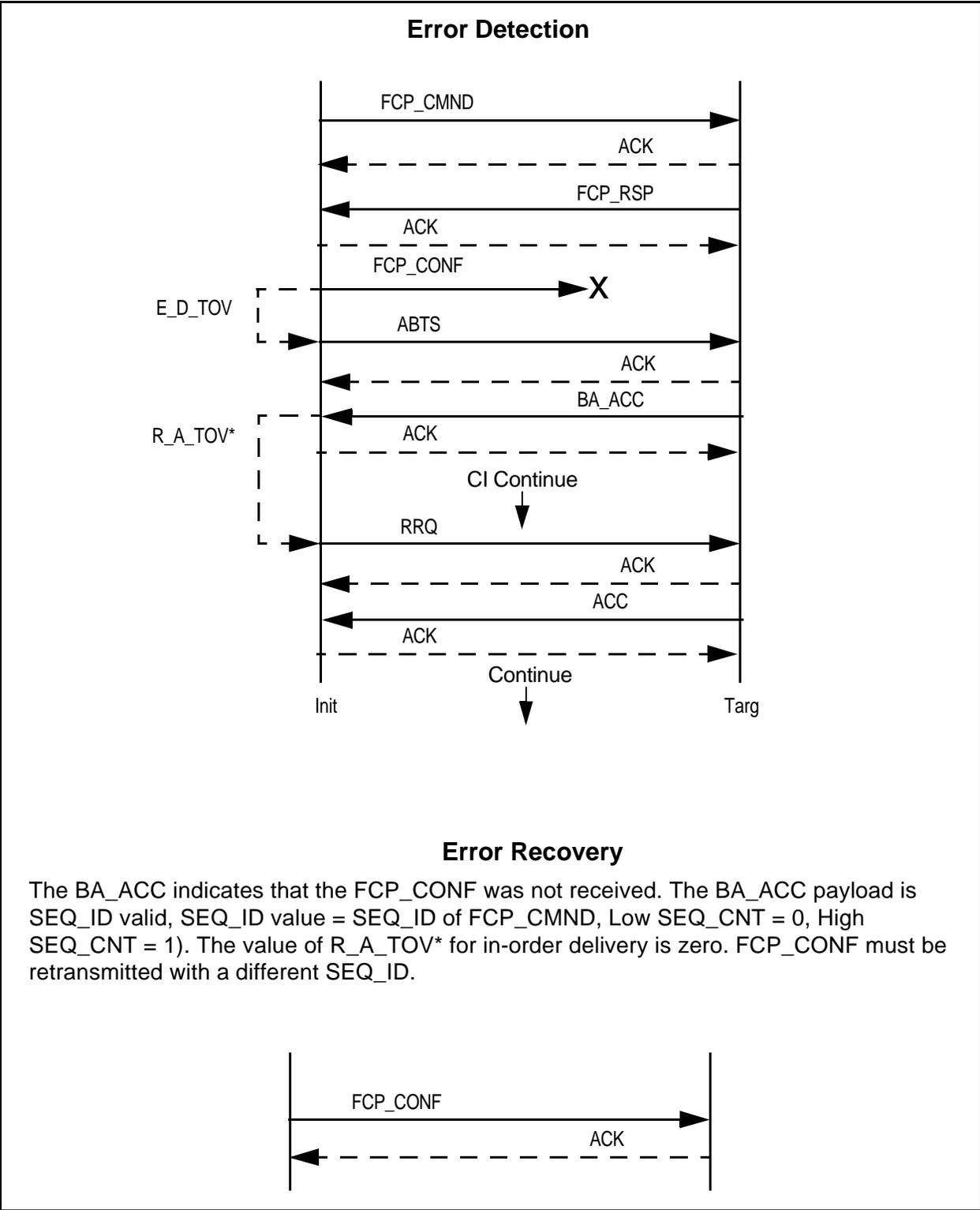


Figure D.25 - ACK lost on FCP\_CONF, Acknowledged Classes

