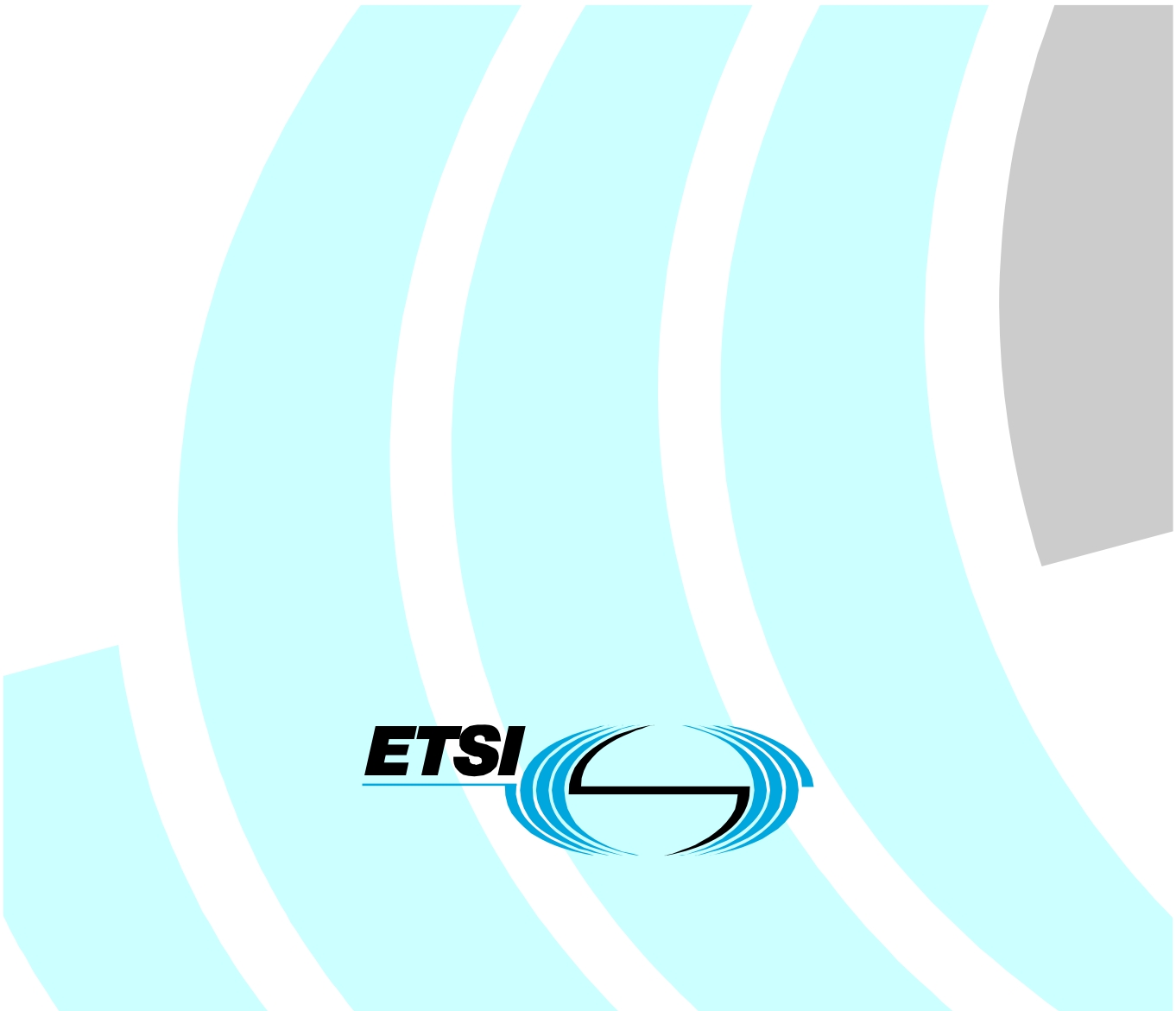
ETSI TS 102 431 V7.0.0 (2007-08)

Technical Specification

Smart Cards;
Test specification for the Transport Protocol of CAT Applications (CAT_TP) validation
(Release 7)



Reference
DTS/SCP-00015

Keywords
protocol, smart card, transport

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Smart Card Platform (SCP).

The contents of the present document are subject to continuing work within TC SCP and may change following formal TC SCP approval. If TC SCP modifies the contents of the present document, it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version x.y.z. where:

x the first digit:

- 0 early working draft;
- 1 presented to TC SCP for information;
- 2 presented to TC SCP for approval;
- 3 or greater indicates TC SCP approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The present document defines the Card Application Toolkit Transport Protocol (CAT-TP) test conformance.

The aim of the present document is to ensure interoperability between a local and remote CAT-TP entities independently of the respective card issuer or operator.

1 Scope

The present document covers the minimum characteristics considered necessary in order to provide compliance to TS 102 127 [1].

The present document describes the technical characteristics and methods of test for testing the CAT-TP implementation.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- In the case of a reference to an TC SCP document, a non specific reference implicitly refers to the latest version of that document in the same Release as the present document.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 102 127: "Smart Cards; Transport protocol for CAT applications; Stage 2 (Release 6)".

[2] ISO 7816-3: "Identification cards -- Integrated circuit cards -- Part 3: Cards with contacts -- Electrical interface and transmission protocols".

2.2 Informative references

[3] ETSI TS 102 223: "Smart Cards; Card Application Toolkit (CAT) (Release 7)".

[4] ETSI TS 102 221: "Smart Cards; UICC-Terminal interface; Physical and logical characteristics (Release 7)".

[5] ISO 7816-4: "Identification cards -- Integrated circuit cards -- Part 4: Organization, security and commands for interchange".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [1] and the following apply:

CAT-TP entity: entity that is under test

CAT-TP Simulator: entity that checks/issues instructions from/to the CAT-TP entity under test

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in [1] and the following apply

ACK	PDU with ACK bit set to '1'
ACK-EACK	PDU with ACK and EACK bits set to '1'
ACK-EACK-UNSEG-DATA	PDU with ACK and EACK bits set to '1' and non-zero data length
ACK-SEG-DATA	PDU with ACK and segmentation bits set to '1' and non-zero data length
ACK-UNSEG-DATA	PDU with ACK bit set to '1' and non-zero data length
CE	CAT-TP entity
CE_PORT	Port address of the CE
CS	CAT-TP simulator
INC_SEQ_NB	Incorrect sequence number
INI_SEQ_NB	Initial sequence number of the CS
ID_LEN	Length of Identification field
IUT	Item under test
MAX_SDU_SIZE	Maximum SDU size
NORMAL	Reason code "Normal ending" in RST PDU
NUL-ACK	PDU with NUL and ACK bits set to '1'
RST	PDU with RST bit set to '1'
RST-ACK	PDU with RST and ACK bits set to '1'
SETUP-FAILED	Reason code "Connection set-up failed, no details given" in RST PDU
SYN	PDU with SYN bit set to '1'
SYN-ACK	PDU with SYN and ACK bits set to '1'
TEMP-UNABLE-SETUP	Reason code "Temporarily unable to set up this connection" in RST PDU
UNAVAILABLE-PORT	Reason code "Requested port not available" in RST PDU
UNEXP-PDU	Reason code "Unexpected PDU received" in RST PDU

4 Test architecture and method

4.1 Test method

The CS consists of the test suite and supporting layers (e.g. TS 102 223 [3], ETSI TS 102 221 [4], ISO 7816-3 [2] and ISO 7816-4 [5] for CAT-TP in UICC, or UDP and IP for CAT-TP in server) which are used to communicate with the CE under test. The supporting layers are out of the scope of the present document. The test suite shall be defined in clauses 7, 8 and 9 of the present document. A test operator shall communicate with the CE using upper layer interfaces defined in clause 5.4.1 of [2]. The test operator shall be responsible for the running of test cases that are applicable to the CE as declared by the manufacturer. During the test, when applicable, the test operator will be instructed to issue test commands to the CE via the upper layer interfaces or be instructed to verify the output of the CE via the upper layer interfaces.

Each test case is independent and therefore, test operator shall reset the CE back to 'CLOSE' state prior to running of any test cases.

4.2 Testing architecture

The testing architecture deployed in this test specification is shown in figure 1.

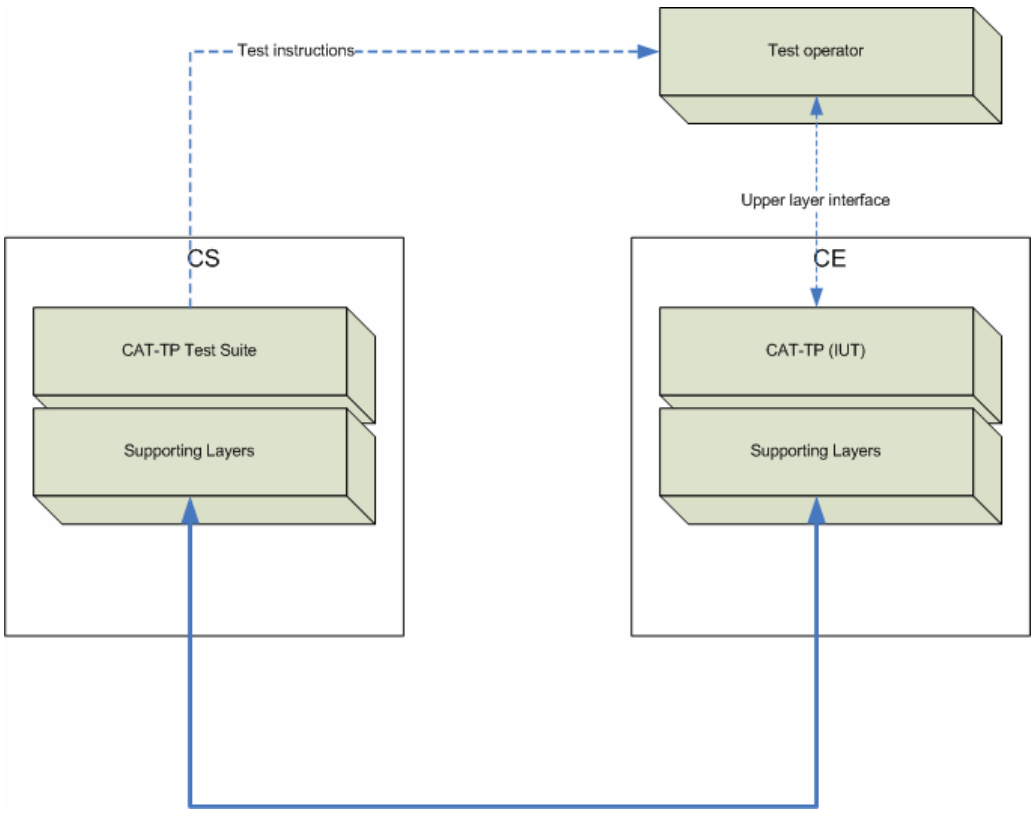


Figure 1: Test architecture

4.3 Test conditions assumptions

This clause defines the following assumptions in order for the testing to be performed in accordance with the test cases described in the present document:

1) Lower layers connections are considered previously established and running successfully.

2) No specific description of the carried data will be provided.

5 Definition of functionalities for testing

In this clause, functionalities of the CAT-TP that can be tested shall be provided. The functionalities shall be classified either as mandatory or optional. All mandatory functionalities of a supported configuration shall be tested. Any function which is optional, as indicated in the present document , shall be subject to a conformance test if it is implemented in the CE. Prior to the test, CE manufacturer should indicate all optional functionalities that have been implemented.

According to TS 102 127 [1], CLOSE-WAIT state is considered a transient state. Although, the entry into CLOSE-WAIT state can be easily set-up, the exit from CLOSE-WAIT state depends solely on the internal timer of the CE. As the timer is totally implementation dependent, the test operator thus has no control over the existence of CLOSE-WAIT state in the CE. Owing to this limitation, testing of CE related to CLOSE-WAIT state is not included in this test specification.Performance related testing shall not be included in this specification.

Table 1: Functionalities to be tested

Index	Functionalities	Mandatory
1	Checksum	**Yes**
2	Counter for the number of retries	**Yes**
3	Detect & discard damaged PDUs	**Yes**
4	Handling of the incoming PDU type	**Yes**
5	Handling of Max PDU size of peer entity	**Yes**
6	Handling of Max SDU size of peer entity	**Yes**
7	Handling of Acknowledgement number	**Yes**
8	Handling of Sequence number	**Yes**
9	Insertion of sequence number in PDU	**Yes**
10	Mechanism to uniquely identify a CAT_TP link (source and destination port), no sharing of port between two applications	See note 1
11	Mechanism to handle out of sequence PDUs	See note 2
12	Positive acknowledgement	**Yes**
13	Retransmission for each PDU transmitted that is not acknowledged	**Yes**
14	Closing the link at any time	**Yes**
15	Delivery of SDU in sequence	**Yes**
16	Reassembly	**Yes**
17	Segmentation of outgoing SDU	See note 3
18	Full duplex data exchange	**Yes**
19	Proper formatting of Identification field in the SYN PDU and SYN-ACK PDU	**Yes**
20	Handling of port number in active open request	See note 4
21	Handling of Window size of peer entity	**Yes**
22	Handling of upper layer request	**Yes**
NOTE 1: CE supports simultaneous open requests. NOTE 2: CE supports window size greater than 1. NOTE 3: CE supports segmentation of outgoing data. NOTE 4: CE supports local port definition in active open request.		

5.1 Test case applicability

Applicability	Test cases number
Mandatory	8.1.1.1.1, 8.1.1.1.2, 8.1.1.1.4, 8.1.1.1.5, 8.1.1.2.1 to 8.1.1.2.7, 8.1.2.1.1, 8.1.2.1.2, 8.1.2.2.1, 8.1.2.2.3, 8.1.2.2.4, 9.1.1 to 9.1.8, 9.1.10 to 9.1.13, 9.2.1 to 9.2.23
Mandatory if window size > 1	7.2.1.5, 7.2.1.6, 8.2.1.1.1 to 8.2.1.1.4, 8.2.2.1.1, 8.2.2.1.3, 8.2.2.2.1, 8.2.2.2.2
Mandatory if simultaneous open requests is supported	8.1.1.1.3
Mandatory if segmentation of outgoing data is supported	8.1.2.1.3, 8.1.2.1.4, 8.1.2.2.2
Mandatory if local port definition in active open request is supported	7.1.1.7
Mandatory if simultaneous open requests and local port definition in active open request is supported	9.1.9
Mandatory if active mode is supported	7.1.1.1 to 7.1.1.6, 7.1.2.1 to 7.1.2.7
Mandatory if passive mode is supported	7.2.1.1, 7.2.1.2, 7.2.1.3, 7.2.1.4, 7.2.1.7, 7.2.1.8, 7.2.2.1 to 7.2.2.11

6 Test Overview

Test cases are encapsulated in three sections:

- Opening of the connection
- Exchange of data
- Closing of the connection

Within a section, tests are divided into two sub-sections:

- Nominal cases
- Non-nominal cases

6.1 Test case format

Definition & applicability

This section identifies a set of functionalities that are specifically tested in the current test.

Conformance requirements

Identify the sub-clause of [1] which describes the requirements to be followed by the CE.

Test purpose

Each test purpose indicates the expected responses from the tested CE.

Method of test

The method of test is expressed in the following way:

- Scenario - expressed the expected behaviour of the CE and CS as indicated by [1]
- Initial conditions - express the steps needed to bring the CE prior to the start of the test
- Procedure - detailed test steps to be followed by the test suite
- Specific message content - detailed PDU content issued by CS
- Expected result - expected PDU content or upper layer interfaces content to be issued by CE

7 Test cases - Opening of the connection

This clause is divided into two mode of testing: testing in active mode; and testing in passive mode. The test operator shall perform the test configuration depending on the mode of operations supported by the CE. Below are the possible combination for the modes of operations:

Possible modes of operations supported by the CE	Test cases to be performed
Active mode only	clause 7.1
Passive mode only	clause 7.2
Both active and passive	clauses 7.1 and 7.2

7.1 Active mode

Unless specified within the test case, the following "Active open generic initial conditions" shall be applied to all the test cases under this clause:

- CE is in CLOSE state and an active open request has been issued to CE.
- CS: Initial sequence number is 200. Max PDU size= 500 bytes. Max SDU size=1000 bytes.
- CS port: 500.

7.1.1 Nominal cases

7.1.1.1 Normal opening of the connection

7.1.1.1.2 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1and 5.4.2.

7.1.1.1.3 Test purpose

To verify that CE is in OPEN state after having issued SYN PDU and ACK PDU.

7.1.1.1.4 Methods of test

Scenario

```
                          CE                                    CS
Time     State
1.       CLOSE      <SEQ=X><SYN>              --->
2.       SYN-SENT                             <---    <SEQ=200><ACK=X><SYN,ACK>
3.       SYN-SENT   <SEQ=X+1><ACK=200><ACK>   --->
4.       OPEN                                 <---    <SEQ=201><ACK!=X><NUL,ACK>
5.       OPEN       <SEQ=X+1><ACK=201><ACK>   --->
```

7.1.1.1.4.2 Initial conditions

The Active open generic initial conditions apply.

7.1.1.1.4.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		
3	CE --> CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.1.1.1.4.4 Specific message content

Step 0: test operator issues OPEN request

Step 2: SYN-ACK PDU

Refer to annex A.

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.1.1.4.5 Expected results

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
4	Header length	'17'+L
23 - 23+L	Identification	See note

NOTE: The test operator has to verify the following:

- The format of the Identification field;
- The consistency of the announced length L in the Header length field with the actual size of the data;
- In the case where L='00', the expected value is:

23	Identification	'00'

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.1.2 Opening of the connection with retransmission of the SYN PDU

7.1.1.2.2 Conformance requirements

CE entity shall support the connection establishment as specified in clauses 5.4.1, 5.4.2 and 5.3.2.4.

7.1.1.2.3 Test purpose

To verify that CE is able to re-issue the SYN PDU as long as the retransmission counter is smaller than the maximum and reaches the OPEN state after having issued the ACK PDU.

7.1.1.2.4 Methods of test

7.1.1.2.4.1 Scenario

```
                              CE                                    CS
Time     State
1.       CLOSE      <SEQ=X><SYN>                ---->    (PDU Lost)
.        SYN-SENT
.
.
N-1      SYN-SENT   <SEQ=X><SYN>                ---->    (PDU Lost)
N        SYN-SENT   <SEQ=X><SYN>                ---->
N+1                                             <----    <SEQ=200><ACK=X><SYN,ACK>
N+2      SYN-SENT   <SEQ=X+1><ACK=200><ACK>     ---->
N+3      OPEN                                   <----    <SEQ=201><ACK!=X><NUL,ACK>
N+4      OPEN       <SEQ=X+1><ACK=201><ACK>     ---->
```

7.1.1.2.4.2 Initial conditions

The following conditions apply:

- Active open generic initial conditions
- The maximum number of retries N has to be supplied by the CE.
- The counter k is used to keep track of the reception of SYN-ACK PDU. Initial value is 0.

7.1.1.2.4.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		*Increment k each time a SYN PDU is received. CS shall not acknowledge SYN PDU.*
N	CE --> CS	SYN PDU		*Last attempt for retransmission of SYN PDU from CE*
N+1	CE <-- CS	SYN-ACK PDU.		*SYN-ACK PDU has to be issued in the limit of the CE timeout*
N+2	CE --> CS	ACK PDU.		
N+3	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
N+4	CE --> CS	ACK PDU		

7.1.1.2.4.4 Specific message content

Step 0: Test operator issues OPEN request

Step N+1: SYN-ACK PDU

Refer to annex A.

Step N+3: NUL-ACK

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.1.2.4.5 Expected results

Steps 1 to N: SYN PDU

Refer to annex A.

At the end of step N, CS checks that the last value of k is equal to the maximum number of retries provided by the CE. If not, the test is considered as failed.

Step N+2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step N+4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.1.3 Handling of SYN-ACK PDU with various Max SDU Size

7.1.1.3.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1 and 5.4.2.

7.1.1.3.2 Test purpose

To verify that CE can acknowledge SYN-ACK PDU with Max SDU Size ranging from '00 01' to 'FF FF'.

7.1.1.3.3 Methods of test

7.1.1.3.3.1 Scenario

```
                              CE                                  CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>               --->
             SYN-SENT                              <---    <SEQ=200><ACK=X><SYN,ACK>
    2.                                                     <MaxSDUSize=S>
    3.       SYN-SENT   <SEQ=X+1><ACK=200><ACK>    --->
    4.       OPEN                                  <---    <SEQ=201><ACK!=X><NUL,ACK>
    5.       OPEN       <SEQ=X+1><ACK=201><ACK>    --->
```

7.1.1.3.3.2 Initial condition

The following conditions apply:

- Active open generic initial conditions.
- The Max SDU Size of CS is defined in clause 7.1.1.3.4.3.

7.1.1.3.3.3 Procedure

This test case has to be run 4 times with the following values for the Max SDU Size field:

- MAX_SDU_SIZE = '00 01'
- MAX_SDU_SIZE = '7F FF'
- MAX_SDU_SIZE = '80 00'
- MAX_SDU_SIZE = 'FF FF'

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		
3	CE --> CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.1.1.3.3.4 Specific message content

Step 0: Test operator issues OPEN request

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
21 - 22	Max SDU Size	MAX_SDU_SIZE

Step 4: NUL-ACK

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.1.3.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.1.4 Handling of SYN-ACK PDU with various Identification length

7.1.1.4.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1, 5.4.2 and 5.5.