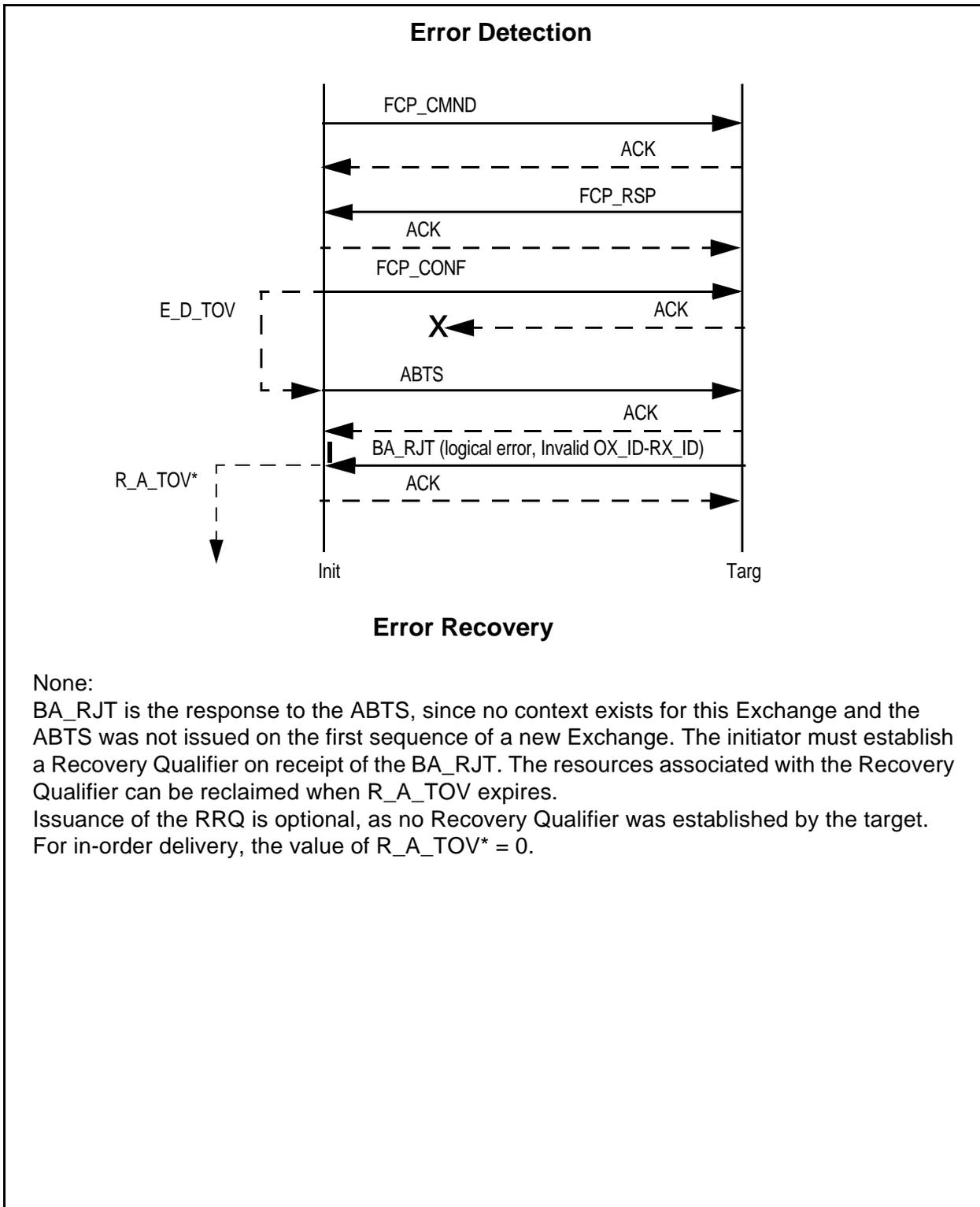
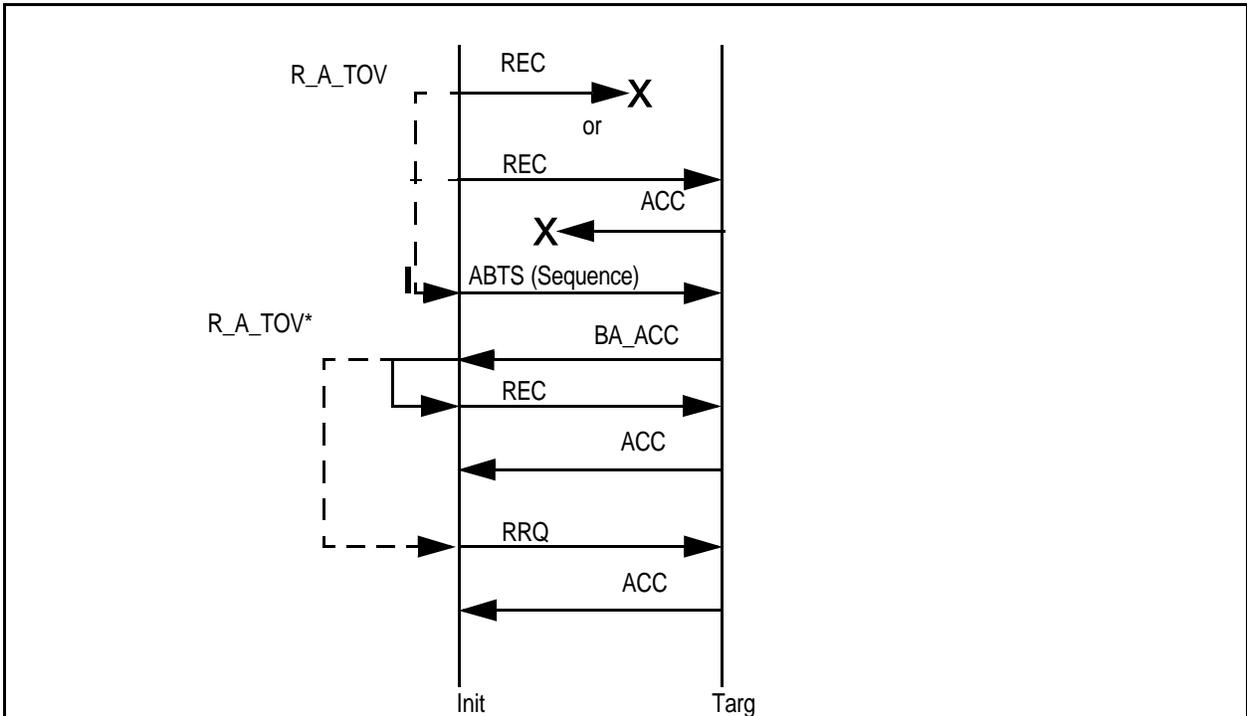


Figure D.26 - REC or REC Response Lost, Unacknowledged Classes

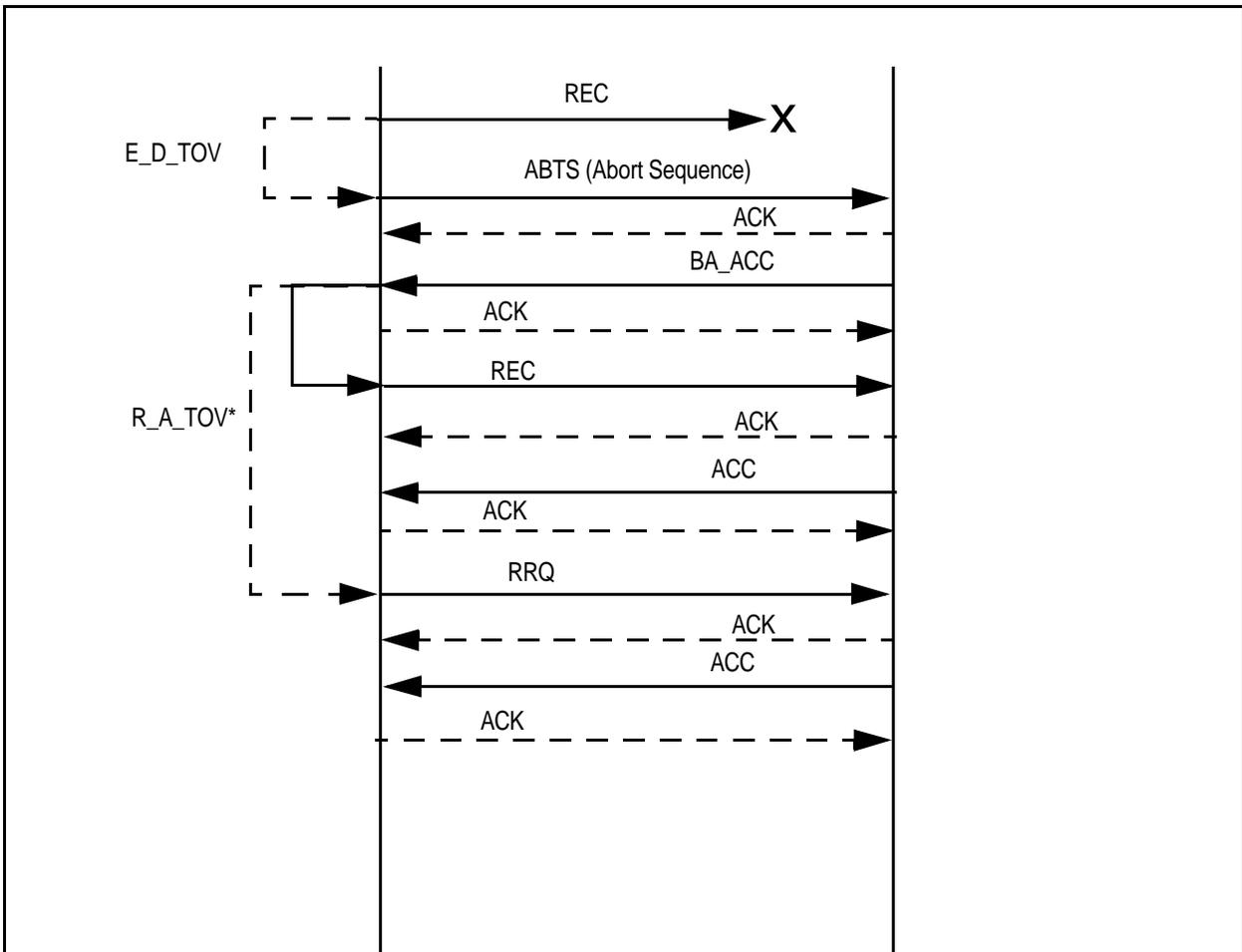


For the case of the REC never having been received, the BA\_ACC payload will be SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = SEQ\_CNT of ABTS = 1.

For the case of the ACC response to REC never having been received, the target would view the ABTS as having