7.1.1.4.2 Test purpose

To verify that CE can acknowledge SYN-ACK PDU with Identification field length ranging from '00' to 'E9'.

7.1.1.4.3 Methods of test

7.1.1.4.3.1 Scenario

```
                              CE                                 CS
Time     State
1.       CLOSE      <SEQ=X><SYN>              --->
2.       SYN-SENT                             <---   <SEQ=200><ACK=X><SYN,ACK>
                                                     <Identification=L'>
3.       SYN-SENT   <SEQ=X+1><ACK=200><ACK>   --->
4.       OPEN                                 <---   <SEQ=201><ACK!=X><NUL,ACK>
5.       OPEN       <SEQ=X+1><ACK=201><ACK>   --->
```

7.1.1.4.3.2 Initial condition

The Active open generic initial conditions apply.

7.1.1.4.3.3 Procedure

This test case has to be run 3 times with the following values for Identification field length:

- ID_LEN = '00'
- ID_LEN = '7F'
- ID_LEN = '80'
- ID_LEN = 'E9'

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		
3	CE --> CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.1.1.4.3.4 Specific message content

Step 0: Test operator issues OPEN request

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
4	Header Length	'17'+ ID_LEN
23 - 23+ ID_LEN	Identification	Insignificant

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.1.4.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.1.5 Handling of SYN-ACK PDU with various sequence number

7.1.1.5.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1 and 5.4.2.

7.1.1.5.2 Test purpose

To verify that CE can acknowledge SYN-ACK PDU with any value of Sequence Number ranging from '00 00' to 'FF FF'.

7.1.1.5.3 Methods of test

7.1.1.5.3.1 Scenario

```
                       CE                                    CS
Time    State
1.      CLOSE      <SEQ=X><SYN>               --->
2.      SYN-SENT                              <---    <SEQ=INI_SEQ_NB><ACK=X><SYN,ACK>
        SYN-SENT   <SEQ=X+1>                  --->
3.                 <ACK=INI_SEQ_NB><ACK>
4.      OPEN                                  <---    <SEQ=INI_SEQ_NB+1><ACK!=X><NUL,ACK>
        OPEN       <SEQ=X+1>                  --->
5.                 <ACK=INI_SEQ_NB+1><ACK>
```

7.1.1.5.3.2 Initial condition

The following conditions apply:

- The Active open generic initial conditions
- The initial Sequence Number is as defined in clause 7.1.1.5.4.3.

7.1.1.5.3.3 Procedure

This test case has to be run 3 times with the following values for the Sequence Number:

- INI_SEQ_NB = '00 00'
- INI_SEQ_NB = 'FF FF'
- INI_SEQ_NB = '7F FF'
- INI_SEQ_NB = '80 00'

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		
3	CE --> CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.1.1.5.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	INI_SEQ_NB

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	INI_SEQ_NB+1
13 - 14	Acknowledgment Number	!=X

NOTE: In the case where INI_SEQ_NB='FF FF', the Sequence Number of the NUL-ACK PDU is '00 00' because it is a cyclic parameter.

7.1.1.5.3.5 Expected results

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	INI_SEQ_NB

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	See Note

NOTE: The expected value is INI_SEQ_NB+1. In the case where INI_SEQ_NB = 'FF FF', the expected value is '00 00' (wrap around of the Acknowledgement number).

7.1.1.6 Active open request when CE is in CLOSE state

7.1.1.6.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.1.1.

7.1.1.6.2 Test purpose

To verify that CE issues a SYN PDU after having received an active open request and goes into SYN-SENT state.

7.1.1.6.3 Methods of test

7.1.1.6.3.1 Scenario

```
                        CE                                    CS
Time     State
1.       CLOSE      <SEQ=X><SYN>                ---> 
2.       SYN-SENT                               <---    <SEQ=200><ACK=X><SYN,ACK>
```

7.1.1.6.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.1.6.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues an active open request without specifying the local port number.	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU		

7.1.1.6.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

7.1.1.6.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

7.1.1.7 Handling of the local port number in the active open request

7.1.1.7.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1.1, 5.4.2, 5.3.1.1 and 5.3.1.2.

7.1.1.7.2 Test purpose

To verify that upon an open request reception CE shall attribute to the connection the local port specified in the request.

7.1.1.7.3 Methods of test

7.1.1.7.3.1 Scenario

```
                        CE                                  CS
Time     State
1.       CLOSE      <SEQ=X><SYN>                ---> 
2.       SYN-SENT                               <---    <SEQ=200><ACK=X><SYN,ACK>
3.       OPEN       <SEQ=X+1><ACK=200><ACK>     ---> 
```

7.1.1.7.3.2 Initial conditions

The following conditions apply:

- Active open generic initial conditions
- Local port '04 00' is not in use.

7.1.1.7.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues an open active request where the local port is specified CE_PORT= '04 00'	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU		
3	CE --> CS	ACK PDU		

7.1.1.7.3.4 Specific message content

Step 3: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
7 - 8	Destination port	'04 00'
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

7.1.1.7.3.5 Expected results

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source port	'04 00'
11 - 12	Sequence Number	X

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source port	'04 00'
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

7.1.2 Non-nominal cases

7.1.2.1 Handling of unexpected PDU when CE in SYN-SENT state

7.1.2.1.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.

7.1.2.1.2 Test purpose

To verify that CE shall discard all the following PDUs:

- ACK/ACK-SEG-DATA/ACK-UNSEG-DATA PDU
- ACK-EACK/ACK-EACK-UNSEG-DATA PDU
- NUL-ACK PDU
- RST PDU

and stays in the SYN-SENT state. It reaches OPEN state after having issued ACK PDU.

7.1.2.1.3 Methods of test

7.1.2.1.3.1 Scenario

```
                              CE                                    CS
Time      State
1.        CLOSE       <SEQ=X><SYN>                 --->
2.        SYN-SENT                                 <---    <Unexpected PDU>
                                                           See the table below
3.        SYN-SENT                                 <---    <SEQ=200><ACK=X><SYN,ACK>
4.        SYN-SENT    <SEQ=X+1><ACK=200><ACK>      --->
5.        OPEN                                     <---    <SEQ=201><ACK!=X><NUL,ACK>
6.        OPEN        <SEQ=X+1><ACK=201><ACK>      --->
```

Case	Unexpected PDU name	Unexpected PDU format
1	ACK PDU	<SEQ=200><ACK=X><ACK>
2	ACK-SEG-DATA PDU	<SEQ=200><ACK=X><Seg=1><Data><ACK>
3	ACK-UNSEG-DATA PDU	<SEQ=200><ACK=X><Seg=0><Data><ACK>
4	ACK-EACK PDU	<SEQ=200><ACK=X><ACK,EACK>
5	ACK-EACK-UNSEG-DATA PDU	<SEQ=200><ACK=X><Seg=0><Data><ACK,EACK>
6	NUL-ACK PDU	<SEQ=200><ACK=X><NUL,ACK>
7	RST PDU	<SEQ=200><RST>

7.1.2.1.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.1.3.3 Procedure

The scenario depicted above has to be executed 7 times to test with a different unexpected PDU each time. For each scenario, the initial conditions are the ones defined above.

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	An unexpected PDU		*CE discards the PDU*
3		SYN-ACK PDU.		
4	CE --> CS	ACK PDU.		
5	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
6	CE --> CS	ACK PDU		

7.1.2.1.3.4 Specific message content

Step 0: Test operator issues OPEN request

Step 2: Unexpected PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
19	Case 7: Reason Code	'00'
19 - 20	Case 4,5: Sequence Number	Insignificant

Step 4: NUL-ACK

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.2.1.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 5: ACK PDU

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.2.2 Handling of SYN-ACK PDU with incorrect Acknowledgement Number when CE in SYN-SENT state

7.1.2.2.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.4.

7.1.2.2.2 Test purpose

To verify that CE discards a SYN-ACK PDU with an incorrect Acknowledgement number and stays in SYN-SENT state.

7.1.2.2.3 Methods of test

7.1.2.2.3.1 Scenario

```
                              CE                                   CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>                ---->
    2.       SYN-SENT                               <----    <SEQ=200><ACK!=X><SYN,ACK>
    3        SYN-SENT   <SEQ=X><SYN>                ---->
    4.       SYN-SENT                               <----    <SEQ=200><ACK=X><SYN,ACK>
    5.       OPEN       <SEQ=X+1><ACK=200><ACK>     ---->
```

7.1.2.2.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.2.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU		*CS issues the SYN-ACK PDU with an incorrect acknowledgement number. CE discards the PDU*
3	CE --> CS	SYN PDU		*CE retransmits SYN PDU due to time out event.*
4	CE <-- CS	SYN-ACK PDU		
5	CE --> CS	ACK PDU		

7.1.2.2.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	!X

Step 3: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

7.1.2.2.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 3: SYN PDU

Refer to annex A.

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

7.1.2.3 Active open request when CE is in SYN-SENT or in OPEN state

7.1.2.3.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.1.1.

7.1.2.3.2 Test purpose

To verify that CE does not consider the open request and stays in its current state.

7.1.2.3.3 Methods of test

7.1.2.3.3.1 Scenario

```
                              CE                                   CS
Time      State
1.        CLOSE      <SEQ=X><SYN>                ---->
2.        SYN-SENT                               <---    <SEQ=200><ACK=X><SYN,ACK>
3.        OPEN       <SEQ=X+1><ACK=200><ACK>     --->
4.        OPEN                                   <---    <SEQ=201><ACK!=X><NUL,ACK>
5.        OPEN       <SEQ=X+1><ACK=201><ACK>     --->
```

7.1.2.3.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.3.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
1a			Test operator issues an active open request	
1b			CE returns "Error-Connection already opened"	
2	CE <-- CS	SYN-ACK PDU		
3	CE --> CS	ACK PDU		
3a			Test operator issues an active open request	
3b			CE returns "Error-Connection already opened"	
4	CE <-- CS	NUL-ACK PDU		
5	CE --> CS	ACK PDU		

7.1.2.3.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: SYN-ACK PDU

Refer to annex A.

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.1.2.3.3.5 Expected results

Step 1b: Test operator checks that CE returns "Error - Connection already opened".

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 3b: Test operator checks that CE returns "Error - Connection already opened".

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.1.2.4 Damaged PDU reception when CE in SYN-SENT state

7.1.2.4.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.4.

7.1.2.4.2 Test purpose

To verify that CE discards the incoming damaged PDU and stays in SYN-SENT state.

7.1.2.4.3 Methods of test

7.1.2.4.3.1 Scenario

```
                           CE                                  CS
Time      State
1.        CLOSE      <SEQ=X><SYN>              --->
2.        SYN-SENT                             <---    Damaged PDU
3.        SYN-SENT                             <---    <SEQ=200><ACK=X><SYN,ACK>
4.        OPEN       <SEQ=X+1><ACK=200><ACK>   --->
```

With damaged PDU:

- Invalid PDU types (e.g. SYN and RST both set);
- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);
- PDU length as received from the lower layer does not match sum of header and data length;
- Wrong checksum;
- Size of PDU exceeds maximum acceptable PDU size (RCV_PDU_SIZE_MAX).

7.1.2.4.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.4.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
2	CE <-- CS	Damaged PDU		*CE discards the PDU*
3	CE <-- CS	SYN-ACK PDU		
4	CE --> CS	ACK PDU		

7.1.2.4.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: Damaged PDU

- Invalid PDU types (e.g. SYN and RST both set).

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	Odd number
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	Different from the correct checksum
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX (only applicable when Max PDU Size announced by CE is smaller than 'FFFF').

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapted according to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

Step 3: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

7.1.2.4.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

7.1.2.5 Receive request when CE is in SYN-SENT state

7.1.2.5.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.1.3.

7.1.2.5.2 Test purpose

To verify that CE does not consider the receive request and stays in its current state.

7.1.2.5.3 Methods of test

7.1.2.5.3.1 Scenario

```
                          CE                                    CS
Time     State
1.       CLOSE      <SEQ=X><SYN>               --->
2.       SYN-SENT                              <---    <SEQ=200><ACK=X><SYN,ACK>
3.       OPEN       <SEQ=X+1><ACK=200><ACK>    --->
```

7.1.2.5.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.5.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
1a			Test operator issues a receive request	
1b			CE returns "Error-No data available"	*CE stays in SYN-SENT state*
2	CE <-- CS	SYN-ACK PDU		
3	CE --> CS	ACK PDU		

7.1.2.5.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: SYN-ACK PDU

Refer to annex A.

7.1.2.5.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 1b: Test operator checks that CE returns "Error - Connection already opened".

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

7.1.2.6 Send request when CE is in SYN-SENT state

7.1.2.6.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.1.4.

7.1.2.6.2 Test purpose

To verify that CE does not consider the send request and stays in its current state.

7.1.2.6.3 Methods of test

7.1.2.6.3.1 Scenario

```
                        CE                                    CS
Time     State
1.       CLOSE     <SEQ=X><SYN>                ---> 
2.       SYN-SENT                              <---    <SEQ=200><ACK=X><SYN,ACK>
3.       OPEN      <SEQ=X+1><ACK=200><ACK>     --->
```

7.1.2.6.3.2 Initial conditions

The Active open generic initial conditions apply.

7.1.2.6.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues OPEN request	
1	CE --> CS	SYN PDU		
1a			Test operator issues a send request	
1b			CE returns "Error-Connection not opened"	CE *stays in SYN-SENT state*
2	CE <-- CS	SYN-ACK PDU		
3	CE --> CS	ACK PDU		

7.1.2.6.3.4 Specific message content

Step 0: Test operator issues OPEN request.

Step 2: SYN-ACK PDU

Refer to annex A.

7.1.2.6.3.5 Expected results

Step 1: SYN PDU

Refer to annex A.

Step 1b: Test operator checks that CE returns "Error - Connection not opened".

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

7.1.2.7 Reception of a SYN-ACK PDU with its sequence number out of the window boundaries when CE in OPEN state

7.1.2.7.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.2.

7.1.2.7.2 Test purpose

To verify that CE shall discard the SYN-ACK PDU and stays in OPEN state.

7.1.2.7.3 Methods of test

7.1.2.7.3.1 Scenario

```
                         CE                                  CS
Time     State
1.       OPEN                                   <---    <SEQ=200><SYN,ACK>
2.       OPEN       <SEQ=X+1><ACK=200><ACK>     --->
3.       OPEN                                   <---    <SEQ=201><ACK=X><Data><ACK>
4.       OPEN       <SEQ=X+1><ACK=201><ACK>     --->
```

7.1.2.7.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

7.1.2.7.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN-ACK PDU		*CE discard SYN-ACK PDU and stays in OPEN state*
2	CE --> CS	ACK PDU		
3	CE <-- CS	ACK-UNSEG-DATA PDU		
4	CE --> CS	ACK PDU		

7.1.2.7.3.4 Specific message content

Step 1: SYN-ACK PDU

Refer to annex A.

Step 3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement number	X

7.1.2.7.3.5 Expected results

Step 2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgement number	'00 C8'

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgement number	'00 C9'

7.2 Passive mode

Unless specified within the test case, the following "Passive open generic initial conditions"shall be applied to all the test cases under this clause:

- A passive open request has been performed to CE and CE is in LISTEN state.
- CS: Initial sequence number is 200. Max PDU size= 500 bytes. Max SDU size=1000 bytes.
- CS port: 1024.
- CE port (CE_PORT): to be provided by the CAT-TP entity. The CS shall use this value as destination port throughout the test cases.

7.2.1 Nominal Cases

7.2.1.1 Normal opening of the connection: reception of ACK PDU in/out of sequence when CE in SYN-RCVD state

7.2.1.1.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.1 and 5.4.2.

7.2.1.1.2 Test purpose

To verify that CE is in OPEN state after having issued the SYN-ACK PDU and received the ACK PDU.

7.2.1.1.3 Methods of test

7.2.1.1.3.1 Scenario 1: ACK PDU is received in sequence

		CE		CS
Time	State			
1.	LISTEN		<---	<SEQ=200><SYN>
2.	SYN-RCVD	<SEQ=X><ACK=200><SYN,ACK>	--->	
3.	SYN-RCVD		<---	<SEQ=201><ACK=X><ACK>
4.	OPEN		<---	<SEQ=201><ACK!=X><NUL,ACK>
5.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	

7.2.1.1.3.2 Scenario 2: ACK PDU is received out of sequence

		CE		CS
Time	State			
1.	LISTEN		<---	<SEQ=200><SYN>
2.	SYN-RCVD	<SEQ=X><ACK=200><SYN,ACK> <WindowSize=W>	--->	
3.	SYN-RCVD		<---	<SEQ=200+W><ACK=X><ACK>
4.	OPEN		<---	<SEQ=201><ACK!=X><NUL,ACK>
5.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	

NOTE: The window size W has to be bigger than 1.

7.2.1.1.3.3 Initial conditions

The Passive open generic initial conditions apply.

7.2.1.1.3.4 Procedure

For both scenarios, the procedure is the same.

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU.		
3	CE <-- CS	ACK PDU.		*For scenario 1, ACK PDU is issued in-sequence. For scenario 2, ACK PDU is issued out of sequence.*
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.2.1.1.3.5 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Scenario 1: Sequence Number	'00 C9'
	Scenario 2: Sequence Number	'00 C8' + W
13 - 14	Acknowledgment Number	X

Step 4: NUL-ACK PDU

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.1.1.3.6 Expected results

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
4	Header length	'17'+L
11 - 12	Sequence Number	X
15 - 16	Scenario 1: Window Size	W=1
	Scenario 2: Window Size	W>1
23 - 23+L	Identification	See note

NOTE: The test operator has to verify the following:

- The format of the Identification field;
- The consistency of the announced length L in the Header length field with the actual size of the data;
- In the case where L='00', the expected value is:

23	Identification	'00'

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.1.2 Opening of the connection with retransmission of the SYN-ACK PDU when CE in LISTEN state

7.2.1.2.1 Conformance requirements

CE entity shall support the connection establishment as specified in clauses 5.3.2.4 and 5.4.2.3.

7.2.1.2.2 Test purpose

To verify that CE is able to re-issue the SYN-ACK PDU as long as the retransmission counter is smaller than the maximum and reaches the OPEN state after having received the ACK PDU

7.2.1.2.3 Methods of test

7.2.1.2.3.1 Scenario

```
                          CE                                   CS
Time     State
1.       LISTEN                                     <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>       --->    (PDU lost)
.
.
N-1      SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>       --->    (PDU lost)
N        SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>       --->
N+1                                                 <---    <SEQ=201><ACK=X><ACK>
N+2      OPEN                                       <---    <SEQ=201><ACK!=X><NUL,ACK>
N+3      OPEN       <SEQ=X+1><ACK=201><ACK>         --->
```

7.2.1.2.3.2 Initial conditions

The following conditions apply:

- Passive open generic initial conditions.
- The maximum number of retries N has to be supplied by the CE.
- The counter k is used to keep track of the reception of SYN-ACK PDU. Initial value is 0.

7.2.1.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU.		*Increment k each time a SYN-ACK PDU is received. CS shall not acknowledge SYN-ACK PDU.*
.				
.				
N	CE --> CS	SYN-ACK PDU.		*Last attempt for retransmission of SYN-ACK PDU from CE*
N+1	CE <-- CS	ACK PDU.		*ACK PDU has to be issued in the limit of the CE timeout*
N+2	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
N+3	CE --> CS	ACK PDU		

7.2.1.2.3.5 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step N+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step N+2: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	! =X

7.2.1.2.4.6 Expected results

Steps 2..N: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
15 - 16	Window Size	Not checked

At the end of step N, CS checks that the last value of k is equal to the maximum number of retries provided by the CE. If not, the test is considered as failed.

Step N+3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.1.3 Handling of SYN PDU with various Max SDU Size when CE in LISTEN state

7.2.1.3.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.3.

7.2.1.3.2 Test purpose

To verify that CE can acknowledge SYN PDU with Max SDU Size ranging from '00 01' to 'FF FF'.

7.2.1.3.3 Methods of test

7.2.1.3.3.1 Scenario

```
                         CE                                     CS
Time     State
         LISTEN                                <---   <SEQ=200><SYN>
1.                                                    <MaxSDUSize=S>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>  --->
3.       SYN-RCVD                              <---   <SEQ=201><ACK=X><ACK>
4.       OPEN                                  <---   <SEQ=201><ACK!=X><NUL,ACK>
5.       OPEN       <SEQ=X+1><ACK=201><ACK>    --->
```

7.2.1.3.3.2 Initial condition

The following conditions apply:

- Passive open generic initial conditions
- The Max SDU Size of CS is defined in clause 7.2.1.3.4.3.

7.2.1.3.3.3 Procedure

This test case has to be run 4 times with the following values for Max SDU Size:

- MAX_SDU_SIZE = '00 01'
- MAX_SDU_SIZE = '7F FF'
- MAX_SDU_SIZE = '80 00'
- MAX_SDU_SIZE = 'FF FF'

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*The SYN PDU is issued with a different value in its MaxSDUSize field each time.*
2	CE --> CS	SYN-ACK PDU.		
3	CE <-- CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.2.1.3.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
21 - 22	Max SDU Size	MAX_SDU_SIZE

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.1.3.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

Step 5: ACK PDU

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.1.4 Handling of SYN PDU with various Identification field Size when CE in LISTEN state

7.2.1.4.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.2.3 and 5.5.

7.2.1.4.2 Test purpose

To verify that CE can acknowledge the SYN PDU with Identification field length ranging from '00' to 'E9'.