been issued on a new Exchange. The BA\_ACC payload will be SEQ\_ID invalid, low SEQ\_CNT = high SEQ\_CNT = SEQ\_CNT of ABTS.

In both cases, a Recovery Qualifier will be established. The second REC is issued in a new Exchange. For in-order delivery, the value of R\_A\_TOV\* is 0

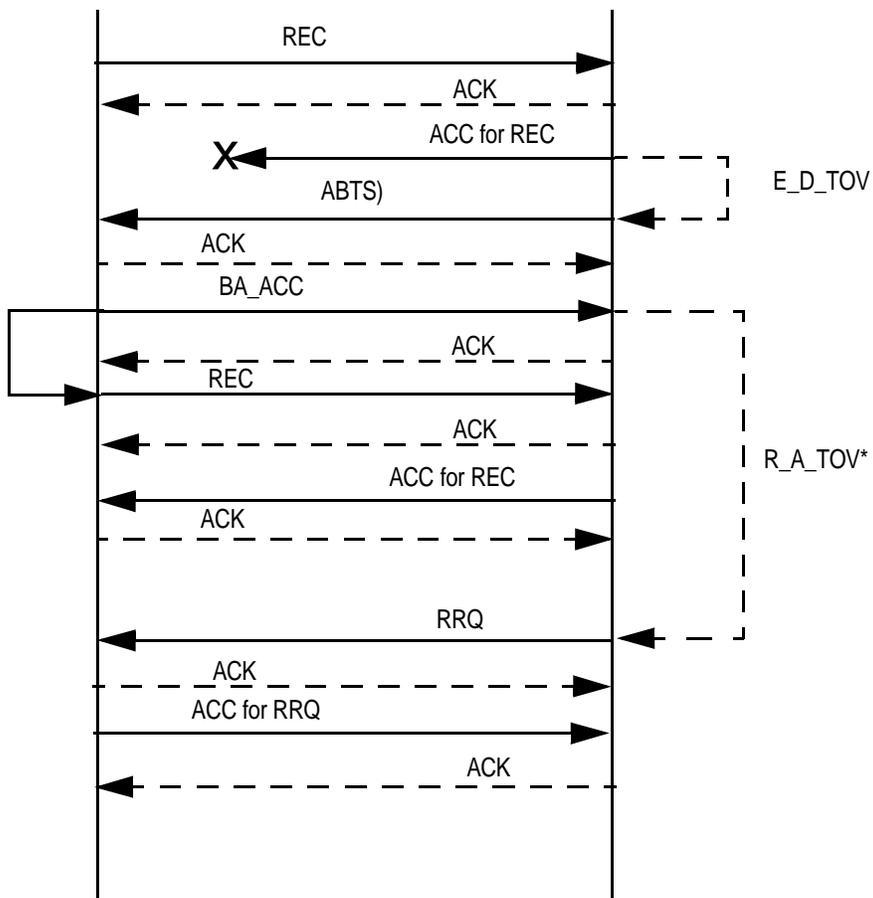
Figure D.27 - REC Lost, Acknowledged Classes



**Error Recovery**

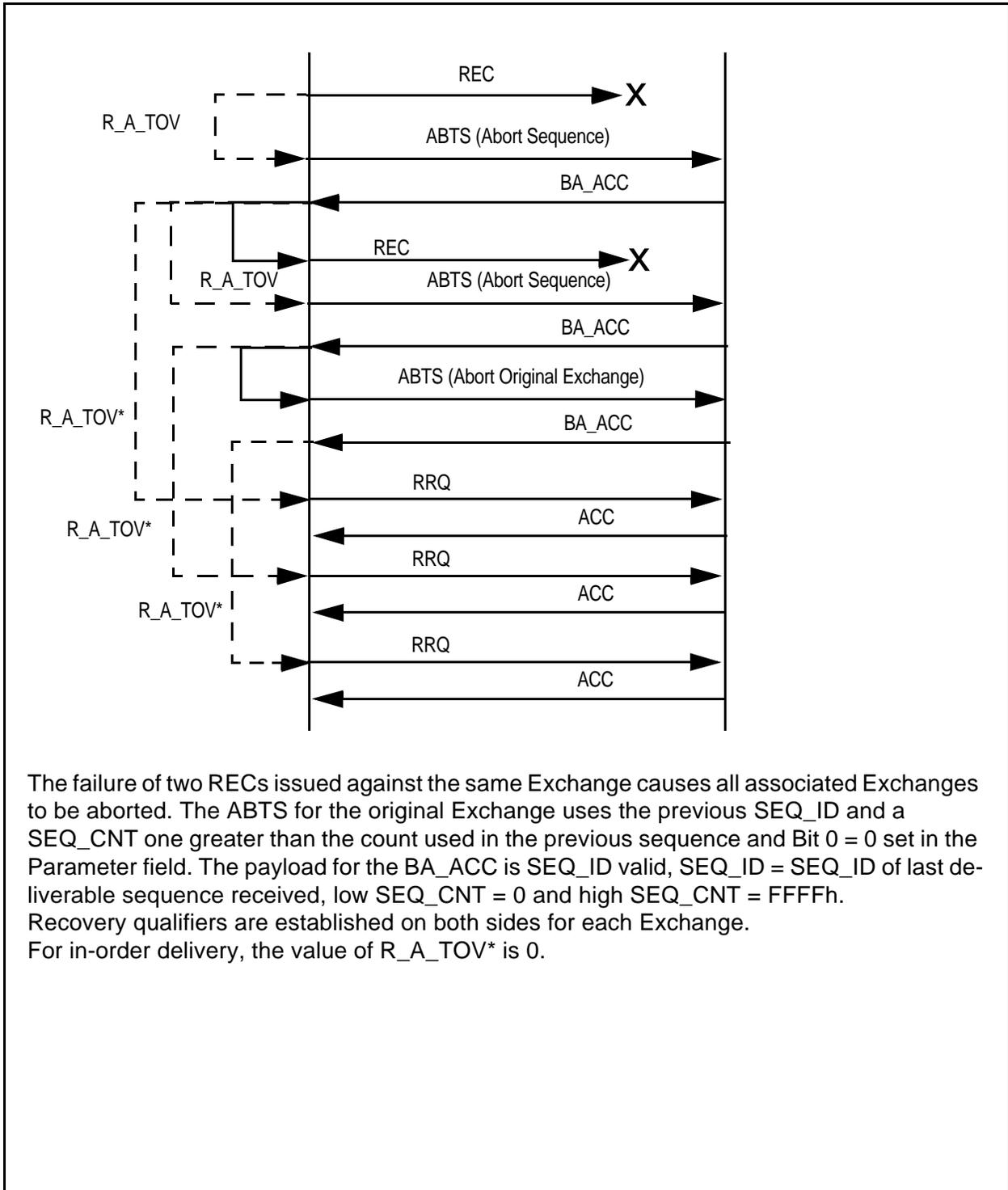
The BA\_ACC payload indicates that the REC was never received by the target. The payload is SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = SEQ\_CNT in ABTS frame. Recovery Qualifiers are established on each side.  
 For in-order delivery, the value of R\_A\_TOV\* is 0.  
 The second REC is issued using a new Exchange.