7.2.1.4.3 Methods of test

7.2.1.4.3.1 Scenario

```
                         CE                                    CS
Time     State
         LISTEN                                 <---    <SEQ=200><SYN>
1.                                                      <Identification=L'>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>   --->
3.       SYN-RCVD                               <---    <SEQ=201><ACK=X><ACK>
4.       OPEN                                   <---    <SEQ=201><ACK!=X><NUL,ACK>
5.       OPEN       <SEQ=X+1><ACK=201><ACK>     --->
```

7.2.1.4.3.2 Initial condition

The Passive open generic initial conditions apply.

7.2.1.4.3.3 Procedure

This test case has to be run 3 times with the following values for Identification field length:

- ID_LEN = '00'
- ID_LEN = '41'
- ID_LEN = 'E9'

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*The length of the content of the Identification field is different each time.*
2	CE --> CS	SYN-ACK PDU.		
3	CE <-- CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.2.1.4.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
4	Header Length	'17'+ ID_LEN
23 - 23+ ID_LEN	Identification	Insignificant

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.1.4.4.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.1.5 Handling of ACK PDU carrying data when CE in SYN-RCVD state

7.2.1.5.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.5.

7.2.1.5.2 Test purpose

To verify that CE is in OPEN state after having received the ACK PDU and issues an ACK or ACK-EACK PDU for the acknowledgement of the ACK PDU carrying data.

7.2.1.5.3 Methods of test

7.2.1.5.3.1 Scenario 1: ACK PDU is received in sequence

		CE		CS
Time	State			
1.	LISTEN		<---	<SEQ=200><SYN>
2.	SYN-RCVD	<SEQ=X><ACK=200><SYN,ACK>	--->	
3.	SYN-RCVD		<---	<SEQ=201><ACK=X><ACK,Data><Seg=0>
4.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
5.	OPEN		<---	<SEQ=202><ACK!=X><NUL,ACK>
6.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	

7.2.1.5.3.2 Scenario 2: ACK PDU is received out of sequence

		CE		CS
Time	State			
1.	LISTEN		<---	<SEQ=200><SYN>
2.	SYN-RCVD	<SEQ=X><ACK=200><SYN,ACK> <WindowSize=W>	--->	
3.	SYN-RCVD		<---	<SEQ=200+W><ACK=X><ACK,Data><Seg=0>
4.	OPEN	<SEQ=X+1><ACK=200><EACK=200+W> <ACK,EACK>	--->	
5.	OPEN		<---	<SEQ=201><ACK!=X><NUL,ACK>
6.	OPEN	If W=2: <SEQ=X+1><ACK=200+W><ACK>	--->	
6.	OPEN	If W>2: <SEQ=X+1><ACK=201><EACK=200+W> <ACK,EACK>	--->	

NOTE: Window size W has to be bigger than 1.

7.2.1.5.3.3 Initial conditions

The following conditions apply:

- Passive open generic initial conditions
- The length L' of the data carried by the ACK PDU in Step 3 shall be different than 0.

7.2.1.5.3.4 Procedure

If the window size of the CE given in the SYN-ACK PDU is greater than 1, scenario 2 has to be run. Else, only scenario 1 is relevant.

For both scenarios, the procedure is the same.

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU.		
3a	CE <-- CS	ACK-UNSEG-DATA PDU		*Scenario 1: ACK PDU is issued in-sequence with data* *Scenario 2: ACK PDU is issued out-of-sequence with data*
3b			Scenario 1: CE signals to the test operator 'SDU available'	*This step may take place after step 4, in which case the PDU in step 5 shall only be issued after the reception of "SDU available" signal.*
4	CE --> CS	Scenario 1: CE issues an ACK PDU		*Acknowledgement of the carried data*
		Scenario 2: CE issues an ACK-EACK PDU		
5	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
6	CE --> CS	Scenario 1: ACK PDU. Scenario 2: ACK PDU (W=2) or ACK-EACK PDU (W>2).		

7.2.1.5.3.5 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Scenario 1: Sequence Number	'00 C9'
	Scenario 2: Sequence Number	'00 C9'+W
13 - 14	Acknowledgment Number	X

Step 5: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.1.5.3.6 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

Step 3b (Scenario 1): CE signals to the test operator 'SDU available'.

Step 4 (Scenario 1): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 4 (Scenario 2): ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
19 - 20	Scenario 2: Sequence number	'01 2C'

Step 6 (Scenario 1): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'+W

Step 6 (Scenario 2): ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
19 - 20	Sequence Number (for out of sequence entries)	'00 C8' + W

7.2.1.6 Handling of NUL-ACK PDU when CE in SYN-RCVD state

7.2.1.6.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.5.

7.2.1.6.2 Test purpose

To verify that CE is in OPEN state after having received the NUL-ACK PDU and issues an ACK PDU or an ACK-EACK PDU for the acknowledgement of the NUL-ACK PDU.

7.2.1.6.3 Methods of test

7.2.1.6.3.1 Scenario 1: NUL-ACK PDU is received in sequence

```
                              CE                                  CS
    Time   State
    1.     LISTEN                                   <---    <SEQ=200><SYN>
    2.     SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>     --->
    3.     SYN-RCVD                                 <---    <SEQ=201><ACK=X><NUL,ACK>
    4.     OPEN       <SEQ=X+1><ACK=201><ACK>       --->
    5.     OPEN                                     <---    <SEQ=202><ACK!=X><NUL,ACK>
    6.     OPEN       <SEQ=X+1><ACK=202><ACK>       --->
```

7.2.1.6.3.2 Scenario 2: NUL-ACK PDU is received out of sequence

```
                           CE                                 CS
Time   State
1.     LISTEN                                         <---    <SEQ=200><SYN>
2.     SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>
                  <WindowSize=W>                      --->
3.     SYN-RCVD                                       <---    <SEQ=200+W><ACK=X><NUL,ACK>
4.     OPEN       <SEQ=X+1><ACK=200><EACK=200+W>
                  <ACK,EACK>                          --->
5.     OPEN                                           <---    <SEQ=201><ACK!=X><NUL,ACK>
6.     OPEN       If W=2:
                  <SEQ=X+1><ACK=200+W><ACK>           --->
                  If W>2:
                  <SEQ=X+1><ACK=201><EACK=200+W>      --->
                  <ACK,EACK>
```

NOTE: Window size W has to be bigger than 1.

7.2.1.6.3.3 Initial conditions

The Passive open generic initial conditions apply.7.2.1.6.4.4 Procedure

If the window size of the CE given in the SYN-ACK PDU is greater than 1, scenario 2 has to be run.

For both scenarii, the procedure is the same.

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU.		
3	CE <-- CS	NUL-ACK PDU.		*Scenario 1: CS acknowledges by issuing an in-sequence NUL-ACK PDU* *Scenario 2: CS acknowledges by issuing an out-of-sequence NUL-ACK PDU*
4	CE --> CS	Scenario 1: ACK PDU		
		Scenario 2: ACK-EACK PDU		
5	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
6	CE --> CS	Scenario 1: ACK PDU		
		Scenario 2: ACK PDU (W=2) or an ACK-EACK PDU (W>2).		

7.2.1.6.3.5 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Scenario 1: Sequence Number	'00 C9'
	Scenario 2: Sequence Number	'00 C8' + W
13 - 14	Acknowledgment Number	X

Step 5: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.1.6.3.6 Expected results

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
15 - 16	Scenario 1: Window Size	Not checked
	Scenario 2: Window Size	W>1

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Scenario 1: Window Size	Not checked
	Scenario 2: Window Size	W>1

Step 6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Scenario 1: Acknowledgment Number	'00 CA'
	Scenario 2: Acknowledgment Number	'00 C8'+W
15 - 16	Scenario 1: Window Size	Not checked
	Scenario 2: Window Size	W=2

Step 6: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	W>2
19 - 20	Sequence Number (Out of sequence)	'00 C8' + W

7.2.1.7 Handling of SYN PDU with various sequence number when CE in LISTEN state

7.2.1.7.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.3.

7.2.1.7.2 Test purpose

To verify that CE can acknowledge SYN PDU with any value of Sequence Number ranging from '00 00' to 'FF FF'.

7.2.1.7.3 Methods of test

7.2.1.7.3.1 Scenario

```
                       CE                                        CS
Time   State
1.     LISTEN                                       <---   <SEQ=INI_SEQ_NB><SYN>
       SYN-RCVD    <SEQ=X>
2.                                                  --->
                   <ACK=INI_SEQ_NB><SYN,ACK>
       OPEN                                                <SEQ=INI_SEQ_NB+1>
3.                                                  <---
                                                           <ACK=X><ACK>
       OPEN                                                <SEQ=INI_SEQ_NB+1>
4.                                                  <---
                                                           <ACK!=X><NUL,ACK>
       OPEN        <SEQ=X+1>
5.                                                  --->
                   <ACK=INI_SEQ_NB+1><ACK>
```

7.2.1.7.3.2 Initial condition

The following conditions apply:

- The Passive open generic initial conditions
- The initial Sequence Number is as defined in clause 7.2.1.7.4.3.

7.2.1.7.3.3 Procedure

This test case has to be run 4 times with the following values for the Sequence Number:

- INI_SEQ_NB = '00 00'
- INI_SEQ_NB = 'FF FF'
- INI_SEQ_NB = '7F FF'
- INI_SEQ_NB = '80 00'

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*Each time the sequence number is different following*
2	CE --> CS	SYN-ACK PDU		
3	CE <-- CS	ACK PDU.		
4	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
5	CE --> CS	ACK PDU		

7.2.1.7.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
11 - 12	Sequence Number	INI_SEQ_NB

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	INI_SEQ_NB+1
13 - 14	Acknowledgment Number	X

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	INI_SEQ_NB+1
13 - 14	Acknowledgment Number	! =X

7.2.1.7.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
13 - 14	Acknowledgment Number	INI_SEQ_NB

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	See Note

NOTE: The expected value is INI_SEQ_NB+1. In the case where INI_SEQ_NB = 'FF FF', the expected value is '00 00' (wrap around of the Acknowledgement number).

7.2.1.8 Passive open request when CE is in CLOSE state

7.2.1.8.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.1.1.

7.2.1.8.2 Test purpose

To verify that CE reaches the LISTEN state after having received a passive open request and is able to handle an incoming SYN PDU.

7.2.1.8.3 Methods of test

7.2.1.8.3.1 Scenario

```
                              CE                                        CS
    Time     State
    0.       LISTEN
    1.       LISTEN                                  <---    <SEQ=200><SYN>
    2.       SYN-SENT    <SEQ=X><ACK=200><SYN,ACK>   --->
```

7.2.1.8.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.1.8.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues a passive open request	
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		

7.2.1.8.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

7.2.1.8.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

7.2.2 Non-nominal cases

7.2.2.1 Handling of RST PDU when CE in LISTEN state

7.2.2.1.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.3.

7.2.2.1.2 Test purpose

To verify that CE shall discard the RST PDU and stays in the LISTEN state. It reaches OPEN state after having issued SYN-ACK PDU and received the ACK PDU.

7.2.2.1.3 Methods of test

7.2.2.1.3.1 Scenario

```
                          CE                                    CS
Time     State
1.       LISTEN                                   <---   <SEQ=200><RST>
2.       LISTEN                                   <---   <SEQ=200><SYN>
3.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>     --->
4.                                                <---   <SEQ=201><ACK=X><ACK>
5.       OPEN                                     <---   <SEQ=201><ACK!=X><NUL,ACK>
6.       OPEN       <SEQ=X+1><ACK=201><ACK>       --->
```

7.2.2.1.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.1.4.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	RST PDU		*CE discards the PDU*
2	CE <-- CS	SYN PDU		
3	CE --> CS	SYN-ACK PDU		
4	CE <-- CS	ACK PDU		
5	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
6	CE --> CS	ACK PDU.		

7.2.2.1.3.4 Specific message content

Step 1: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
19	Reason Code	'00'

Step 3: SYN PDU

Refer to annex A.

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 6: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.2.1.3.5 Expected results

Step 4: SYN-ACK PDU

Refer to annex A.

Step 6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.2 Handling of unexpected PDU when CE in LISTEN state

7.2.2.2.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.3.

7.2.2.2.2 Test purpose

To verify that CE shall discard all the following PDUs:

- ACK/ACK-SEG-DATA/ACK-UNSEG-DATA PDU
- ACK-EACK PDU
- NUL-ACK PDU
- SYN-ACK PDU

CE issues a RST PDU and stays in the LISTEN state. It reaches OPEN state after having issued SYN-ACK PDU and received the ACK PDU.

7.2.2.2.3 Methods of test

7.2.2.2.3.1 Scenario

```
                          CE                                    CS
Time    State
        LISTEN                                           <Unexpected PDU>
1.                                                <---   See the table below
2.      LISTEN    <SEQ=Y+1><RST>                  --->
3.      LISTEN                                    <---   <SEQ=200><SYN>
4.      SYN-RCVD  <SEQ=Y+1><ACK=200><SYN,ACK>     --->
5.                                                <---   <SEQ=201><ACK=Y+1><ACK>
6.      OPEN                                      <---   <SEQ=201><ACK!=Y+1><NUL,ACK>
7.      OPEN      <SEQ=Y+2><ACK=201><ACK>         --->
```

Unexpected PDU name	Unexpected PDU format
ACK PDU	<SEQ=200><ACK=Y><ACK>
ACK-SEG-DATA PDU	<SEQ=200><ACK=Y><Seg=1><Data><ACK>
ACK-UNSEG-DATA PDU	<SEQ=200><ACK=Y><Seg=0><Data><ACK>
ACK-EACK PDU	<SEQ=200><ACK=Y><ACK,EACK>
ACK-EACK-UNSEG-DATA PDU	<SEQ=200><ACK=Y><Data><ACK,EACK>
NUL-ACK PDU	<SEQ=200><ACK=Y><NUL,ACK>
SYN-ACK PDU	<SEQ=200><ACK=Y><SYN,ACK>

7.2.2.2.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.2.4.3 Procedure

The scenario depicted above has to be executed 7 times to test with a different unexpected PDU each time. For each scenario, the initial conditions are the same.

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	An unexpected PDU as described above		*CE discards the PDU and stays in LISTEN state*
2	CE --> CS	RST PDU		
3	CE <-- CS	SYN PDU		
4	CE --> CS	SYN-ACK PDU		
5	CE <-- CS	ACK PDU		
6	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
7	CE --> CS	ACK PDU.		

7.2.2.2.3.4 Specific message content

Step 1: Unexpected PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	Y

Step 3: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	Y

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	Y+1

Step 6: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=Y+1

7.2.2.2.3.5 Expected results

Step 2: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	Y+1
13 - 14	Acknowledgment Number	Insignificant
19	Reason code	'04'

Step 4: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step 7: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Y+2
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.3 Handling of incoming PDU with its Sequence number out of the window boundaries when CE in SYN-RCVD state

7.2.2.3.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.5.

7.2.2.3.2 Test purpose

To verify that CE discards the incoming PDU with its sequence number out of the window boundaries, issues an ACK PDU and stays in SYN-RCVD state. It reaches OPEN state after having received in-sequence ACK PDU.

7.2.2.3.3 Methods of test

7.2.2.3.3.1 Scenario

```
                         CE                                       CS
Time     State
1.       LISTEN                                       <---   <SEQ=200><SYN>
         SYN-RCVD    <SEQ=X><ACK=200><SYN,ACK>
2.                                                    --->
                     <WindowSize=W>
3.       SYN-RCVD                                     <---   <SEQ=INC_SEQ_NB><ACK=X><ACK>
4.       SYN-RCVD    <SEQ=X+1><ACK=200><ACK>          --->
5.       SYN-RCVD                                     <---   <SEQ=201><ACK=X><ACK>
6.       OPEN                                         <---   <SEQ=201><ACK!=X><NUL,ACK>
7.       OPEN        <SEQ=X+1><ACK=201><ACK>          --->
```

7.2.2.3.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.3.3.3 Procedure

The scenario depicted above has to be executed 2 times to test with a different incorrect sequence number:

- INC_SEQ_NB =200
- INC_SEQ_NB =200+W+1

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		
4	CE <-- CS	ACK PDU		*An ACK PDU with an incorrect sequence number*
4	CE --> CS	ACK PDU		*CE discards the PDU and issues an ACK PDU*
5	CE <-- CS	ACK PDU		
6	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
7	CE --> CS	ACK PDU.		

7.2.2.3.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	INC_SEQ_NB
13 - 14	Acknowledgment Number	X

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 6: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.2.3.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

Step 4: ACK PDU

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	INC_SEQ_NB

Step 7: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.4 Handling of ACK-EACK/ ACK-EACK-UNSEG-DATA PDU when CE in SYN-RCVD state

7.2.2.4.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.5.

7.2.2.4.2 Test purpose

To verify that CE shall discard the ACK-EACK/ ACK-EACK-UNSEG-DATA PDU, issues a RST PDU and stays in the SYN-RCVD state. It reaches OPEN state after having received ACK PDU.

7.2.2.4.3 Methods of test

7.2.2.4.3.1 Scenario

```
                          CE                                     CS
Time     State
1.       LISTEN                                   <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>     --->
3.       SYN-RCVD                                         <Unexpected PDU>
                                                  <---
                                                          See the table below
4.       SYN-RCVD   <SEQ=X+1><RST>                --->
5.       SYN-RCVD                                 <---    <SEQ=201><ACK=X><ACK>
6.       OPEN                                     <---    <SEQ=201><ACK!=X><NUL,ACK>
7.       OPEN       <SEQ=X+1><ACK=201><ACK>       --->
```

Unexpected PDU name	Unexpected PDU format
ACK-EACK PDU	<SEQ=201><ACK=X><EACK=300><ACK,EACK>
ACK-EACK-UNSEG-DATA PDU	<SEQ=201><ACK=X><Seg=0><EACK=300><Data><ACK,EACK>

7.2.2.4.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.4.3.3 Procedure

The scenario depicted above has to be executed twice to test with the two PDUs defined above. For each scenario, the initial conditions are the ones defined above.

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		
3	CE <-- CS	An unexpected PDU		*CE discards the PDU*
4	CE --> CS	RST PDU		
5	CE <-- CS	ACK PDU		
6	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
7	CE --> CS	ACK PDU.		

7.2.2.4.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: Unexpected PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
4	Scenario1: Header length	'14'
	Scenario2: Header length	'14'+L
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X
19 - 20	Sequence number (Out of sequence)	'01 2C'
21 - 21+L	Scenario 2: Data	Insignificant

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 6: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.2.4.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A.

Step 4: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	Not checked
19	Reason code	'04'

Step 7: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.5 Passive open request when CE is in LISTEN or in SYN-RCVD or in OPEN state

7.2.2.5.1 Conformance requirements

CE shall support the connection establishment as specified clause 5.4.1.1.

7.2.2.5.2 Test purpose

To verify that CE does not take into account the open request and stays in its current state.

7.2.2.5.3 Methods of test

7.2.2.5.3.1 Scenario

```
                         CE                                   CS
Time     State
1.       LISTEN                                 <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>   --->
3.       OPEN                                   <---    <SEQ=201><ACK=X><ACK>
4.       OPEN                                   <---    <SEQ=201><ACK!=X><NUL,ACK>
5.       OPEN       <SEQ=X+1><ACK=201><ACK>     --->
```

7.2.2.5.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.5.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0a			Test operator issues a passive open request	
0b			CE returns "Error-Connection already opened"	*CE stays in LISTEN state.*
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		
2a			Test operator issues a passive open request	
2b			CE returns "Error-Connection already opened"	*CE stays in SYN-RCVD state.*
3	CE <-- CS	ACK PDU		
3a			Test operator issues a passive open request	
3b			CE returns "Error-Connection already opened"	*CE stays in OPEN state.*
4	CE <-- CS	NUL-ACK PDU		
5	CE --> CS	ACK PDU		

7.2.2.5.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.2.5.3.5 Expected results

Step 0b: Test operator checks that CE returns "Error - Connection already opened".

Step 2: SYN-ACK PDU

Refer to annex A.

Step 2b: Test operator checks that CE returns "Error - Connection already opened".

Step 3b: Test operator checks that CE returns "Error - Connection already opened".

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.6 Damaged PDU reception when CE in LISTEN or in SYN-RCVD state

7.2.2.6.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.2.3 and 5.4.2.5.

7.2.2.6.2 Test purpose

To verify that CE discards the incoming invalid PDU and stays in its current state.

7.2.2.6.3 Methods of test

7.2.2.6.3.1 Scenario

```
                      CE                                    CS
Time     State
1.       LISTEN                                   <---    Damaged PDU
2.       LISTEN                                   <---    <SEQ=200><SYN>
3.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>     --->
4.       SYN-RCVD                                 <---    Damaged PDU
5.       OPEN                                     <---    <SEQ=201><ACK=X><ACK>
```

With damaged PDU:

- Invalid PDU types (e.g. SYN and RST both set);
- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);
- PDU length as received from the lower layer does not match sum of header and data length;
- Wrong checksum;
- Size of PDU exceeds maximum acceptable PDU size (RCV_PDU_SIZE_MAX).

7.2.2.6.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.6.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	Damaged PDU	Test operator issues a passive open request	*CE discards the PDU*
2	CE <-- CS	SYN PDU	CE returns "Error-Connection already opened"	
3	CE --> CS	SYN-ACK PDU		
4	CE <-- CS	Damaged PDU		*CE discards the PDU*
5	CE <-- CS	ACK PDU		

7.2.2.6.3.4 Specific message content

Steps 1 and 4: Damaged PDU

- Invalid PDU types (e.g. SYN and RST both set).