Figure D.28 - REC Response Lost, Acknowledged Classes



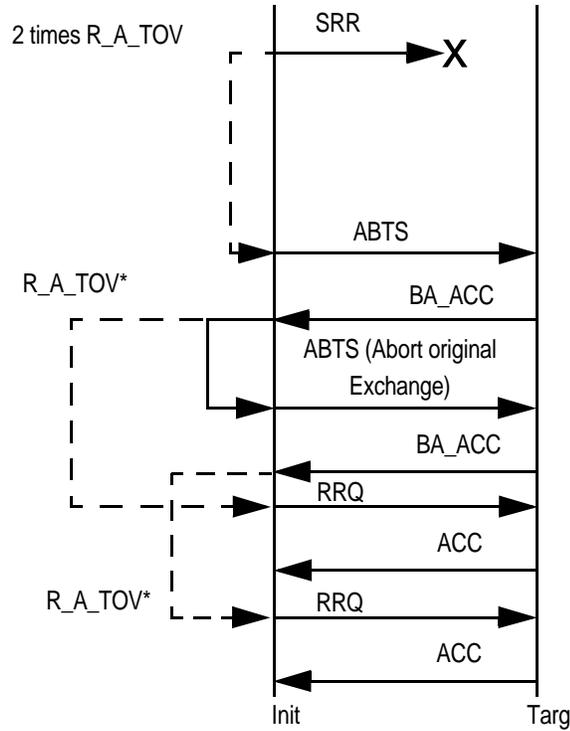
The BA\_ACC payload indicates that the ACC was never received by the initiator. The payload is SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = SEQ\_CNT in ABTS frame. After responding to the ABTS, the initiator reissues the REC in a new Exchange. Recovery Qualifiers are established on each side. For in-order delivery, the value of R\_A\_TOV\* is 0.

**Figure D.29 - Two RECs Lost, Unacknowledged Classes, Abort the original exchange**



The failure of two RECs issued against the same Exchange causes all associated Exchanges to be aborted. The ABTS for the original Exchange uses the previous SEQ\_ID and a SEQ\_CNT one greater than the count used in the previous sequence and Bit 0 = 0 set in the Parameter field. The payload for the BA\_ACC is SEQ\_ID valid, SEQ\_ID = SEQ\_ID of last deliverable sequence received, low SEQ\_CNT = 0 and high SEQ\_CNT = FFFFh. Recovery qualifiers are established on both sides for each Exchange. For in-order delivery, the value of R\_A\_TOV\* is 0.

**Figure D.30 - SRR Lost, Unacknowledged Classes, Abort original exchange**

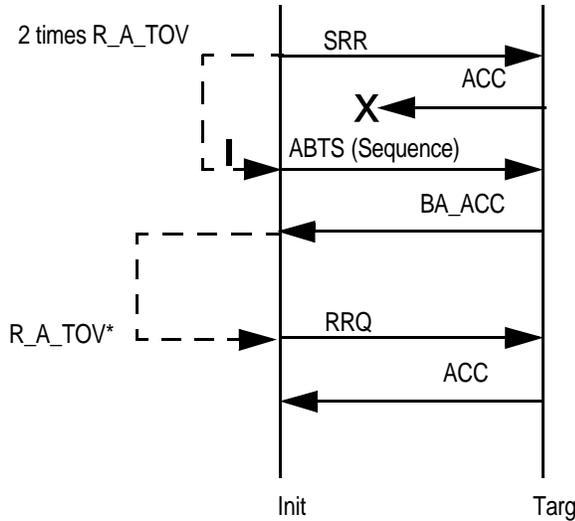


The payload for the BA\_ACC associated with the ABTS of the SRR is SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = SEQ\_CNT of the ABTS frame.

The ABTS for the original Exchange uses the previous SEQ\_ID and a SEQ\_CNT one greater than the count used in the previous Sequence and Bit 0 = 0 in the Parameter field. The payload for the BA\_ACC associated with the ABTS for the original Exchange is SEQ\_ID valid, the SEQ\_ID = SEQ\_ID of the last deliverable Sequence of the original Exchange received, low SEQ\_CNT = 0, and high SEQ\_CNT = FFFFh.

Recovery Qualifiers are established on both sides for each Exchange. For in-order delivery, the value of R\_A\_TOV\* is 0.

Figure D.31 - SRR Response Lost, Unacknowledged Classes



If the SRR Exchange is unknown to the Recipient, the Exchange was completed and the context purged. The payload for the BA\_ACC is SEQ\_ID invalid, low SEQ\_CNT = 0, high SEQ\_CNT = FFFFh. Recovery Qualifiers are established on both sides.

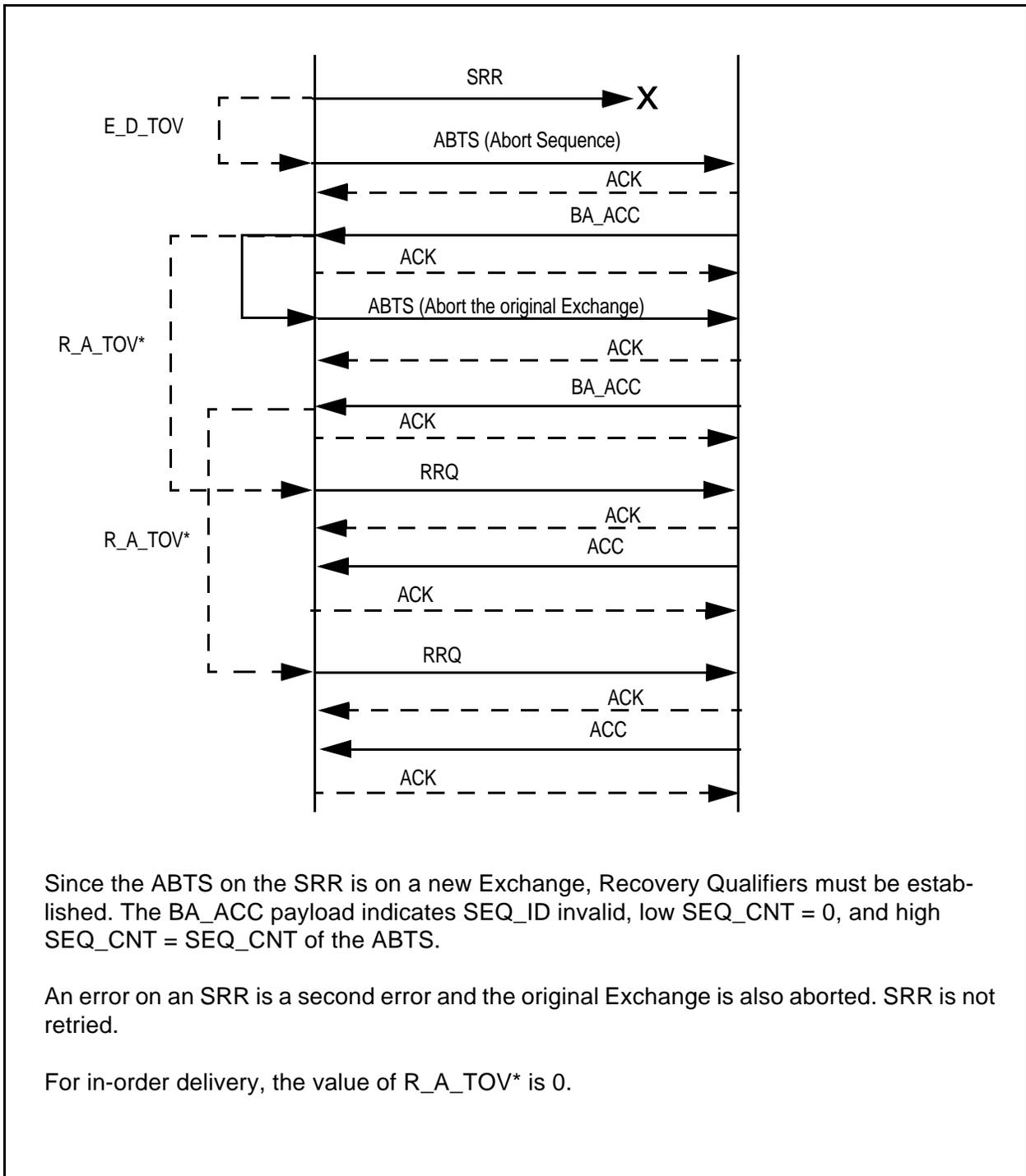
If the SRR Exchange is still known to the Recipient, the payload for the BA\_ACC is SEQ\_ID valid, SEQ\_ID = SEQ\_ID of the SRR, low SEQ\_CNT = high SEQ\_CNT = SEQ\_CNT of the ABTS frame. Since no Recovery Qualifier is established, RRQ need not be issued. The Recovery Qualifier is established on the initiator side and must be timed out for R\_A\_TOV.

For in-order delivery, the value of R\_A\_TOV\* is 0.

In either case, the original Exchange need not be aborted.

The RRQ references the exchange of the SRR.