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field).

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	Odd number
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum;

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	Different from the correct checksum
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX (only applicable when Max PDU Size announced by CE is smaller than 'FFFF').

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapted according to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

Step 2: SYN PDU

Refer to annex A.

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

7.2.2.6.3.5 Expected results

Step 3: SYN-ACK PDU

Refer to annex A.

7.2.2.7 Receive request when CE is in LISTEN or in SYN-RCVD state

7.2.2.7.1 Conformance requirements

CE shall support the connection establishment as specified clause 5.4.1.3.

7.2.2.7.2 Test purpose

To verify that CE does not take into account the receive request and stays in its current state.

7.2.2.7.3 Methods of test

7.2.2.7.3.1 Scenario

```
                               CE                                     CS
    Time     State
    1.       LISTEN                                  <---    <SEQ=200><SYN>
    2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>    --->
    3.       OPEN                                    <---    <SEQ=201><ACK=X><ACK>
```

7.2.2.7.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.7.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0a			Test operator issues a receive request	
0b			CE returns "Error-No data available"	*CE stays in LISTEN state.*
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		
2a			Test operator issues a receive request	
2b			CE returns "Error-No data available"	*CE stays in SYN-RCVD state.*
3	CE <-- CS	ACK PDU		

7.2.2.7.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

7.2.2.7.3.5 Expected results

Step 0b: Test operator checks that CE returns "Error - Error-No data available".

Step 2: SYN-ACK PDU

Refer to annex A.

Step 2b: Test operator checks that CE returns "Error - Error-No data available".

7.2.2.8 Send request when CE is in LISTEN or in SYN-RCVD state

7.2.2.8.1 Conformance requirements

CE shall support the connection establishment as specified clause 5.4.1.4.

7.2.2.8.2 Test purpose

To verify that CE does not take into account the receive request and stays in its current state.

7.2.2.8.3 Methods of test

7.2.2.8.3.1 Scenario

```
                          CE                                    CS
Time     State
1.       LISTEN                                       <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>         --->
3.       OPEN                                         <---    <SEQ=201><ACK=X><ACK>
```

7.2.2.8.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.8.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0a			Test operator issues a send request	
0b			CE returns "Error-Connection not opened"	*CE stays in LISTEN state.*
1	CE <-- CS	SYN PDU		
2	CE --> CS	SYN-ACK PDU		
2a			Test operator issues a receive request	
2b			CE returns "Error- Connection not opened"	*CE stays in SYN-RCVD state.*
3	CE <-- CS	ACK PDU		

7.2.2.8.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

7.2.2.8.3.5 Expected results

Step 0b: Test operator checks that CE returns "Error - Connection not opened".

Step 2: SYN-ACK PDU

Refer to annex A.

Step 2b: Test operator checks that CE returns "Error - Connection not opened".

7.2.2.9 Handling of SYN PDU with incorrect MaxPDUSize when CE in LISTEN state

7.2.2.9.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.3.

7.2.2.9.2 Test purpose

To verify that CE shall discard the SYN PDU, sends a RST PDU and stays in the LISTEN state. It reaches OPEN state after having issued SYN-ACK PDU and received the ACK PDU.

7.2.2.9.3 Methods of test

7.2.2.9.3.1 Scenario

```
                         CE                                    CS
Time     State
1.       LISTEN                              <---   <SEQ=200><ACK=300><MaxPDUSize=S><SYN>
2.       LISTEN     <SEQ=301><RST>           --->
3.       LISTEN                              <---   <SEQ=200><SYN>
4.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK> --->
5.       SYN-RCVD                            <---   <SEQ=201><ACK=X><ACK>
6.       OPEN                                <---   <SEQ=201><ACK!=X><NUL,ACK>
7.       OPEN       <SEQ=X+1><ACK=201><ACK>  --->
```

7.2.2.9.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.9.3.3 Procedure

This test case has to be run 3 times with the following values for the maximum PDU size:

- MAX_PDU_SIZE = '00'
- MAX_PDU_SIZE = '10'
- MAX_PDU_SIZE = '16'

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*CE discards the PDU*
2	CE --> CS	RST PDU		
3	CE <-- CS	SYN PDU		
4	CE --> CS	SYN-ACK PDU		
5	CE <-- CS	ACK PDU		
6	CE <-- CS	NUL-ACK PDU		*To check that CE actual state is OPEN*
7	CE --> CS	ACK PDU.		

7.2.2.9.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
13 - 14	Acknowledgement number	'012C'
19 - 20	Max PDU Size	MAX_PDU_SIZE

Step 3: SYN PDU

Refer to annex A.

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 6: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	!=X

7.2.2.9.3.5 Expected results

Step 2: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'012D'
19	Reason Code	'01'

Step 4: SYN-ACK PDU

Refer to annex A.

Step 7: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

7.2.2.10 Reception of SYN PDU with an incorrect destination port

7.2.2.10.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.1.

7.2.2.10.2 Test purpose

To verify that, upon the reception of a SYN PDU with an incorrect destination port, CE shall consider the incoming PDU as associated to a closed connection and shall issue an RST-ACK PDU.

7.2.2.10.3 Methods of test

7.2.2.10.3.1 Scenario

```
                         CE                                    CS
Time     State
1.       LISTEN                                <---    <SEQ=200><DestPort=INC_PORT><SYN>
2.       LISTEN     <SEQ=X><ACK=200><RST,ACK>  --->
3.       LISTEN                                <---    <SEQ=200><SYN>
4.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>  --->
5.       SYN-RCVD                              <---    <SEQ=201><ACK=X><ACK>
```

7.2.2.10.3.2 Initial conditions

The Passive open generic initial conditions apply.

7.2.2.10.3.3 Procedure

In Step 1, the SYN PDU has to be issued with a destination port INC_PORT different from CE_PORT (the port provided by CE).

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*CE discards the PDU and keeps on listening on CE_PORT*
2	CE --> CS	RST-ACK PDU		
3	CE <-- CS	SYN PDU		
4	CE --> CS	SYN-ACK PDU		
5	CE <-- CS	ACK PDU		

7.2.2.10.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
7 - 8	Destination port	INC_PORT

Step 2: SYN PDU

Refer to annex A.

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

7.2.2.10.3.5 Expected results

Step 2: RST-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source port	INC_PORT
7 - 8	Destination port	'04 00'
11 - 12	Sequence number	Insignificant
13 - 14	Acknowledgement number	'00 C8'

Step 4: SYN-ACK PDU

Refer to annex A.

Step 7: ACK PDU

7.2.2.11 Reception of a SYN PDU with its sequence number out of the window boundaries when CE in OPEN state

7.2.2.11.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.2.

7.2.2.11.2 Test purpose

To verify that CE shall discard the SYN PDU and stays in OPEN state.

7.2.2.11.3 Methods of test

7.2.2.11.3.1 Scenario

```
                         CE                                  CS
Time     State
1.       OPEN                                        <---    <SEQ=200><SYN>
2.       OPEN       <SEQ=X+1><ACK=200><ACK>          --->
3.       OPEN                                        <---    <SEQ=201><ACK=X><ACK,Data><Seg=0>
4.       OPEN       <SEQ=X+1><ACK=201><ACK>          --->
```

7.2.2.11.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

7.2.2.11.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*CE discard SYN PDU and stays in OPEN state*
2	CE --> CS	ACK PDU		
3	CE <-- CS	ACK-UNSEG-DATA PDU		
4	CE --> CS	ACK PDU		

7.2.2.11.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement number	X

7.2.2.11.3.5 Expected results

Step 2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgement number	'00 C8'

Step 4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgement number	'00 C9'

8 Test cases - Exchange of data

All subsections "Initial conditions" described into section 8 refer to annex B for connection establishement. Test operator is responsible to apply passive or active connection establishment according to the CE capabilities.

Test operator is responsible for the verification of SDU data received by CE. This can be done by comparing SDU data sent by CS with the SDU data returned by CE in response to a receive request. This comparison is applicable whenever the test step indicates that CE signals to the test operator 'SDU available'. The test fails if the SDU data from CE does not match the SDU data from CS.

According to TS 102 127 [1] re-assembly of PDU is mandatory, whereas the segmentation of SDU implementation dependent. Therefore testing of re-assembly is mandatory in this specification and the testing of SDU segmentation is mandatory if CE supports segmentation.

Depending on CE implementation, the CE may only send one ACK PDU to acknowledge several received PDUs (known as cumulative acknowledgement). This usually happens when several (data or NUL) PDUs are recievd by the CE before the CE has had the opportunity to send out an ACK PDU. Under such circumstances, there are two possible behaviour that conform to TS 102 127 [1]. In the first case, the CE sends a cumulative ACK PDU. In the second case, the CE sends an ACK PDU for each (data or NUL) PDU received. For consistency in the test cases unless stated otherwise, the CS shall always wait for the acknowledgement of the previous data or NUL PDU before sending the next data or NUL PDU.

8.1 Common test cases in OPEN state

This section is used to test CE that supports any window size.

8.1.1 Exchange of non-segmented data

When test operator wants to send a non-segmented PDU, he shall take care of the MaxPDUSize of CE and CS.

8.1.1.1 Nominal cases

8.1.1.1.1 Bidirectional exchange of in-sequence data PDUs

8.1.1.1.1.1 Conformance requirements

- Sequence number clause 5.3.2.1
- Header flags combinations clause 5.12
- OPEN state PDU arrival event processing clause 5.4.2.2

8.1.1.1.1.2 Test purpose

To verify that:

- the sequence number of ACK-DATA PDU is post-incremented by CE,
- the ACK-DATA PDU are positively acknowledged,
- the sequence number of ACK PDUs is not incremented.
- Acknowledgement and issue of data at the same time (optionally)

8.1.1.1.1.3 Methods of test

8.1.1.1.1.3.1 Scenario

Time	State	CE		CS
1.	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=0>	--->	
2.	OPEN		<---	<SEQ=201><ACK=X+1><ACK><SEG=0>
3.	OPEN	<SEQ=X+2><ACK=200><ACK,Data><SEG=0>	--->	
4.	OPEN		<---	<SEQ=201><ACK=X+2><ACK,Data><SEG=0>
5.	OPEN	<SEQ=X+3><ACK=201><ACK><SEG=0>	--->	
6.	OPEN		<---	<SEQ=202><ACK=X+3><ACK,Data><SEG=0>
7.	OPEN	<SEQ=X+3><ACK=202><ACK><SEG=0> (optional)	--->	
8.	OPEN	<SEQ=X+3><ACK=202><ACK,Data><SEG=0>	--->	
9.	OPEN		<---	<SEQ=203><ACK=X+3><ACK><SEG=0>

8.1.1.1.1.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.1.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues a send data request to CE	
1	CE -> CS	ACK-UNSEG-DATA PDU		
2	CE <- CS	ACK PDU		
2a			Test operator issues a send data request to CE	
3	CE -> CS	ACK-UNSEG-DATA PDU		
4a	CE <- CS	ACK-UNSEG-DATA PDU		
4b			CE signals to the test operator 'SDU available'	*This step may take place after step 5, in which case the PDU in step 6a shall only be issued after the reception of "SDU available" signal.*
5	CE -> CS	ACK PDU		
6a	CE <- CS	ACK-UNSEG-DATA PDU		
6b			CE signals to the test operator 'SDU available'	*This step may take place after step 7, in which case the request in step 7a shall only be issued after the reception of "SDU available" signal.*
7	CE -> CS	ACK PDU		This step is optional depending on the implementation of CE
7a			Test operator issues a send data request to CE	
8	CE -> CS	ACK-UNSEG-DATA PDU		
9	CE <- CS	ACK PDU		

8.1.1.1.1.3.4 Specific message content

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

Step 4a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+2

Step 6a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+3

Step9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+3

8.1.1.1.1.3.5 Expected results

Step1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C8'

Step 4b: Test operator checks that CE signals 'SDU available'.Step5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+3
13 - 14	Acknowledgment Number	'00 C9'

Step 6b: Test operator checks that CE signals 'SDU available'.Step7: ACK PDU (optional)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+3
13 - 14	Acknowledgment Number	'00 CA'

Step8: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+3
13 - 14	Acknowledgment Number	'00 CA'

Test operator shall check that CE delivers the different value of the data field to the upper layer.

8.1.1.1.2 Handling of NUL-ACK PDUs during reception of data PDUs

8.1.1.1.2.1 Conformance requirements

- NUL PDU clause 5.11.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.1.2.2 Test purpose

To verify that:

- the NUL-ACK PDU is acknowledged and discarded.

8.1.1.1.2.3 Methods of test

8.1.1.1.2.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data><SEG=0>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN		<---	<SEQ=202><ACK=X><NUL,ACK><SEG=0>
4.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
5.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data><SEG=0>
6.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	

8.1.1.1.2.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.1.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1a	CE <- CS	ACK-UNSEG-DATA PDU		
1b			CE signals to the test operator 'SDU available'	
1c			Test operator issues a receive request to CE and verify content of data	
2	CE -> CS	ACK PDU		
3	CE <- CS	NUL-ACK PDU		
4	CE -> CS	ACK PDU		
5a	CE <- CS	ACK-UNSEG-DATA PDU		
5b			CE signals to the test operator 'SDU available'	
5c			Test operator issues a receive request to CE and verify content of data	
6	CE -> CS	ACK PDU		

8.1.1.1.2.3.4 Specific message content

Step 1a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 1c: Test operator issues a receive request and checks content of data returned

Step3: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 5a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step 5c: Test operator issues a receive request and checks content of data returned

8.1.1.1.2.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 5b: Test operator checks that CE signals 'SDU available'.

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

8.1.1.1.3 Bidirectional exchange of in-sequence PDUs on 2 different connections

8.1.1.1.3.1 Conformance requirements

- CAT-TP connection management clause 5.3.1.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.1.3.2 Test purpose

To verify that CE is able to send/receive data on 2 different CAT-TP links.

8.1.1.1.3.3 Methods of test

8.1.1.1.3.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	Link#1 <SEQ=201><ACK=X><ACK,Data><SEG=0>
2.	OPEN	Link#1 <SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN	Link#1 <SEQ=X+1><ACK=201><ACK,Data><SEG=0>	--->	
4.			<---	Link#1 <SEQ=202><ACK=X+1><ACK>
5.	OPEN		<---	Link#2 <SEQ=201><ACK=Y><ACK,Data><SEG=0>
6.	OPEN	Link#2 <SEQ=Y+1><ACK=201><ACK>	--->	
7.	OPEN	Link#2 <SEQ=Y+1><ACK=201><ACK,Data><SEG=0>	--->	
8.			<---	Link#2 <SEQ=202><ACK=Y+1><ACK>
9.	OPEN		<---	Link#1 <SEQ=202><ACK=X+1><ACK,Data><SEG=0>
10.	OPEN	Link#1 <SEQ=X+1><ACK=202><ACK>	--->	
11.	OPEN		<---	Link#2 <SEQ=202><ACK=Y+1><ACK,Data><SEG=0>
12.	OPEN	Link#2 <SEQ=Y+2><ACK=202><ACK>	--->	

NOTE: Y is the initial sequence number of CE on Link #2.

8.1.1.1.3.3.2 Initial conditions

The test operator has to perform the following according to the capabilities of CE:

- Scenario 1: two open active requests (refer to annex B)
- Scenario 2: two open passive requests (refer to annex B)

With these values for the local port: Link#1 -> CE_PORT and Link#2 -> CE_PORT_2=CE_PORT+/-1.

8.1.1.1.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1a	CE <- CS	ACK-UNSEG-DATA PDU		*Link#1*
1b			CE signals to the test operator 'SDU available'	*This step may take place after step 2, in which case the request in step 3 shall only be issued after the reception of "SDU available" signal.*
1c			Test operator issues a receive request to CE and verify content of data	
2	CE -> CS	ACK PDU		*Link#1*
3	CE -> CS	ACK-UNSEG-DATA PDU	Test operator issues a send data request	*Link#1*
4	CE <- CS	ACK PDU		*Link#1*
5a	CE <- CS	ACK-UNSEG-DATA PDU		*Link#2*
5b			CE signals to the test operator 'SDU available'	*This step may take place after step 6, in which case the request in step 7 shall only be issued after the reception of "SDU available" signal.*
5c			Test operator issues a receive request to CE and verify content of data	
6	CE -> CS	ACK PDU		*Link#2*
7	CE -> CS	ACK-UNSEG-DATA PDU	Test operator issues a send data request	*Link#2*
8	CE <- CS	ACK PDU		*Link#2*
9a	CE <- CS	ACK-UNSEG-DATA PDU		*Link#1*
9b			CE signals to the test operator 'SDU available'	*This step may take place after step 10, in which case the PDU in step 11a shall only be issued after the reception of "SDU available" signal.*
9c			Test operator issues a receive request to CE and verify content of data	
10	CE -> CS	ACK PDU		*Link#1*
11a	CE <- CS	ACK-UNSEG-DATA PDU		*Link#2*
11b			CE signals to the test operator 'SDU available'	*This step may take place after step 12.*
11c			Test operator issues a receive request to CE and verify content of data	
12	CE -> CS	ACK PDU		*Link21*

8.1.1.1.3.3.4 Specific message content

Step 1a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 1c: Test operator issues a receive request and checks content of data returned

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1

Step 5a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
7 - 8	Destination Port	CE_PORT_2
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	Y

Step 5c: Test operator issues a receive request and checks content of data returned

Step8: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
7 - 8	Destination Port	CE_PORT_2
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	Y+1

Step 9a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1

Step 9c: Test operator issues a receive request and checks content of data returned

Step 11a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
7 - 8	Destination Port	CE_PORT_2
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	Y+1

Step 11c: Test operator issues a receive request and checks content of data returned

8.1.1.1.3.3.5 Expected results

Step 1b: Test operator checks that CE signals 'SDU available'.

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 5b: Test operator checks that CE signals 'SDU available'.

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source Port	CE_PORT_2
11 - 12	Sequence Number	Y+1
13 - 14	Acknowledgment Number	'00 C9'

Step7: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source Port	CE_PORT_2
11 - 12	Sequence Number	Y+1
13 - 14	Acknowledgment Number	'00 C9'

Step 9b: Test operator checks that CE signals 'SDU available'.

Step10: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 11b: Test operator checks that CE signals 'SDU available'.

Step12: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source Port	CE_PORT_2
11 - 12	Sequence Number	Y+2
13 - 14	Acknowledgment Number	'00 CA'

8.1.1.1.4 Handling of window size = 0

8.1.1.1.4.1 Conformance requirements

- Flow control and window management clause 5.3.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.1.4.2 Test purpose

Check that CE stops the exchange of data when the peer entity announces a window size of 0:

8.1.1.1.4.3 Methods of test

8.1.1.1.4.3.1 Scenario

```
                              CE                                              CS
Time     State
0.       OPEN
1.       OPEN    <SEQ=X+1><ACK=200><ACK, Data><SEG=0>          --->
2.       OPEN                                                  <---    <SEQ=201><ACK=X+1/0>
3.       OPEN
4.                                                             <---    <SEQ=201><ACK=X+1/3><NUL,ACK>
5.       OPEN    <SEQ=X+2><ACK=201><ACK><SEG=0> (optional)     --->
6.       OPEN    <SEQ=X+2><ACK=201><ACK, Data><SEG=0>          --->
7.       OPEN                                                  <---    <SEQ=202><ACK=X+2/3><ACK, Data><SEG=0>
8.       OPEN    <SEQ=X+3><ACK=202><ACK><SEG=0>                --->
```

8.1.1.1.4.3.2 Initial conditions

8.1.1.1.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues a send data request	
1	CE -> CS	ACK-UNSEG-DATA PDU		
2	CE <- CS	ACK PDU		*CS announces Window size = 0*
3			Test operator issues a send data request	The communication is temporarily blocked until CS announces a window size greater than 0
4	CE <- CS	NUL-ACK PDU		*CS announces a reopening of its window*
5	CE -> CS	ACK PDU		*optional*
6	CE -> CS	ACK-UNSEG-DATA PDU		
7a	CE <- CS	ACK-UNSEG-DATA PDU		
7b			CE signals to the test operator 'SDU available'	*This step may take place after step 8.*
7c			Test operator issues a receive request to CE and verify content of data	
8	CE -> CS	ACK PDU		

8.1.1.1.4.3.4 Specific message content

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1
15 - 16	Window Size	0

Step4: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1
15 - 16	Window Size	3

Step 7a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+2
15 - 16	Window Size	3

Step 7c: Test operator issues a receive request and checks content of data returned

8.1.1.1.4.3.5 Expected results

Step1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step5: ACK PDU (optional)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

Step6: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

Step 7b: Test operator checks that CE signals 'SDU available'.

Step8: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+3
13 - 14	Acknowledgment Number	'00 CA'

8.1.1.1.5 Retransmission of NUL-ACK after closing of window

8.1.1.1.5.1 Conformance requirements

- Positive acknowledgement clause 5.3.2.3.
- Flow control and window management clause 5.3.3.

8.1.1.1.5.2 Test purpose

Check that:

- CE shall acknowledge the PDUs out of sequence (extended or non-cumulative acknowledgement),
- CE accepts PDUs in sequence that falls within the acceptance window.
- CE shall acknowledge NUL-ACK PDU even while its window size is 0.