Figure D.32 - SRR Lost, Acknowledged Classes

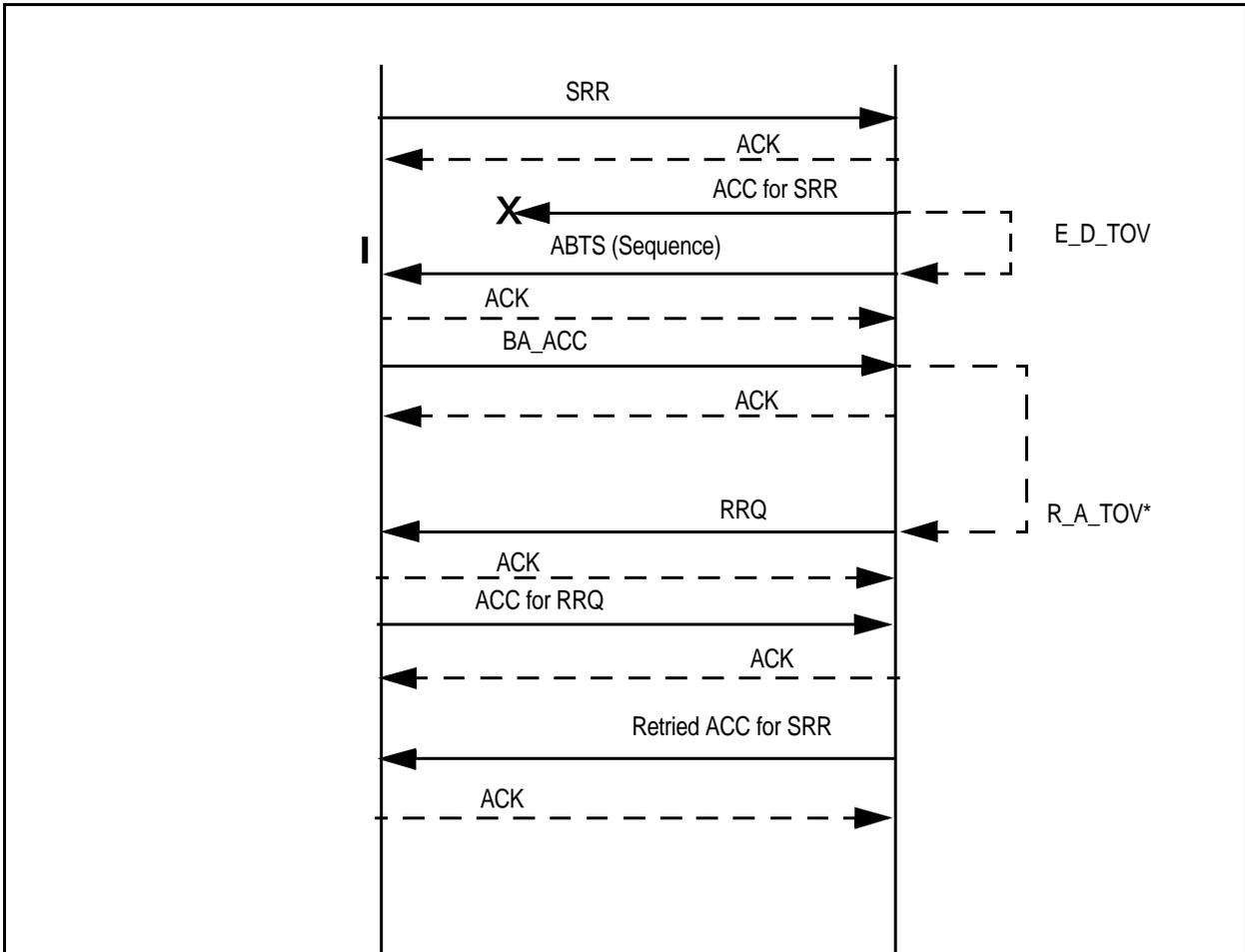


Since the ABTS on the SRR is on a new Exchange, Recovery Qualifiers must be established. The BA\_ACC payload indicates SEQ\_ID invalid, low SEQ\_CNT = 0, and high SEQ\_CNT = SEQ\_CNT of the ABTS.

An error on an SRR is a second error and the original Exchange is also aborted. SRR is not retried.

For in-order delivery, the value of R\_A\_TOV\* is 0.

Figure D.33 - SRR Response Lost, Acknowledged Classes



The BA\_ACC of the ABTS associated with the SRR indicates that the ACC for the SRR was not received and will be discarded if it is later received. The BA\_ACC payload indicates SEQ\_ID invalid, low SEQ\_CNT = 0, and high SEQ\_CNT = SEQ\_CNT of the ABTS. The retry of the ACC for SRR is issued with a new SEQ\_ID. Recovery Qualifiers are established on each side. For in-order delivery, the value of R\_A\_TOV\* is 0.