8.1.1.1.5.3 Methods of test

8.1.1.1.5.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
...	OPEN	Repetition N times of step 1 and 2 until the window size announced by CE equals to 1		
3+(2xN).	OPEN		<---	<SEQ=(201+N)><ACK=X><ACK,Data>
4+(2xN).	OPEN	<SEQ=X+1><ACK=(201+N)/0><ACK>	--->	
5+(2xN).	OPEN		<---	<SEQ=(202+N)><ACK=X><NUL,ACK>
6+(2xN).	OPEN	<SEQ=X+1><ACK=202+N/0><ACK>	--->	
7+(2xN).	OPEN	<SEQ=X+1><ACK=202+N/W><NUL,ACK>	--->	
8+(2xN).	OPEN		<---	(No ACK)
9+(2xN).	OPEN	<SEQ=X+1><ACK=202+N/W><NUL,ACK>(first retransmission)	--->	
10+(2xN).	OPEN		<---	<SEQ=(203+N)><ACK=X+1><ACK>

8.1.1.1.5.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.1.5.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2a			CE signals to the test operator 'SDU available'	
2b	CE -> CS	ACK PDU		
(Step1&2)xN				*N Repeat step1 and 2.*
3+(2xN)(a)	CE <- CS	ACK-UNSEG-DATA PDU		
3+(2xN)(b)			CE signals to the test operator 'SDU available'	
4+(2xN)	CE -> CS	ACK PDU		*Window size = 0*
5+(2xN)	CE <- CS	NUL-ACK PDU		
6+(2xN)(a)	CE -> CS	ACK PDU		*Window size = 0*
6+(2xN)(b)			Test operator issues receive request to CE.	
7+(2xN)	CE -> CS	NUL-ACK PDU		*Window size = W*
8+(2xN)				*No ACK PDU sent*
9+(2xN)	CE -> CS	NUL-ACK PDU		*First retransmission*
10+(2xN)	CE <- CS	ACK PDU		

8.1.1.1.5.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 3+(2xN)(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9' + N
13 - 14	Acknowledgment Number	X

Step 5+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA' + N
13 - 14	Acknowledgment Number	X

Step 6+(2xN)(b): Test operator issues a receive request and checks content of data returned

Step 10+(2xN) : ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'+N
13 - 14	Acknowledgment Number	X+1

8.1.1.1.5.3.5 Expected results

Step 2a: Test operator checks that CE signals 'SDU available'.

Step2b: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 4+(2xN): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9' + N
15 - 16	Window Size	0

Step 6+(2xN)(a): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + N
15 - 16	Window Size	0

Step 7+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + N
15 - 16	Window Size	W

Step 9+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + N
15 - 16	Window Size	W

8.1.1.2 Non-nominal cases

8.1.1.2.1 Handling of incoming data PDU with its sequence number out of the window boundaries

8.1.1.2.1.1 Conformance requirements

- Flow control and window management clause 5.3.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.2.1.2 Test purpose

To verify that CE discards the incoming data PDU with its sequence number out of the window boundaries and issues an ACK PDU.

8.1.1.2.1.3 Methods of test

Test operator shall use the maximum window size declared by CE as the value of W.

8.1.1.2.1.3.1 Scenario

```
                                    CE                                                   CS
Time       State
1.         OPEN                        (PDU discarded)    <---    <SEQ=202+W><ACK=X><ACK,Data><SEG=0>
2.         OPEN    <SEQ=X+1><ACK=200/W><ACK>              --->
3.         OPEN                        (PDU discarded)    <---    <SEQ=200><ACK=X><ACK,Data><SEG=0>
4.         OPEN    <SEQ=X+1><ACK=200/W><ACK>              --->
5.         OPEN                                           <---    <SEQ=201><ACK=X><ACK,Data><SEG=0>
6.         OPEN    <SEQ=X+1><ACK=201><ACK>                --->
```

8.1.1.2.1.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.2.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		*PDU is discarded*
2	CE -> CS	ACK PDU		
3	CE <- CS	ACK-UNSEG-DATA PDU		*PDU is discarded*
4	CE -> CS	ACK PDU		
5a	CE <- CS	ACK-UNSEG-DATA PDU		
5b			CE signals to the test operator 'SDU available'	*This step may take place after step 6.*
6	CE -> CS	ACK PDU		

8.1.1.2.1.3.4 Specific message content

Step1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA' + W
13 - 14	Acknowledgment Number	X

Step3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

Step 5a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

8.1.1.2.1.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
15 - 16	Window Size	W

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
15 - 16	Window Size	W

Step 5b: Test operator checks that CE signals 'SDU available'.

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

8.1.1.2.2 Handling of incoming damaged PDU

8.1.1.2.2.1 Conformance requirements

- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.2.2.2 Test purpose

To verify that CE discards any damaged PDUs.

8.1.1.2.2.3 Methods of test

8.1.1.2.2.3.1 Scenario

```
                        CE                                                          CS
Time   State
1.     OPEN                                      <---    <SEQ=201><ACK=X><ACK,Data><SEG=0>
2.     OPEN    <SEQ=X+1><ACK=201><ACK>           --->
3.     OPEN               (discarded)            <---    DAMAGED PDU
4.     OPEN                                      <---    <SEQ=203><ACK=X><ACK,Data><SEG=0>
5.     OPEN    <SEQ=X+1><ACK=203><ACK>           --->
```

With DAMAGED PDU:

- Invalid PDU types (e.g. SYN and RST both set);
- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);
- PDU length as received from the lower layer does not match sum of header and data length;
- Wrong checksum;
- Size of PDU exceeds maximum acceptable PDU size (RCV_PDU_SIZE_MAX).

8.1.1.2.2.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.2.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1a	CE <- CS	ACK-UNSEG-DATA PDU		
1b			CE signals to the test operator 'SDU available'	*This step may take place after step 2, in which case the PDU in step 3 shall only be issued after the reception of "SDU available" signal.*
1c			Test operator issues a receive request to CE and verify content of data	
2	CE -> CS	ACK PDU		
3	CE <- CS	DAMAGED PDU		*(discarded)*
4a	CE <- CS	ACK-UNSEG-DATA PDU		
4b			CE signals to the test operator 'SDU available'	*This step may take place after step 5.*
4c			Test operator issues a receive request to CE and verify content of data	
5	CE -> CS	ACK PDU		

8.1.1.2.2.3.4 Specific message content

Step 1a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 1c: Test operator issues a receive request and checks content of data returned

Step3: DAMAGED PDU

- Invalid PDU types (e.g. SYN and RST both set);

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field).

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	odd number
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum;

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	Different from the correct checksum
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX (only applicable when Max PDU Size announced by CE is smaller than 'FFFF').

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapt to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

Step 4a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1

Step 4c: Test operator issues a receive request and checks content of data returned

8.1.1.2.2.3.5 Expected results

Step 1b: Test operator checks that CE signals 'SDU available'.

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 4b: Test operator checks that CE signals 'SDU available'.

Step5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

8.1.1.2.3 Retransmission of unacknowledged data PDU

8.1.1.2.3.1 Conformance requirements

- Retransmission timeout clause 5.3.2.4.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.2.3.2 Test purpose

To verify that CE is able to re-issue the ACK-UNSEG-DATA PDU as long as the retransmission counter is smaller than its maximum value.

8.1.1.2.3.3 Methods of test

8.1.1.2.3.3.1 Scenario

```
                          CE                                                   CS
Time  State
1.    OPEN    <SEQ=X+1><ACK=200><ACK,Data>       --->
2.    OPEN    <SEQ=X+1><ACK=200><ACK,Data>       --->
              (first retransmission)
…                                                --->
N-1   OPEN    <SEQ=X+1><ACK=200><ACK,Data>       --->
              (N-1 retransmission)
N.    OPEN    <SEQ=X+1><ACK=200><ACK,Data>       --->
              (N retransmission)
N+1.  OPEN                                       <---   <SEQ=201><ACK=X+1><ACK>
                                                        (send ACK before retransmission timeout reached)
N+2.  OPEN    <SEQ=X+2><ACK=201><ACK,Data>       --->
```

NOTE: N is the number of retries annouced by CE.

8.1.1.2.3.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.
- The maximum number of retries N has to be supplied by the CE.
- The counter k is used to keep track of the reception of ACK PDU. Initial value is 0.

8.1.1.2.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues send data request	
1	CE -> CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK-UNSEG-DATA PDU		*Increment k each time a ACK-UNSEG-DATA PDU is received. CS shall not acknowledge ACK-UNSEG-DATA PDU.*
…	CE -> CS	ACK-UNSEG-DATA PDU		
N-1	CE -> CS	ACK-UNSEG-DATA PDU		
N	CE -> CS	ACK-UNSEG-DATA PDU		*Last attempt*
N+1	CE <- CS	ACK PDU		*Send ACK before retransmission timeout reached*
			Test operator issues send data request	
N+2	CE -> CS	ACK-UNSEG-DATA PDU		

8.1.1.2.3.3.4 Specific message content

StepN+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

8.1.1.2.3.3.5 Expected results

Step1 to N: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Increment k each time that a ACK-UNSEG-DATA PDU is sent from step2 to stepN.

At the end of step N, CS checks that the last value of k is equal to the maximum number of retries provided by the CE. If not, the test is considered as failed.

StepN+2: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

8.1.1.2.4 Reception of Send NUL request during out-of-sequence data reception

8.1.1.2.4.1 Conformance requirements

CE shall support the reception of out-of-sequence data PDUs as specified in clause 5.4.2.2 of the TS 102 127 [1].

CE shall support the sending of NUL-ACK PDU after it receives send NUL request in OPEN state according to figure 21a of TS 102 127 [1].

8.1.1.2.4.2 Test purpose

To verify that CE after receiving send NUL request and out-of-sequence data PDU, sends NUL-EACK PDU to CS.

8.1.1.2.4.3 Methods of test

8.1.1.2.4.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X+1><ACK, Data><SEG=0>
2.	OPEN	<SEQ=X+1><ACK=201/W><ACK>	--->	
3.	OPEN		<---	<SEQ=203><ACK=X+1><ACK, Data><SEG=0>
4.	OPEN	<SEQ=X+1><ACK=201><EACK=203><ACK,EACK>	--->	
5	OPEN	<SEQ=X+1><ACK=201><EACK=203><ACK,EACK,NUL>	--->	

8.1.1.2.4.3.2 Initial conditions

CE is in OPEN state.

8.1.1.2.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK PDU		
3	CE <- CS	ACK-UNSEG-DATA PDU		
4	CE -> CS	ACK-EACK PDU		
5			Test operator issues a send NUL request	
6	CE -> CS	NUL-EACK PDU		

8.1.1.2.4.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	00 C9
13 - 14	Acknowledgment Number	'X+1'

Step 3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	00 CB
13 - 14	Acknowledgment Number	'X+1'

Step 5: Test operator issues "Send NUL" request.

8.1.1.2.4.3.5 Expected results

Step 2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	"00 C9"

Step 4: EACK-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	"00 C9"
19 - 20	Sequence Number (for out of sequence entries)	"00 CB"

Step 4: NUL-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	"00 C9"
19 - 20	Sequence Number (for out of sequence entries)	"00 CB"

8.1.1.2.5 Handling of incoming data PDU with its sequence number out of the window boundaries

8.1.1.2.5.1 Conformance requirements

- Flow control and window management clause 5.3.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.2.5.2 Test purpose

Check that CE discards SYN PDUs with sequence number out of window boundaries while in OPEN state.

8.1.1.2.5.3 Methods of test

8.1.1.2.5.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data><SEG=0>
2.	OPEN	<SEQ=X+1><ACK=201/W><ACK>	--->	
3.	OPEN	(PDU discarded)	<---	<SEQ=200><SYN>
4.	OPEN	<SEQ=X+1><ACK=201/W><ACK>	--->	
5.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data><SEG=0>
6.	OPEN	<SEQ=X+1><ACK=202/W><ACK>	--->	
7.	OPEN	(PDU discarded)	<---	<SEQ=204+W><SYN>
8.	OPEN	<SEQ=X+1><ACK=202/W><ACK>	--->	
9.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data><SEG=0>
10.	OPEN	<SEQ=X+1><ACK=203/W><ACK>	--->	

8.1.1.2.5.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.2.5.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2			CE signals to the test operator 'SDU available'	*This step may take place after step 3.*
3	CE -> CS	ACK PDU		
4			*Test operator issues receive request upon get the signal "SDU available"*	
5	CE <- CS	SYN PDU		*PDU is discarded*
6	CE -> CS	ACK PDU		
7	CE <- CS	ACK-UNSEG-DATA PDU		
8			CE signals to the test operator 'SDU available'	*This step may take place after step 6.*
9	CE -> CS	ACK PDU		
10			*Test operator issues receive request upon get the signal "SDU available"*	
11	CE <- CS	SYN PDU		*PDU is discarded*
12	CE -> CS	ACK PDU		
13	CE <- CS	ACK-UNSEG-DATA PDU		
14			CE signals to the test operator 'SDU available'	*This step may take place after step 6.*
15	CE -> CS	ACK PDU		
16			*Test operator issues receive request upon get the signal "SDU available"*	

8.1.1.2.5.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 5: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

Step 7: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 11: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC'+W
13 - 14	Acknowledgment Number	X

Step 13: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

8.1.1.2.5.3.5 Expected results

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	W

After step 1: Test operator checks that CE signals 'SDU available'.

Step 6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	W

After step 7: Test operator checks that CE signals 'SDU available'.

Step 9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CA'
15 - 16	Window Size	W

Step 12: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CA'
15 - 16	Window Size	W

After step 13: Test operator checks that CE signals 'SDU available'.

Step 9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CB'
15 - 16	Window Size	W

8.1.1.2.6 Handling of SYN-ACK PDU with its sequence number out of the window boundaries

8.1.1.2.6.1 Conformance requirements

- Flow control and window management clause 5.3.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.1.2.6.2 Test purpose

Check that CE discards SYN-ACK PDUs with sequence number out of window boundaries while in OPEN state.

8.1.1.2.6.3 Methods of test

8.1.1.2.6.3.1 Scenario

	CE			CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data><SEG=0>
2.	OPEN	<SEQ=X+1><ACK=201/W><ACK>	--->	
3.	OPEN	(PDU discarded)	<---	<SEQ=200><SYN,ACK>
4.	OPEN	<SEQ=X+1><ACK=201/W><ACK>	--->	
5.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data><SEG=0>
6.	OPEN	<SEQ=X+1><ACK=202/W><ACK>	--->	
7.	OPEN	(PDU discarded)	<---	<SEQ=204+W><SYN,ACK>
8.	OPEN	<SEQ=X+1><ACK=202/W><ACK>	--->	
9.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data><SEG=0>
10.	OPEN	<SEQ=X+1><ACK=203/W><ACK>	--->	

8.1.1.2.6.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.2.6.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2			CE signals to the test operator 'SDU available'	*This step may take place after step 3.*
3	CE -> CS	ACK PDU		
4			*Test operator issues receive request upon get the signal "SDU available"*	
5	CE <- CS	SYN-ACK PDU		*PDU is discarded*
6	CE -> CS	ACK PDU		
7	CE <- CS	ACK-UNSEG-DATA PDU		
8			CE signals to the test operator 'SDU available'	*This step may take place after step 6.*
9	CE -> CS	ACK PDU		
10			*Test operator issues receive request upon get the signal "SDU available"*	
11	CE <- CS	SYN-ACK PDU		*PDU is discarded*
12	CE -> CS	ACK PDU		
13	CE <- CS	ACK-UNSEG-DATA PDU		
14			CE signals to the test operator 'SDU available'	*This step may take place after step 6.*
15	CE -> CS	ACK PDU		
16			*Test operator issues receive request upon get the signal "SDU available"*	

8.1.1.2.6.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 5: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

Step 7: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 11: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC'+W
13 - 14	Acknowledgment Number	X

Step 13: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

8.1.1.2.6.3.5 Expected results

Step 3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	W

After step 1: Test operator checks that CE signals 'SDU available'.

Step 6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	W

After step 7: Test operator checks that CE signals 'SDU available'.

Step 9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CA'
15 - 16	Window Size	W

Step 12: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CA'
15 - 16	Window Size	W

After step 13: Test operator checks that CE signals 'SDU available'.

Step 9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X
13 - 14	Acknowledgment Number	'00 CB'
15 - 16	Window Size	W

8.1.1.2.7 Receive request while no data available

8.1.1.2.7.1 Conformance requirements

- Receive request in OPEN state clause 5.4.1.3, figure 17.

8.1.1.2.7.2 Test purpose

To verify that CE returns with no data to the upper layer when no SDU data is available.

8.1.1.2.7.3 Methods of test

8.1.1.2.7.3.1 Scenario

None.

8.1.1.2.7.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.1.2.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1			Test operator issues receive data request	*No data available*

8.1.1.2.7.3.4 Specific message content

Step 1: Test operator issues receive data request.

8.1.1.2.7.3.5 Expected results

CE returns to the upper layer with no data.

8.1.2 Exchange of data with segmentation

8.1.2.1 Nominal cases

8.1.2.1.1 Handling of in-sequence data PDUs

8.1.2.1.1.1 Conformance requirements

- CAT_TP segmentation management clause 5.2.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.2.1.1.2 Test purpose

Check that :

- CE acknowledges segmented PDUs.
- CE shall pass to upper layer the reassembled SDU.
- CE shall be able to handle data PDUs smaller than the MaxPDU size.

8.1.2.1.1.3 Methods of test

8.1.2.1.1.3.1 Scenario

```
                          CE                                                       CS
Time  State
1.    OPEN                                   <---    <SEQ=201><ACK=X><ACK,Data1_k><SEG=1>
2.    OPEN   <SEQ=X+1><ACK=201><ACK>         --->
…
N                                            <---    <SEQ=200+k-1><ACK=X><ACK,Datak-1_k><SEG=1>
N+1.  OPEN   <SEQ=X+1><ACK=200+k-1><ACK>     --->
N+2.  OPEN                                   <---    <SEQ=200+k><ACK=X><ACK,Datak_k><SEG=0>
N+3.  OPEN   <SEQ=X+1><ACK=200+k><ACK>       --->
```

k is the number of PDUs to be issued, SDU=k x PDU.

8.1.2.1.1.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.1.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1a	CE <- CS	ACK-SEG-DATA PDU		*PDU#1*
1b			CE signals to the test operator 'SDU available'	
1c			Test operator issues a receive request to CE and verify content of data	
2	CE -> CS	ACK PDU		
…				
N(a)	CE <- CS	ACK-SEG-DATA PDU		*PDU#(k-1)*
N(b)			CE signals to the test operator 'SDU available'	
N(c)			Test operator issues a receive request to CE and verify content of data	
N+1	CE -> CS	ACK PDU		
N+2(a)	CE <- CS	ACK-UNSEG-DATA PDU		*PDU#k*
N+2(b)			CE signals to the test operator 'SDU available'	
N+2(c)			Test operator issues a receive request to CE and verify content of data	
N+3	CE -> CS	ACK PDU		

Test operator shall run the test twice with the following sets of values:

Case A:

SDU size issued by CS = k x (MaxPDU size of CE), where k is chosen such that k x (MaxPDU size of CE) < MaxSDU size of CE

Case B:

SDU size issued by CS = k x PDUsize, where PDUsize < MaxPDUsize and k is chosen such that k x PDU size < MaxSDU size of CE

8.1.2.1.1.3.4 Specific message content

Step1a: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 1c: Test operator issues a receive request and checks content of data returned

Step N(a): ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'C8+k-1'
13 - 14	Acknowledgment Number	X

Step N(c): Test operator issues a receive request and checks content of data returned

Step N+2(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'C8+k'
13 - 14	Acknowledgment Number	X

Step N+2(c): Test operator issues a receive request and checks content of data returned

8.1.2.1.1.3.5 Expected results

Step 1b: Test operator checks that CE signals 'SDU available'.

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step N(b): Test operator checks that CE signals 'SDU available'.

Step N+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'C8'+k-1

Step N+2(b): Test operator checks that CE signals 'SDU available'.

Step N+3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'C8'+k

8.1.2.1.2 Handling of NUL-ACK PDUs during reception of data PDUs

8.1.2.1.2.1 Conformance requirements

- CAT_TP segmentation management clause 5.2.3.
- NUL PDU clause 5.11.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.2.1.2.2 Test purpose

Check that :

- NUL-ACK PDUs have no impact on reassembly,
- CE acknowledges segmented PDUs.
- CE shall pass to the upper layer the reassembled SDU.

8.1.2.1.2.3 Methods of test

8.1.2.1.2.3.1 Scenario

```
                         CE                                                   CS
Time   State
1.     OPEN                                <---    <SEQ=201><ACK=X><ACK,Data1_3><SEG=1>
2.     OPEN    <SEQ=X+1><ACK=201><ACK>     --->
3.     OPEN                                <---    <SEQ=202><ACK=X><NUL,ACK><SEG=0>
4.     OPEN    <SEQ=X+1><ACK=202><ACK>     --->
5.     OPEN                                        <--- <SEQ=203><ACK=X><ACK,Data2_3><SEG=1>
6.     OPEN    <SEQ=X+1><ACK=203><ACK>     --->
7.     OPEN                                <---    <SEQ=204><ACK=X><NUL,ACK><SEG=0>
8.     OPEN    <SEQ=X+1><ACK=204><ACK>     --->
9.     OPEN                                <---    <SEQ=205><ACK=X><ACK,Data3_3><SEG=0>
10.    OPEN    <SEQ=X+1><ACK=205><ACK>     --->
```

8.1.2.1.2.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.1.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		*PDU#1*
2	CE -> CS	ACK PDU		
3	CE <- CS	NUL-ACK PDU		
4	CE -> CS	ACK PDU		
5	CE <- CS	ACK-SEG-DATA PDU		*PDU#2*
6	CE -> CS	ACK PDU		
7	CE <- CS	NUL-ACK PDU		
8	CE -> CS	ACK PDU		
9a	CE <- CS	ACK-UNSEG-DATA PDU		*PDU#3*
9b			CE signals to the test operator 'SDU available'	
9c			Test operator issues a receive request to CE and verify content of data	
10	CE -> CS	ACK PDU		

8.1.2.1.2.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step3: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step5: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step3: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC'
13 - 14	Acknowledgment Number	X

Step 9a: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CD'
13 - 14	Acknowledgment Number	X

Step 9c: Test operator issues a receive request and checks content of data returned

8.1.2.1.2.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step8: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CC'

Step 9b: Test operator checks that CE signals 'SDU available'.

Step10: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CD'

8.1.2.1.3 Segmentation of outgoing data PDUs

8.1.2.1.3.1 Conformance requirements

- CAT_TP segmentation management clause 5.2.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.2.1.3.2 Test purpose

Check that CE is able to segment a SDU when its size exceeds the MaxPDUSize.

8.1.2.1.3.3 Methods of test

8.1.2.1.3.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=1>	--->	
2.	OPEN		<---	<SEQ=201><ACK=X+1><ACK>
...		Repeat step1 and step2 as many time as necessary		
N.	OPEN	<SEQ=X+k><ACK=200><ACK,Data><SEG=1>	--->	
N+1.			<---	<SEQ=201><ACK=X+k><ACK>
N+2.	OPEN	<SEQ=X+k+1><ACK=200><ACK,Data><SEG=0>	--->	
N+3.	OPEN		<---	<SEQ=201><ACK=X+k+1><ACK>

k is the number of PDUs to be issued, SDU=k x PDU.

8.1.2.1.3.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.1.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues a send data request to CE	*SDU size shall be greater than maximum outgoing PDU size of CE*
1	CE -> CS	ACK-SEG-DATA PDU		*First PDU*
2	CE <- CS	ACK PDU		
…				*Number of PDU sent by CE depends on PDU and SDU size of CS and CE*
N	CE -> CS	ACK-SEG-DATA PDU		*One before last PDU*
N+1	CE <- CS	ACK PDU		
N+2	CE -> CS	ACK-UNSEG-DATA PDU		*Last PDU*
N+3	CE <- CS	ACK PDU		

8.1.2.1.3.3.4 Specific message content

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

StepN+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+k

StepN+3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+k+1

8.1.2.1.3.3.5 Expected results

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

StepN: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+k
13 - 14	Acknowledgment Number	'00 C8'

StepN+2: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+k+1
13 - 14	Acknowledgment Number	'00 C8'

8.1.2.1.4 Bidirectional exchange of segmented data

8.1.2.1.4.1 Conformance requirements

- CAT_TP segmentation management clause 5.2.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.2.1.4.2 Test purpose

Check that CE is able to issue and receive a segmented SDU concurrently.

8.1.2.1.4.3 Methods of test

8.1.2.1.4.3.1 Scenario

```
                                   CE                                                CS
Time   State
1.     OPEN    <SEQ=X+1><ACK=200><ACK,Data><SEG=1>          --->
2.     OPEN                                                 <---   <SEQ=201><ACK=X+1><ACK,Data><SEG=1>
...            Repeat step1 and step2 as many time as
               necessary
N.     OPEN    <SEQ=X+k-1><ACK=201+k-2><ACK,Data><SEG=1>    --->
N+1.                                                        <---   <SEQ=201+k-1><ACK=X+k-1><ACK,Data><SEG=1>
N+2.   OPEN    <SEQ=X+k<ACK=201+k-1><ACK,Data><SEG=0>       --->
N+3.   OPEN                                                 <---   <SEQ=201+k><ACK=X+k><ACK,Data><SEG=0>
N+4.   OPEN    <SEQ=X+k+1><ACK=201+k><ACK>                  --->
```

k is the number of PDUs to be issued, SDU = k x PDU.

8.1.2.1.4.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.1.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues send data request to CE	*SDU size shall be greater than maximum PDU size of CS*
1	CE -> CS	ACK-SEG-DATA PDU		*First PDU from CE*
2	CE <- CS	ACK-SEG-DATA PDU		*First PDU from CS*
…				*Number of PDU sent by CE depends on PDU and SDU size of CS and CE*
N	CE -> CS	ACK-SEG-DATA PDU		*One before last PDU*
N+1	CE <- CS	ACK-SEG-DATA PDU		
N+2	CE -> CS	ACK-UNSEG-DATA PDU		*Last PDU from CE*
N+3(a)	CE <- CS	ACK-UNSEG-DATA PDU		*Last PDU from CS*
N+3(b)			CE signals to the test operator 'SDU available'	*This step may take place after step N+4.*
N+4	CE -> CS	ACK PDU		

8.1.2.1.4.3.4 Specific message content

Step2: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

StepN+1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9' + k-1
13 - 14	Acknowledgment Number	X+k-1

Step N+3(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9' + k
13 - 14	Acknowledgment Number	X+k

8.1.2.1.4.3.5 Expected results

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

StepN: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+k-1
13 - 14	Acknowledgment Number	'00 C9' + k-2

StepN+2: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+k
13 - 14	Acknowledgment Number	'00 C9' + k-1

Step N+3 (b): Test operator checks that CE signals 'SDU available'.

StepN+4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+k+1
13 - 14	Acknowledgment Number	'00 C9' + k

8.1.2.2 Non-nominal cases

8.1.2.2.1 Handling of incoming damaged PDU

8.1.2.2.1.1 Conformance requirements

- CAT-TP segmentation management clause 5.2.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.1.2.2.1.2 Test purpose

Ensure that CE discards damaged PDUs during the exchange of segmented data.

8.1.2.2.1.3 Methods of test

8.1.2.2.1.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data1_3><SEG=1>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN	(PDU discarded)	<---	DAMAGED PDU
4.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data2_3><SEG=1>
5.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
6.	OPEN	(PDU discarded)	<---	DAMAGED PDU
7.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
8.	OPEN	(PDU discarded)	<---	<SEQ=203><ACK=X><ACK><SEG=0>
9.	OPEN		<---	<SEQ=203><ACK=X><Data3_3><SEG=0>
10.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	

With DAMAGED PDU:

- Invalid PDU types (e.g. SYN and RST both set);
- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);
- PDU length as received from the lower layer does not match sum of header and data length;
- Wrong checksum;
- Size of PDU exceeds maximum acceptable PDU size (RCV_PDU_SIZE_MAX).

8.1.2.2.1.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.2.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		*PDU#1*
2	CE -> CS	ACK PDU		
3	CE <- CS	DAMAGED PDU		*discarded*
4	CE <- CS	ACK-SEG-DATA PDU		*PDU#2*
5	CE -> CS	ACK PDU		
6	CE <- CS	DAMAGED PDU		*discarded*
7	CE -> CS	ACK PDU		
8	CE <- CS	ACK-SEG-DATA PDU		*No data*
9a	CE <- CS	ACK-SEG-DATA PDU		*PDU#3*
9b			CE signals to the test operator 'SDU available'	
9c			Test operator issues a receive request to CE and verify content of data	
10	CE -> CS	ACK PDU		

8.1.2.2.1.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

Step3: DAMAGED PDU

- Invalid PDU types (e.g. SYN and RST both set);

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	odd number
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	'0000'
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX **(only applicable when Max PDU Size announced by CE is smaller than 'FFFF')**.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapt to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

Step4: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X+1

Step6: DAMAGED PDU

- Invalid PDU types (e.g. SYN and RST both set).

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field).

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	odd number
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum;

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	'0000'
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX **(only applicable when Max PDU Size announced by CE is smaller than 'FFFF')**.

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapt to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

Step8: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1

Step 9a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X+1

Step 9c: Test operator issues a receive request and checks content of data returned

8.1.2.2.1.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 7: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 9b: Test operator checks that CE signals 'SDU available'.

Step10: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

8.1.2.2.2 Retransmission of unacknowledged data PDU

8.1.2.2.2.1 Conformance requirements

- Retransmission timeout clause 5.3.2.4.

8.1.2.2.2.2 Test purpose

To verify that CE is able to re-issue the ACK-SEG-DATA PDU as long as the retransmission counter is smaller than its maximum value.

8.1.2.2.2.3 Methods of test

8.1.2.2.2.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=1>	--->	
2.	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=1> (first retransmission)	--->	
…			--->	
N-1	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=1> (N-1 retransmission)	--->	
N.	OPEN	<SEQ=X+1><ACK=200><ACK,Data><SEG=1> (N retransmission)	--->	
N+1.	OPEN		<---	<SEQ=201><ACK=X+1><ACK>
N+2.	OPEN	<SEQ=X+2><ACK=201><ACK,Data><SEG=0>	--->	
N+3.	OPEN	<SEQ=X+2><ACK=201><ACK,Data><SEG=0> (first retransmission)	--->	
…			--->	
M-1	OPEN	<SEQ=X+2><ACK=201><ACK,Data><SEG=0> (N-1 retransmission)	--->	
M.	OPEN	<SEQ=X+2><ACK=201><ACK,Data><SEG=0> (N retransmission)	--->	
M+1.	OPEN		<---	<SEQ=201><ACK=X+2><ACK>

NOTE: N is the number of retries allowed by CE.

8.1.2.2.2.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.
- The maximum number of retries N has to be supplied by the CE.
- The counter k is used to keep track of the reception of ACK PDU. Initial value is 0.

8.1.2.2.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator shall issues send data request	
1	CE -> CS	ACK-SEG-DATA PDU		
2	CE -> CS	ACK-SEG-DATA PDU		*Increment k each time a ACK-SEG-DATA PDU is received. CS shall not acknowledge ACK-SEG-DATA PDU.*
…	CE -> CS	ACK-SEG-DATA PDU		
N-1	CE -> CS	ACK-SEG-DATA PDU		
N	CE -> CS	ACK-SEG-DATA PDU		*Last attempt*
N+1	CE <- CS	ACK PDU		*Send ACK before retransmission timeout reached*
N+2	CE -> CS	ACK-UNSEG-DATA PDU	Test operator shall issues send data request	*K is reset*
N+3	CE -> CS	ACK-UNSEG-DATA PDU		*Increment k each time a ACK-UNSEG-DATA PDU is received. CS shall not acknowledge ACK-UNSEG-DATA PDU.*
…	CE -> CS	ACK-UNSEG-DATA PDU		
M-1	CE -> CS	ACK-UNSEG-DATA PDU		
M	CE -> CS	ACK-UNSEG-DATA PDU		*Last attempt*
M+1	CE <- CS	ACK PDU		*Send ACK before retransmission timeout reached*

8.1.2.2.2.3.4 Specific message content

StepN+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

StepM+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+2

8.1.2.2.2.3.5 Expected results

Step1 to N: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

At the end of step N, test operator checks that the last value of k is equal to the maximum number of retries provided by the CE. If not, the test is considered as failed.

StepN+2 to M: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

At the end of step N, test operator checks that the last value of k is equal to the maximum number of retries provided by the CE. If not, the test is considered as failed.

8.1.2.2.3 Reception of an oversized segmented SDU

8.1.2.2.3.1 Conformance requirements

- Segmentation and re-assembly clause 5.2.1.

8.1.2.2.3.2 Test purpose

Verify that CE does not re-assembly an oversized SDU.

8.1.2.2.3.3 Methods of test

8.1.2.2.3.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data><SEG=1>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN	Repetition N times of step 1 and 2 (see note below)		
4.	OPEN		<---	<SEQ=201+N><ACK=X><ACK,Data><SEG=1>
5.	OPEN	<SEQ=X+1><ACK=201+N><ACK,data>	--->	

NOTE: NxPDU size sent by CS should be greater than Max SDU size announced by CE.

8.1.2.2.3.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.1.2.2.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		
2	CE -> CS	ACK PDU		
3				*Repetition N times of step 1 and 2*
4	CE <- CS	ACK-SEG-DATA PDU		
5	CE -> CS	ACK PDU		
6			Test operator should verify that no 'SDU available' is signalled by CE	*CE cannot re-assembly the oversized SDU*

8.1.2.2.3.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step4: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9' + N
13 - 14	Acknowledgment Number	X

8.1.2.2.3.3.5 Expected results

Step 2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 5: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9' + N

Step 6: Test operator should verify that no 'SDU available' is signalled by CE.

8.1.2.2.4 Reception of NUL-EACK PDU

8.1.2.2.4.1 Conformance requirements

CE shall support the handling of NUL and EACK PDUs as specified in clause 5.4.2.2 of the TS 102 127 [1].

8.1.2.2.4.2 Test purpose

To verify that CE after receiving NUL-EACK PDU, re-transmits the missing data PDUs to CS.

8.1.2.2.4.3 Methods of test

8.1.2.2.4.3.1 Scenario

```
                                              CE                                                CS
Time     State
1.       OPEN    <SEQ=X+1><ACK=201><ACK, Data1_3>           --->
2.       OPEN    <SEQ=X+2><ACK=201><ACK, Data2_3>           --->
3.       OPEN    <SEQ=X+3><ACK=201><ACK, Data3_3>           --->
4.       OPEN                                               <---    <SEQ=201><ACK=X+1><NUL,EACK><EACK=X+3>
5.       OPEN    <SEQ=X+2><ACK=201><ACK, Data2_3>           --->
```

8.1.2.2.4.3.2 Initial conditions

CE is in OPEN state.

8.1.2.2.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1			Test operator issues a send data request	*The SDU size must be at least 2 times the Max PDU size of CE but not more than 3 times the Max PDU size of CE, as well as smaller than the Max SDU size of CE.*
2	CE -> CS	ACK-SEG-DATA PDU		*PDU #1*
3	CE -> CS	ACK-SEG-DATA PDU		*PDU #2*
4	CE -> CS	ACK-UNSEG-DATA PDU		*PDU #3*
5	CE <- CS	NUL-EACK PDU		*CS announces PDU #2 is not received.*
6	CE -> CS	ACK-SEG-DATA PDU		

8.1.2.2.4.3.4 Specific message content

Step 5: NUL-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	'X+1'
19 - 20	Sequence Number	'X+3''

8.1.2.2.4.3.5 Expected results

Step 2: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	'00 C9'

Step 3: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+2'
13 - 14	Acknowledgment Number	'00 C9'

Step 4: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+3'
13 - 14	Acknowledgment Number	'00 C9'

Step 6: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+2'
13 - 14	Acknowledgment Number	'00 C9'

8.2 Exchange of data (CE's maximum window size > 1)

For all the following test cases, the window size is given after "/" in the ACK PDU.

8.2.1 Exchange of non-segmented data

8.2.1.1 Nominal cases

8.2.1.1.1 Handling of out-of-sequence data PDUs

8.2.1.1.1.1 Conformance requirements

- Positive acknowledgement clause 5.3.2.3.
- Flow control and window management clause 5.3.3.

8.2.1.1.1.2 Test purpose

Check that:

- CE shall acknowledge the PDUs out of sequence (extended or non-cumulative acknowledgement).
- CE accepts PDUs in sequence that falls within the acceptance window.
- CE shall acknowledge NUL-ACK PDU even while its window size is 0.

8.2.1.1.1.3 Methods of test

8.2.1.1.1.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data>
2.	OPEN	<SEQ=X+1><ACK=200><EACK=202>	--->	
3.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data>
4.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
5.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data>
6.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	
...	OPEN	Repetition N times of step 5 and 6 until the window size announced by CE equals to 1		
7+(2xN).	OPEN		<---	<SEQ=(203+N)><ACK=X><ACK,Data>
8+(2xN).	OPEN	<SEQ=X+1><ACK=(203+N)/0><ACK>	--->	
9+(2xN).	OPEN		<---	<SEQ=(203+N+1)><ACK=X><NUL,ACK>
10+(2xN).	OPEN	<SEQ=X+1><ACK=203+N+1/0><ACK>	--->	
11+(2xN).		<SEQ=X+1><ACK=203+N+1/W><NUL,ACK>	--->	
12+(2xN).	OPEN		<---	<SEQ=(203+N+2)><ACK=X+1><ACK,Data>
13+(2xN).		<SEQ=X+2><ACK=(203+N+2)><ACK>	--->	

8.2.1.1.1.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

8.2.1.1.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK-EACK PDU		
3a	CE <- CS	ACK-UNSEG-DATA PDU		
3b			CE signals to the test operator 'SDU available'	*This step may take place after step 4, in which case the PDU in step 5a shall only be issued after the reception of "SDU available" signal.*
3c			Test operator issues a receive request to CE and verify content of data	
4	CE -> CS	ACK PDU		
5a	CE <- CS	ACK-UNSEG-DATA PDU		
5b			CE signals to the test operator 'SDU available'	*This step may take place after step 6, in which case the PDU in step 7 shall only be issued after the reception of "SDU available" signal. (test operator does not issue a receive request in order to force CE to reduce its window size)*
6	CE -> CS	ACK PDU		
(Step5&6)xN				*N Repeat step5, 6*
7+(2xN)(a)	CE <- CS	ACK-UNSEG-DATA PDU		
7+(2xN)(b)			CE signals to the test operator 'SDU available'	*This step may take place after step 8+(2xN), in which case the PDU in step 9+(2xN) shall only be issued after the reception of "SDU available" signal.*
8+(2xN)	CE -> CS	ACK PDU		*Window size = 0*
9+(2xN)	CE <- CS	NUL-ACK PDU		
10+(2xN)(a)	CE -> CS	ACK PDU		
10+(2xN)(b)			test operator issues receive request to CE.	
11+(2xN)	CE -> CS	NUL-ACK PDU		
12+(2xN)(a)	CE <- CS	ACK-UNSEG-DATA PDU		
12+(2xN)(b)			CE signals to the test operator 'SDU available'	*This step may take place after step 13+(2xN).*
13+(2xN)	CE -> CS	ACK PDU		

8.2.1.1.1.3.4 Specific message content

Step 1a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 3a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 3c: Test operator issues a receive request and checks content of data returned

Step 5a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step 5c: Test operator issues a receive request and checks content of data returned

N times Step5 and Step6.

Step 7+(2xN)(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'+N
13 - 14	Acknowledgment Number	X

Step 9+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB' + (N+1)
13 - 14	Acknowledgment Number	X

Step 10+(2xN)(b): Test operator issues a receive request and checks content of data returned

Step 12+(2xN)(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB' + (N+2)
13 - 14	Acknowledgment Number	X+1

8.2.1.1.1.3.5 Expected results

Step 1b: Test operator checks that CE signals 'SDU available'.

Step2: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
19 - 20	Sequence Number (for out of sequence entries)	'00CA'

Step 3b: Test operator checks that CE signals 'SDU available'.

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 5b: Test operator checks that CE signals 'SDU available'.

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step 7+(2xN)(b): Test operator checks that CE signals 'SDU available'.

Step8+(2xN): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + N
15 - 16	Window Size	0

Step10+(2xN)(a): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + (N+1)
15 - 16	Window Size	0

Step11+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + (N+1)
15 - 16	Window Size	W

Step 12+(2xN)(b): Test operator checks that CE signals 'SDU available'.

Step13+(2xN): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB' + (N+2)

8.2.1.1.2 Handling of in-sequence data PDUs

8.2.1.1.2.1 Conformance requirements

- Positive acknowledgement clause 5.3.2.3.
- Flow control and window management clause 5.3.3.

8.2.1.1.2.2 Test purpose

Check that:

- CE shall acknowledge the PDUs in sequence which fall within the acceptance window.

8.2.1.1.2.3 Methods of test

8.2.1.1.2.3.1 Scenario

```
                           CE                                              CS
Time     State
1.       OPEN                                         <---   <SEQ=201><ACK=X><ACK,Data><SEG=0>
2.       OPEN    <SEQ=X+1><ACK=201><ACK>              --->
...      OPEN    Repeat W-2 times step1 and step2
N.       OPEN                                         <---   <SEQ=201+W><ACK=X><ACK,Data><SEG=0>
N+1.     OPEN    <SEQ=X+1><ACK=201+W><ACK>            --->
```

8.2.1.1.2.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

W is the window size announced by CE in open connection step.

8.2.1.1.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1a	CE <- CS	ACK-UNSEG-DATA PDU		
1b			CE signals to the test operator 'SDU available'	*This step may take place after step 2, in which case the PDU in step N(a) shall only be issued after the reception of "SDU available" signal.*
2	CE -> CS	ACK PDU		
N(a)	CE <- CS	ACK-UNSEG-DATA PDU		
N(b)			CE signals to the test operator 'SDU available'	*This step may take place after step N+1.*
N+1	CE -> CS	ACK PDU		

8.2.1.1.2.3.4 Specific message content

Step 1a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Repeat W-2 times step1 and step2

Step N(a): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'C9+W'
13 - 14	Acknowledgment Number	X

8.2.1.1.2.3.5 Expected results

Step 1b: Test operator checks that CE signals 'SDU available'.

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step N(b): Test operator checks that CE signals 'SDU available'.

StepN+1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'C9+W'

8.2.1.1.3 Handling of send Data request and out of sequence (in a single EACK-data PDU)

8.2.1.1.3.1 Conformance requirements

- EACK PDU field clause 5.9.1.
- CE shall support the reception of out of sequence data PDUs as specified in clause 5.4.2.2 of the TS 102 127 [1].

8.2.1.1.3.2 Test purpose

To verify that CE is able to send an EACK PDU with data.

8.2.1.1.3.3 Methods of test

8.2.1.1.3.3.1 Scenario

	CE		CS
Time State			
1. OPEN		<---	<SEQ=202><ACK=X><ACK,Data>
2. OPEN	<SEQ=X+1><ACK=200><EACK=202>	--->	
3 OPEN	<SEQ=X+1><ACK=200><EACK=202,Data>	--->	

8.2.1.1.3.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.2.1.1.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK-EACK PDU		
3			Test operator issues a send data request	
4	CE -> CS	ACK-EACK-UNSEG-DATA PDU		

8.2.1.1.3.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 3: Test operator issues a send data request.

8.2.1.1.3.3.5 Expected results

Step 2: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
19 - 20	Sequence Number (for out of sequence entries)	'00 CA'

Step 4: ACK-EACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
19 - 20	Sequence number (Out of sequence)	'00 CA'

8.2.1.1.4 Handling of send Data request and out of sequence PDU (in separate EACK and data PDUs)

8.2.1.1.4.1 Conformance requirements

- EACK PDU field clause 5.9.1.
- CE shall support the reception of out of sequence data PDUs as specified in clause 5.4.2.2 of the TS 102 127 [1].

8.2.1.1.4.2 Test purpose

To verify that CE is able to send an data even if data length is too big to be send into EACK PDU.

8.2.1.1.4.3 Methods of test

8.2.1.1.4.3.1 Scenario

```
                       CE                                              CS
Time  State
1.    OPEN                                     <---   <SEQ=202><ACK=X><ACK,Data>
2.    OPEN   <SEQ=X+1><ACK=200><EACK=202>      --->
3     OPEN   <SEQ=X+1><ACK=200><ACK,Data>      --->
```

NOTE: Data length should be equal to (CE's Max PDU size - 18), so that CE is able to encapsulate the data in an ACK PDU, but not in EACK PDU.

8.2.1.1.4.3.2 Initial conditions

- CE and CS are in OPEN state following the sequence described in annex B.

8.2.1.1.4.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK-EACK PDU		
3			Test operator issues a send data request	*Data length = CE's Max PDU size - 18*
4	CE -> CS	ACK-UNSEG-DATA PDU		

8.2.1.1.4.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 3: Test operator issues a send data request with *Data length = CE's Max PDU size - 18*.

8.2.1.1.4.3.5 Expected results

Step 2: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
19 - 20	Sequence Number (for out of sequence entries)	'00 CA'

Step 4: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value to set
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'
9 - 10	Data Length	CE's Max PDU size - 18

8.2.1.2 Non-nominal cases

8.2.1.2.1 void

8.2.1.2.2 void

8.2.2 Exchange of data with segmentation

8.2.2.1 Nominal cases

8.2.2.1.1 Handling of NUL-ACK PDUs during reception of data PDUs

8.2.2.1.1.1 Conformance requirements

- NUL PDU clause 5.11.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.2.2.1.1.2 Test purpose

Check that :

- NUL-ACK PDUs have no impact on reassembly,
- CE acknowledges segmented PDUs.
- CE issues EACK PDU after having received out of sequence NUL-ACK PDU.

8.2.2.1.1.3 Methods of test

8.2.2.1.1.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data1_3><SEG=1>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN		<---	<SEQ=202><ACK=X><NUL,ACK><SEG=0>
4.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
5.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data2_3><SEG=1>
6.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	
7.	OPEN		<---	<SEQ=205><ACK=X><NUL, ACK><SEG=0>
8.	OPEN	<SEQ=X+1><ACK=203><EACK=205>	--->	
9.	OPEN		<---	<SEQ=204><ACK=X><ACK,Data3_3><SEG=0>
10.	OPEN	<SEQ=X+1><ACK=205><ACK>	--->	
11.	OPEN	<SEQ=X+1><ACK=205/W><NUL,ACK> (this PDU is sent only if CE announces W=0 in Step 10)	--->	

NOTE: W > 2.

8.2.2.1.1.3.2 Initial conditions

8.2.2.1.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		*PDU#1*
2	CE -> CS	ACK PDU		
3	CE <- CS	NUL-ACK PDU		
4	CE -> CS	ACK PDU		
5	CE <- CS	ACK-SEG-DATA PDU		*PDU#2*
6	CE -> CS	ACK PDU		
7	CE <- CS	NUL-ACK PDU		
8	CE -> CS	ACK-EACK PDU		
9a	CE <- CS	ACK-UNSEG-DATA PDU		*PDU#3*
9b			CE signals to the test operator 'SDU available'	*This step may take place after step 10.*
9c			test operator issues receive request to CE.	
10	CE -> CS	ACK PDU		
11	CE -> CS	NUL-ACK PDU		*Conditional*

8.2.2.1.1.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step3: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step5: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step7: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CD'
13 - 14	Acknowledgment Number	X

Step 9a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC'
13 - 14	Acknowledgment Number	X

Step 9c: Test operator issues a receive request and checks content of data returned

8.2.2.1.1.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step8: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'
19 - 20	Sequence Number (for out of sequence entries)	'00 CD'

Step 9b: Test operator checks that CE signals 'SDU available'.

Step10: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CD'

Step11: NUL-ACK PDU (conditional, this PDU is sent only if CE announces W=0 in Step 10)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CD'
15 - 16	Window Size	W

8.2.2.1.2 void

Void.

8.2.2.1.3 Handling of out-of-sequence data PDUs

8.2.2.1.3.1 Conformance requirements

- Positive acknowledgement of PDUs clause 5.3.2.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.2.2.1.3.2 Test purpose

Exchange segmented data with PDUs out of sequence. Non-cumulative or cumulative acknowledgement mechanism is checked.

8.2.2.1.3.3 Methods of test

8.2.2.1.3.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data><SEG=1>
2.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
3.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data><SEG=0>
4.	OPEN	<SEQ=X+1><ACK=201><EACK=203>	--->	
5.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data><SEG=1>
6.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	
7.	OPEN	<SEQ=X+1><ACK=203/W><NUL,ACK> (this PDU is sent only if CE announces W=0 in Step 6)	--->	
8.	OPEN		<---	<SEQ=204><ACK=X+1><ACK,Data><SEG=0>
9.	OPEN	<SEQ=X+2><ACK=204/W><ACK>	--->	

NOTE: W > 2.

8.2.2.1.3.3.2 Initial conditions

8.2.2.1.3.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		*PDU#1*
2	CE -> CS	ACK PDU		
3	CE <- CS	ACK-UNSEG-DATA PDU		*PDU#2*
4	CE -> CS	ACK-EACK PDU		
5a	CE <- CS	ACK-SEG-DATA PDU		*PDU#3*
5b			CE signals to the test operator 'SDU available'	*This step may take place after step 6 but before step 7.*
5c			Test operator issues a receive request	
6	CE -> CS	ACK PDU		
7	CE -> CS	ACK PDU		*Conditional*
8	CE <- CS	ACK-UNSEG-DATA PDU		
9	CE -> CS	ACK PDU		

8.2.2.1.3.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step3: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step 5a: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 5c: Test operator issues a receive request and checks content of data returned

Step8: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC'
13 - 14	Acknowledgment Number	X+1

8.2.2.1.3.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step4: ACK-EACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
19 - 20	Sequence Number (for out of sequence entries)	'00 CB'

Step 5b: Test operator checks that CE signals 'SDU available'.

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step7: ACK PDU (Conditional, this PDU is sent only if CE announces W=0 in Step 6)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step9: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 CC'

After step 8, CE shall signal an available SDU to the upper layer.

8.2.2.2 Non-nominal cases

8.2.2.2.1 Handling of incoming segmented data PDU with its sequence number out of the window boundaries

8.2.2.2.1.1 Conformance requirements

- Flow control and window management clause 5.3.3.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.2.2.2.1.2 Test purpose

Check that CE discards a PDU with its sequence number out of the window boundaries in a segmented message.

8.2.2.2.1.3 Methods of test

8.2.2.2.1.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN	(PDU discarded)	<---	<SEQ=202+W><ACK=X><ACK,Data><SEG=1>
2.	OPEN	<SEQ=X+1><ACK=200/W><ACK>	--->	
3.	OPEN		<---	SEQ=201><ACK=X><ACK,Data><SEG=1>
4.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
5.	OPEN	(PDU discarded)	<---	SEQ=200><ACK=1><ACK,Data><SEG=1>
6.	OPEN	<SEQ=X+1><ACK=201><ACK>	--->	
7.	OPEN		<---	<SEQ=202><ACK=X><ACK,Data><SEG=1>
8.	OPEN	<SEQ=X+1><ACK=202><ACK>	--->	
9.	OPEN		<---	<SEQ=203><ACK=X><ACK,Data><SEG=0>
10.	OPEN	<SEQ=X+1><ACK=203><ACK>	--->	
11.	OPEN	<SEQ=X+1><ACK=203/W><NUL,ACK> (this PDU is sent only if CE announces W=0 in Step 10)	--->	

NOTE: W > 2.

8.2.2.2.1.3.2 Initial conditions

8.2.2.2.1.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-SEG-DATA PDU		*Sequence number is out of the window boundaries*
2	CE -> CS	ACK PDU		
3	CE <- CS	ACK-SEG-DATA PDU		
4	CE -> CS	ACK PDU		
5	CE <- CS	ACK-SEG-DATA PDU		*Sequence number is out of the window boundaries*
6	CE -> CS	ACK PDU		
7	CE <- CS	ACK-SEG-DATA PDU		
8	CE -> CS	ACK PDU		
9a	CE <- CS	ACK-UNSEG-DATA PDU		
9b			CE signals to the test operator 'SDU available'	*This step may take place after step 10.*
9c			Test operator issues receive request	
10	CE -> CS	ACK PDU		
11	CE -> CS	NUL-ACK PDU		*Conditional*

8.2.2.2.1.3.4 Specific message content

Step1: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'+W
13 - 14	Acknowledgment Number	X

Step3: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step5: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgment Number	X

Step7: ACK-SEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgment Number	X

Step 9a: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB'
13 - 14	Acknowledgment Number	X

Step 9c: Test operator issues a receive request and checks content of data returned

8.2.2.2.1.3.5 Expected results

Step2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step4: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step6: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step8: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CA'

Step 9b: Test operator checks that CE signals 'SDU available'.

Step10: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

Step11: NUL-ACK PDU (Conditional, this PDU is sent only if CE announces W=0 in Step 10)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 CB'

8.2.2.2.2 Handling of ACK and NUL-ACK PDU when window of CE and CS is 0

8.2.2.2.2.1 Conformance requirements

- NUL PDU clause 5.11.
- OPEN state PDU arrival event processing clause 5.4.2.2.

8.2.2.2.2.2 Test purpose

Check that:

- CE shall acknowledge NUL-ACK PDU even when its window and CS window size is 0.
- CE issues NUL-ACK after having received Send NUL request when its window and CS window size is 0.

8.2.2.2.2.3 Methods of test

8.2.2.2.2.3.1 Scenario

		CE		CS
Time	State			
1.	OPEN		<---	<SEQ=201><ACK=X><ACK,Data>
1a.	OPEN	<SEQ=X+1><ACK=201><ACK>(optional)	--->	
2.	OPEN	<SEQ=X+1><ACK=201><ACK,Data>	--->	
...	OPEN	Repetition N times of step 1 and 2 until the window size announced by CE equals to 1		
3+(2x(N-1)).			<---	<SEQ=201+N><ACK=X+N><ACK,Data>
3+(2x(N-1))a.	OPEN	<SEQ=X+1+N><ACK=201+N><ACK>(optional)	--->	
4+(2x(N-1)).		<SEQ=X+1+N><ACK=(201+N)/0><ACK,data>	--->	
3+(2xN).	OPEN		<---	<SEQ=202+N><ACK=X+1+N/0><ACK,Data>
4+(2xN).	OPEN	<SEQ=X+2+N><ACK=(202+N)/0><ACK>	--->	
5+(2xN).	OPEN		<---	<SEQ=203+N><ACK=X+1+N/0><NUL,ACK>
6+(2xN).	OPEN	<SEQ=X+2+N><ACK=(203+N)/0><ACK>	--->	
7+(2xN).	OPEN	(discarded)	<---	<SEQ=204+N><ACK=X+1+N/0><ACK>
8+(2xN).	OPEN	<SEQ=X+2+N><ACK=(203+N)/0><NUL,ACK>	--->	

8.2.2.2.2.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

8.2.2.2.2.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
1a	CE -> CS	ACK PDU		*Optional*
2a			*Test operator issues a send data request*	
2b	CE -> CS	ACK-UNSEG-DATA PDU		
…				
3+(2x(N-1))	CE <- CS	ACK-UNSEG-DATA PDU		
3+(2x(N-1))a	CE -> CS	ACK PDU		*Optional*
4+(2x(N-1))a			*Test operator issues a send data request*	
4+(2x(N-1))b	CE -> CS	ACK-UNSEG-DATA PDU		
3+(2xN).	CE <- CS	ACK-UNSEG-DATA PDU		
4+(2xN).	CE -> CS	ACK PDU		
5+(2xN).	CE <- CS	NUL-ACK PDU		
6+(2xN).	CE -> CS	ACK PDU		
7+(2xN).	CE <- CS	ACK PDU		
8+(2xN)a.			*Test operator issues a NUL request*	
8+(2xN)b.	CE -> CS	NUL-ACK PDU		

8.2.2.2.2.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

Step 2a: Test operator issues send data request.

Step 3+(2x(N-1)): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'+N
13 - 14	Acknowledgment Number	X

Step 3+(2xN): ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'+N
13 - 14	Acknowledgment Number	X
15 - 16	Window Size	0

Step 5+(2xN): NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CB' + N
13 - 14	Acknowledgment Number	X
15 - 16	Window Size	0

Step 7+(2xN).: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CC' + N
13 - 14	Acknowledgment Number	X
15 - 16	Window Size	0

Step 8+(2xN)a: Test operator issues a NUL request.

8.2.2.2.2.3.5 Expected results

Step1a: ACK PDU (optional)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 2b: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'

Step 3+(2x(N-1))a: ACK PDU (optional)

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1+N
13 - 14	Acknowledgment Number	'00 C9'+N

Step4+(2x(N-1))b: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1+N
13 - 14	Acknowledgment Number	'00 C9'+N
15 - 16	Window Size	0

Step 4+(2xN): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2+N
13 - 14	Acknowledgment Number	'00 CA'+N
15 - 16	Window Size	0

Step 6+(2xN): ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2+N
13 - 14	Acknowledgment Number	'00 CB'+N
15 - 16	Window Size	0

Step 8+(2xN)b: NUL-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2+N
13 - 14	Acknowledgment Number	'00 CB'+N
15 - 16	Window Size	0

9 Test cases - Closing of the connection

9.1 Closing of the connection (Triggered by tester)

9.1.1 Connection close in the 'OPEN' state (active open)

9.1.1.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.1.2 Test purpose

To verify that CE after receiving a close request, issues a RST PDU and enters 'CLOSE' state.

9.1.1.3 Methods of test

9.1.1.3.1 Scenario

```
                              CE                                        CS
    Time     State
    1.       OPEN       <SEQ=X+1><RST>                 --->
    2.       CLOSE
```

9.1.1.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex A.

9.1.1.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues close request to CE	
1	CE→CS	RST PDU		
2			Test operator issues close request to CE	
3			CE returns "Error-Connection not opened"	

9.1.1.3.4 Specific message content

None.

9.1.1.3.5 Expected results

Step 1: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	Not Checked
15 - 16	Window Size	Not Checked
19	Reason	'00'

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.2 Connection close in the 'OPEN' state (passive open)

9.1.2.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.2.2 Test purpose

To verify that CE after receiving a close request, issues a RST PDU and enters 'CLOSE' state.

9.1.2.3 Methods of test

9.1.2.3.1 Scenario

```
                    CE                                      CS
Time    State
1.      OPEN        <SEQ=X+1><ACK=201><WIN=0><RS  --->
                    T>
2.      CLOSE
```

9.1.2.3.2 Initial conditions

Step sequences of scenario 1 in test case 7.2.1.1 are used to bring CE and CS into OPEN state.

9.1.2.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issue close request to CE.	Correct CAT-TP link
1	CE→CS	RST PDU		Window size is set to "0".
2			Test operator issue close request to CE.	
3			CE return "Error-Connection not opened"	

9.1.2.3.4 Specific message content

None.

9.1.2.3.5 Expected results

Step 1: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	'00 00'
19	Reason	'00'

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.3 Connection close in the 'LISTEN' state

9.1.3.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.3.2 Test purpose

To verify that CE enters 'CLOSE' state after receiving a close request.

9.1.3.3 Methods of test

9.1.3.3.1 Scenario

Not applicable.

9.1.3.3.2 Initial conditions

CE is in LISTEN state.

9.1.3.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issue close request to CE	
2			Test operator issue close request to CE.	
3			CE returns "Error-Connection not opened"	

9.1.3.3.4 Specific message content

None.

9.1.3.3.5 Expected results

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.4 Connection close in the 'CLOSE' state

9.1.4.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.4.2 Test purpose

To verify that the CE returns an error to test operator after test operator issues a close request to the CE in 'CLOSE' state.

9.1.4.3 Methods of test

This has been implicitly tested in the rest of the test cases in this sub-section.

9.1.5 Connection close in the 'SYN-SENT' state

9.1.5.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.5.2 Test purpose

To verify that CE after receiving a close request, issues a RST PDU and enters 'CLOSE' state.

9.1.5.3 Methods of test

9.1.5.3.1 Scenario

```
                              CE                                    CS
    Time     State
    1.       SYN-SENT   <SEQ=X+1><RST>              --->
    2.       CLOSE
```

9.1.5.3.2 Initial conditions

CE is in SYN-SENT state.

9.1.5.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issue close request to CE.	
1	CE→CS	RST PDU		
2			Test operator issue close request to CE.	
3			CE return "Error-Connection not opened"	

9.1.5.3.4 Specific message content

None.

9.1.5.3.5 Expected results

Step 1: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
19	Reason	'00'

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.6 Connection close in the 'SYN-RCVD' state

9.1.6.1 Conformance requirements

CE shall support the connection closing as specified in clauses 5.4.1.2 and 5.10 of the TS 102 127 [1].

9.1.6.2 Test purpose

To verify that CE after receiving a close request, issues a RST PDU and enters 'CLOSE' state.

9.1.6.3 Methods of test

9.1.6.3.1 Scenario

```
                              CE                                    CS
    Time     State
    1.       SYN-RCVD   <SEQ=X+1><RST>              --->
    2.       CLOSE
```

9.1.6.3.2 Initial conditions

CE is in SYN-RCVD state.

9.1.6.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issue close request to CE	
2	CE→CS	RST PDU		
3			Test operator issue close request to CE.	
4			CE return "Error-Connection not opened"	

9.1.6.3.4 Specific message content

None.

9.1.6.3.5 Expected results

Step 2: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
19	Reason	'00'

Step 4:

Test operator checks that client returns "Error - Connection not opened".

9.1.7 Connection open failure in the 'CLOSE' state - Local port not specified (Passive open)

9.1.7.1 Conformance requirements

CE shall support the connection closing as specified in clause 5.4.1.1 of the TS 102 127 [1].

9.1.7.2 Test purpose

To verify that CE after receiving a passive open request without local port specified, signal to upper layer and remain in 'CLOSE' state.

9.1.7.3 Methods of test

9.1.7.3.1 Scenario

Not applicable.

9.1.7.3.2 Initial conditions

CE is in CLOSE state.

9.1.7.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issue passive open request to CE.	Local port is not included in the request.
1a			CE returns "Error - Local port not specified"	
2			Test operator issue close request to CE.	
3			CE returns "Error - Connection not opened"	

9.1.7.3.4 Specific message content

None.

9.1.7.3.5 Expected results

Step 1a:

Test operator checks that CE returns "Error - Local port not specified".

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.8 Connection open failure in the 'CLOSE' state - No destination port specified (Active open)

9.1.8.1 Conformance requirements

CE shall support the connection closing as specified in clause 5.4.1.1 of the TS 102 127 [1].

9.1.8.2. Test purpose

To verify that CE after receiving an active open request without destination port specified, signal to upper layer and remain in 'CLOSE' state.

9.1.8.3 Methods of test

9.1.8.3.1 Scenario

No applicable.

9.1.8.3.2 Initial conditions

CE is in CLOSE state.

9.1.8.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issue active open request to CE.	Destination port is not included in the request.
1a			CE returns "Error - Dest. port not specified"	
2			Test operator issue close request to CE.	
3			CE returns "Error - Connection not opened"	

9.1.8.3.4 Specific message content

None.

9.1.8.3.5 Expected results

Step 1a:

Test operator checks that CE returns "Error - Dest. port not specified".

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.9 Connection open failure in the 'CLOSE' state - No port sharing between an active and a passive connection

9.1.9.1 Conformance requirements

A CAT_TP entity shall not use the same local port number for an active and a passive request simultaneously, as specified in clause 5.3.1.2 of the TS 102 127 [1].

CE shall support the connection closing as specified in clause 5.4.1.1 of the TS 102 127 [1].

9.1.9.2 Test purpose

To verify that CE after receiving an active open request with the same port number as the one specified in the passive connection, signal to upper layer and remain in 'CLOSE' state.

9.1.9.3 Methods of test

9.1.9.3.1 Scenario

No applicable.

9.1.9.3.2 Initial conditions

CE is in CLOSE state.

9.1.9.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issue passive open request to CE.	
2			Test operator issue active open request to CE.	Local port is included in the request is the same as the local port given in step 1.
2a			CE returns "Error - Local port not specified"	
3			Test operator issue close request to CE	.
4			CE returns "Error - Connection not opened"	

9.1.9.3.4 Specific message content

None.

9.1.9.3.5 Expected results

Step 2a:

Test operator checks that CE returns "Error - Local port not specified".

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.1.10 Receive request in the 'CLOSE' state

9.1.10.1 Conformance requirements

CE shall support the receive request as specified in clause 5.4.1.3 of the TS 102 127 [1].

9.1.10.2 Test purpose

To verify that the CE returns an error to test operator after test operator issues a receive request to the CE in 'CLOSE' state.

9.1.10.3 Methods of test

9.1.10.3.1 Scenario

Not applicable.

9.1.10.3.2 Initial conditions

CE is in CLOSE state.

9.1.10.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issues receive request to CE	.
1a			CE returns "Error - Connection not opened".	
2			Test operator issues close request to CE.	
3			CE returns "Error-Connection not opened".	

9.1.10.3.4 Specific message content

None.

9.1.10.3.5 Expected results

Step 1a:

Test operator checks that CE returns "Error - Connection not opened".

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.11 Send request in the 'CLOSE' state

9.1.11.1 Conformance requirements

CE shall support the send request as specified in clause 5.4.1.4 of the TS 102 127 [1].

9.1.11.2. Test purpose

To verify that the CE returns an error to test operator after test operator issues a send request to the CE in 'CLOSE' state.

9.1.11.3 Methods of test

9.1.11.3.1 Scenario

Not applicable.

9.1.11.3.2 Initial conditions

CE is in CLOSE state.

9.1.11.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator issues send request to CE.	
1a			CE returns "Error - Connection not opened".	
2			Test operator issues close request to CE.	
3			CE returns "Error-Connection not opened".	

9.1.11.3.4 Specific message content

None.

9.1.11.3.5 Expected results

Step 1a:

Test operator checks that CE returns "Error - Connection not opened".

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.1.12 Connection open failure in the 'CLOSE' state - No local port specified (Passive open)

9.1.12.1 Conformance requirements

CE shall support the connection closing as specified in clause 5.4.1.1 of the TS 102 127 [1].

9.1.12.2 Test purpose

To verify that CE after receiving an passive open request without local port specified, signal to upper layer and remain in 'CLOSE' state.

9.1.12.3 Methods of test

9.1.12.3.1 Scenario

No applicable.

9.1.12.3.2 Initial conditions

CE is in CLOSE state.

9.1.12.3.3 Procedure

Step	Direction	PDU types	Upper layer interface	Comments
1			Test operator issue passive open request to CE.	Local port is not included in the request.
2			CE returns "Error - Local port not specified"	
3			Test operator issue close request to CE.	
4			CE returns "Error - Connection not opened"	

9.1.12.3.4 Specific message content

None.

9.1.12.3.5 Expected results

Step 2:

Test operator checks that CE returns "Error - Local port not specified".

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.1.13 CLOSE request in the 'OPEN' state - CS's window size = 0

9.1.13.1 Conformance requirements

CE shall support the connection closing as specified in clause 5.4.1.1 of the TS 102 127 [1].

9.1.13.2 Test purpose

To verify that CE after receiving close request, sends RST PDU to CS, which has previously declared window size = 0.

9.1.13.3 Methods of test

9.1.13.3.1 Scenario

```
                                               CE                                                 CS
Time     State
1.       OPEN    <SEQ=X+1><ACK=200><ACK, Data><SEG=0>        --->
2.       OPEN                                                <---    <SEQ=201><ACK=X+1/0><ACK,Data><SEG=0>
3.       OPEN    <SEQ=X+2><ACK=201><ACK>                     --->
4.       OPEN    <SEQ=X+2><ACK=201><RST>                     --->
5.       CLOSE
```

9.1.13.3.2 Initial conditions

CE is in OPEN state.

9.1.13.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
0			Test operator issues a send data request	
1	CE -> CS	ACK-UNSEG-DATA PDU		
2	CE <- CS	ACK-UNSEG-DATA PDU		*CS announces Window size = 0*
3	CE -> CS	ACK PDU	CE signals "SDU available"	
4			Test operator issues a close request	
5	CE -> CS	RST PDU		
6			Test operator issues a close request	*This step is used to test that CE is in CLOSE state*
7			CE returns "Error - Connection not opened"	

9.1.13.3.4 Specific message content

Step 2: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1
15 - 16	Window Size	0

9.1.13.3.5 Expected results

Step1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgment Number	'00 C8'

Step3: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'

Step5: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+2'
13 - 14	Acknowledgment Number	'00 C9'
19	Reason Code	'00'

Step 6: Test operator checks that CE signals 'Error- Connection not opened'.

9.2 Closing of the connection (Non-Nominal case)

9.2.1 Retransmission counter exceeds maximum number of retries when attempting to send SYN PDU

9.2.1.1 Conformance requirements

CE shall resume the connection phase as specified in clauses 5.3.1.3, 5.3.2.3, 5.3.2.4, 5.4.3.1, 5.4.2.4, 5.7 and 5.10.

9.2.1.2 Test purpose

To verify that CE issues SYN PDU when timeout event occurs as long as the maximum number of retries counter has not been reached. If so, CE issues RST PDU and goes to CLOSE-WAIT state.

9.2.1.3 Methods of test

9.2.1.3.1 Scenario

	CE		CS
Time	State		
1	CLOSE		
2.	SYN-SENT	<SEQ=X+1><SYN>	--->
3.	SYN-SENT	<SEQ=X+1><SYN> (first retransmission)	--->
…			--->
N+2	SYN-SENT	<SEQ=X+1><SYN> (N-1 retransmission)	--->
N+3.	SYN-SENT	<SEQ=X+1><SYN> (N retransmission)	--->
N+4.	CLOSE-WAIT	<SEQ=X+1><RST>	--->
N+5.	CLOSE		

NOTE: N is the number of retries allowed by CE.

9.2.1.3.2 Initial conditions

- CE is in CLOSE state.
- Test operator shall be informed the maximum number of re-tries by CE for PDUs that require acknowledgement and the value of the Close-wait timer.
- The counter k is used to keep track of the reception of retransmitted SYN PDU. Initial value is 0.

9.2.1.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator send active open request to CE.	
2	CE→CS	SYN PDU		CS shall not acknowledge.
3	CE→CS	SYN PDU		CE retransmits after timeout of the first data PDU. Set counter k to '1' after receiving this PDU. Increment k each time CS receives SYN PDU. CS shall wait until k = maximum number of retransmission, N.
…				
N+3	CE→CS	SYN PDU		
N+4	CE→CS	RST PDU		
N+5			After RST PDU is received, test operator shall wait the close-wait period before issuing the close request to CE.	
N+6			CE returns "Error - Connection not opened"	

9.2.1.3.4 Specific message content

None.

9.2.1.3.5 Expected results

Step 2 to N+3: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step N+4: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'
19	Reason Code	'05'

Step N+6:

Test operator checks that CE signals "Error - Connection not opened".

9.2.2 Reception of SYN PDU when CE in SYN-SENT state

9.2.2.1 Conformance requirements

CE shall resume the connection phase as specified in clauses 5.3.1.3, 5.3.2.3, 5.3.2.3, 5.4.2.4, 5.7 and 5.10.

9.2.2.2 Test purpose

To verify that CE issues RST-ACK PDU and goes to CLOSE state, after receiving a SYN PDU.

9.2.2.3 Methods of test

9.2.2.3.1 Scenario

```
                              CE                                        CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>                  --->
    2.       SYN-SENT                                 <---    <SEQ=200><SYN>
    3.       SYN-SENT   <SEQ=X+1><ACK=200><RST,ACK>   --->
    4.       CLOSE
```

9.2.2.3.2 Initial conditions

CE is in CLOSE state.

9.2.2.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE→CS	SYN PDU	Test operator send active open request to CE.	
2	CE←CS	SYN PDU		
3	CE→CS	RST-ACK PDU		Window size set to '0'.
4			Test operator issue close request to CE.	
5			CE returns "Error - Connection not opened"	

9.2.2.3.4 Specific message content

Step 2: SYN PDU

Refer to annex A.

9.2.2.3.5 Expected results

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 3: RST-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Insignificant
13 - 14	Acknowledgement Number	'00 C8'
19	Reason	'04'

Step 5:

Test operator checks that CE returns "Error - Connection not opened".

9.2.3 Reception of RST-ACK PDU when in SYN-SENT state

9.2.3.1 Conformance requirements

CE shall resume the connection phase as specified in clauses 5.3.1.3, 5.3.2.3, 5.4.2.4, 5.7 and 5.10.

9.2.3.2 Test purpose

To verify that CE discards the RST-ACK PDU and goes to CLOSE state.

9.2.3.3 Methods of test

9.2.3.3.1 Scenario

```
                              CE                                          CS
Time     State
1.       CLOSE      <SEQ=X><SYN>                ---->
2.       SYN-SENT                               <---     <SEQ=200><ACK=200><RST,ACK>
3.       CLOSE
```

9.2.3.3.2 Initial conditions

CE is in CLOSE state.

9.2.3.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator sends active open request to CE	
1	CE→CS	SYN PDU		
2	CE←CS	RST-ACK PDU		
3			Test operator issue close request to CE	
4			CE returns "Error - Connection not opened"	

9.2.3.3.4 Specific message content

Step 2: RST-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement Number	'X'
19	Reason	Insignificant

9.2.3.3.5 Expected results

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 4:

Test operator checks that CE returns "Error-Connection not opened".

9.2.4 Retransmission failure of SYN-ACK PDU

9.2.4.1 Conformance requirements

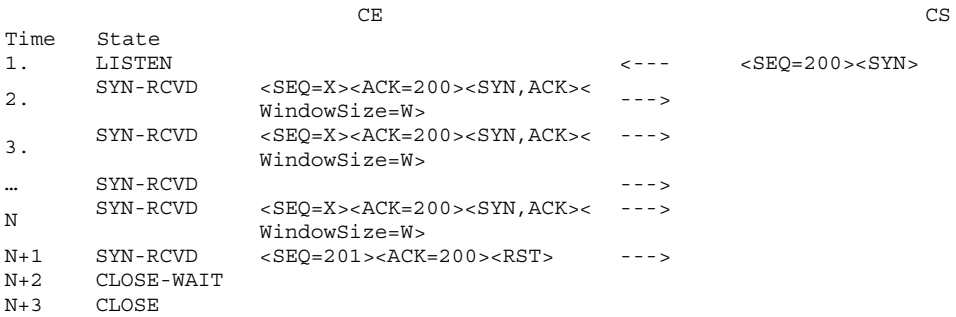
CE shall support retransmission timeout as specified in clauses 5.3.2.4 and 5.4.3.1.

9.2.4.2 Test purpose

To verify that CE stop transmission of SYN_ACK PDUs after maximum retries.

9.2.4.3 Method of test

9.2.4.3.1 Scenario



9.2.4.3.2 Initial conditions

- CE is in LISTEN state.
- Test operator shall be informed the maximum number of re-tries by CE for PDUs that require acknowledgement and the value of the Close-wait timer.
- The counter k is used to keep track of the reception of retransmitted SYN PDU. Initial value is 0.

9.2.4.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN PDU		Set counter k to '0'.
2	CE→CS	SYN-ACK PDU		CS shall not acknowledge.
3	CE→CS	SYN-ACK PDU		CE retransmits SYN-ACK PDU for the maximum number. Increment k each time CS receives SYN-ACK PDU from CE.
4	CE→CS	RST PDU	CE signals "Connection reset"	
5			After RST PDU is received, test operator shall wait the close-wait period before issuing the close request to CE.	
6			CE returns "Error - Connection not opened"	

9.2.4.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

9.2.4.3.5 Expected results

Step 2 and 3: SYN-ACK PDU

Refer to annex A, with the following exceptions.

After step 3, CS checks that the value of k shall be the value of the maximum of retries of the CE.

Step 4: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
19	Reason Code	'05'

Test operator checks that CE signals "Connection reset".

Step 5:

Test operator checks that CE signals "Error - Connection not opened".

9.2.5 Reception of ACK/ACK-SEG-DATA PDU with Acknowledgement Number different from initial sequence number when in SYN-SENT state

9.2.5.1 Conformance requirements

CE shall support ACK PDU arrival event processing as specified in clause 5.4.2.4.

9.2.5.2 Test purpose

To verify that CE issues RST PDU after it receives an ACK PDU with Acknowledgement number different from the initial sequence number of the CE and returns to CLOSE state.

9.2.5.3 Method of test

9.2.5.3.1 Scenario

Case 1:

```
                        CE                                  CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>           --->
    2.       SYN-SENT                          <---         <SEQ=200><ACK=Z!=X><ACK>
    3.       SYN-SENT   <SEQ=Z+1><RST>         --->
    4.       CLOSE
```

Case 2:

```
                        CE                                  CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>           --->
    2.       SYN-SENT                          <---         <SEQ=200><ACK=Z!=X><ACK,data>
    3.       SYN-SENT   <SEQ=Z+1><RST>         --->
    4.       CLOSE
```

9.2.5.3.2 Initial conditions

CE is in CLOSE state.

9.2.5.3.3 Procedure

Case 1:

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator send active open request to CE.	
1	CE→CS	SYN PDU		
2	CE←CS	ACK PDU		Acknowledgement number is different from the sequence number sent by CE in the initial condition.
3	CE→CS	RST PDU		
4			Test operator issue close request to CE.	
5			CE returns "Error - Connection not opened"	

Case 2:

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator send active open request to CE.	
1	CE→CS	SYN PDU		
2	CE←CS	ACK-SEG-DATA PDU		Acknowledgement number is different from the sequence number sent by CE in the initial condition.
3	CE→CS	RST PDU		
4			Test operator issue close request to CE.	
5			CE returns "Error - Connection not opened"	

9.2.5.3.4 Specific message content

Step 2 (for case 1): ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgement Number	Z!='X'

Step 2 (for case 2): ACK-SEG-DATA PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C8'
13 - 14	Acknowledgement Number	Z!='X'

9.2.5.3.5 Expected results

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 3: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'Z+1'
19	Reason	'04'

Step 5:

Test operator checks that CE returns "Error - Connection not opened".

9.2.6 Reception of RST PDU in SYN-RCVD state

9.2.6.1 Conformance requirements

CE shall support RST PDU arrival event processing as specified in clause 5.4.2.5.

9.2.6.2 Test purpose

To verify that CE informs upper layer of connection reset after it receives RST PDU and returns to CLOSE state.

9.2.6.3 Method of test

9.2.6.3.1 Scenario

```
                          CE                                      CS
Time     State
1.       LISTEN                                    <---       <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>      --->
3.       SYN-RCVD                                  <---       <SEQ=201><RST>
4.       CLOSE
```

9.2.6.3.2 Initial conditions

CE is in CLOSE state.

9.2.6.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator send passive open request to CE.	
1	CE←CS	SYN PDU		
2	CE→CS	SYN-ACK PDU		
3	CE←CS	RST PDU		
3a			CE signals "Connection reset"	
4			Test operator issue close request to CE	
5			CE returns "Error - Connection not opened"	

9.2.6.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'

9.2.6.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X'
13 - 14	Acknowledgement Number	'00 C8'

Step 3a:

Test operator checks that CE signals "Connection reset".

Step 5:

Test operator checks that CE signals "Error - Connection not opened".

9.2.7 Reception of SYN-ACK PDU in SYN-RCVD state

9.2.7.1 Conformance requirements

CE shall support SYN-ACK PDU arrival event processing as specified in clause 5.4.2.5.

9.2.7.2 Test purpose

To verify that CE informs upper layer of connection reset, issues RST PDU and enters CLOSE state after it receives SYN-ACK PDU.

9.2.7.3 Method of test

9.2.7.3.1 Scenario

```
                          CE                                      CS
Time     State
1.       LISTEN                               <---       <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>  --->
3.       SYN-RCVD                              <---       <SEQ=201><ACK=X><SYN,ACK>
4.       SYN-RCVD   <SEQ=X+1><RST>             --->
5.       CLOSE
```

9.2.7.3.2 Initial conditions

CE is in CLOSE state.

9.2.7.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator send passive open request to CE.	
1	CE←CS	SYN PDU		
2	CE→CS	SYN-ACK PDU		
3	CE←CS	SYN-ACK PDU		
4	CE→CS	RST PDU	CE signals "Connection reset"	
5			Test operator issue close request to CE.	
6			CE returns "Error - Connection not opened"	

9.2.7.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement Number	'X'

9.2.7.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X'
13 - 14	Acknowledgement Number	'00 C8'

Step 4: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1'
19	Reason	'04'

Test operator shall check that CE signals "Connection reset".

Step 6:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.8 Reception of ACK PDU with Acknowledgement Number different from initial sequence number when in SYN-RCVD state

9.2.8.1 Conformance requirements

CE shall support ACK PDU arrival event processing as specified in clause 5.4.2.5.

9.2.8.2 Test purpose

To verify that CE issues RST PDU and enters CLOSE state after it receives ACK PDU, with acknowledgement number different from the initial sequence number.

9.2.8.3 Method of test

9.2.8.3.1 Scenario

```
                              CE                                          CS
    Time     State
    1.       CLOSE
    2.       LISTEN                                    <---       <SEQ=200><SYN>
    3.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>      --->
    4.       SYN-RCVD                                  <---       <SEQ=201><ACK!=X><ACK>
    5.       SYN-RCVD   <SEQ=X+1><RST>                 --->
    6.       CLOSE
```

9.2.8.3.2 Initial conditions

CE is in CLOSE state.

9.2.8.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1			Test operator send passive open request to CE.	
2	CE←CS	SYN PDU		
3	CE→CS	SYN-ACK PDU		
4	CE←CS	ACK PDU		
5	CE→CS	RST PDU		
6			Test operator issue close request to CE.	
7			CE returns "Error - Connection not opened"	

9.2.8.3.4 Specific message content

Step 2: SYN PDU

Refer to annex A.

Step 4: ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement Number	'Z=!X'

9.2.8.3.5 Expected results

Step 3: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X'
13 - 14	Acknowledgement Number	'00 C8'

Step 5: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'Z+1'
19	Reason	'04'

Step 7:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.9 Reception of SYN PDU when in SYN-RCVD state

9.2.9.1 Conformance requirements

CE shall support SYN PDU arrival event processing as specified in clause 5.4.2.5.

9.2.9.2 Test purpose

To verify that CE issues RST-ACK PDU and enters CLOSE state after it receives SYN PDU.

9.2.9.3 Method of test

9.2.9.3.1 Scenario

```
                           CE                                  CS
Time     State
1.       LISTEN                                  <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>    --->
3.       SYN-RCVD                                <---    <SEQ=201><SYN>
4.       SYN-RCVD   <SEQ=><ACK=201><RST,ACK>     --->
5.       CLOSE
```

9.2.9.3.2 Initial conditions

Test operator send passive open request to CE to set it into LISTEN state.

9.2.9.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN PDU		
2	CE→CS	SYN-ACK PDU		
3	CE←CS	SYN PDU		
4	CE→CS	RST-ACK PDU	CE signals "Connection reset"	Window size set to '0'.
5			Test operator issue close request to CE.	.
6			CE returns "Error - Connection not opened"	

9.2.9.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'

9.2.9.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 4: RST-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Not checked
13 - 14	Acknowledgement Number	'00 C9'
19	Reason	'04'

Test operator shall check that CE signals "Connection reset".

Step 6:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.10 Reception of EACK PDU when in SYN-RCVD state

9.2.10.1 Conformance requirements

CE shall support EACK PDU arrival event processing as specified in clause 5.4.2.5.

9.2.10.2 Test purpose

To verify that CE issues RST PDU and enters CLOSE state after it receives ACK-EACK PDU.

9.2.10.3 Method of test

9.2.10.3.1 Scenario

```
                          CE                                    CS
Time     State
1.       LISTEN                                <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>  --->
3.       SYN-RCVD                              <---    <SEQ=201><ACK=X><ACK,EACK>
4.       SYN-RCVD   <SEQ=X+1><RST>             --->
5.       CLOSE
```

9.2.10.3.2 Initial conditions

CE is in LISTEN state.

9.2.10.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN PDU		
2	CE→CS	SYN-ACK PDU		
3	CE←CS	ACK-EACK PDU		
4	CE→CS	RST PDU		
5	CE←CS		Test operator issue close request to CE.	
6			CE returns "Error - Connection not opened"	

9.2.10.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

Step 3: ACK-EACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement Number	'X'

9.2.10.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 4: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X+1'
19	Reason	'04'

Step 6:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.11 Data PDU exchange failure (maximum number of retransmission exceeded)

9.2.11.1 Conformance requirements

CE shall support retransmission timeout in OPEN state as specified in clauses 5.3.2.4 and 5.4.3.1.

9.2.11.2 Test purpose

To verify that CE informs upper layer of connection reset, issues RST PDU and enters CLOSE state after maximum number of retransmission is exceeded.

9.2.11.3 Method of test

9.2.11.3.1 Scenario

		CE		CS
Time	State			
1	OPEN	<SEQ=X+1><Data><ACK	--->	
2.	OPEN	<SEQ=X+1><Data><ACK> (first retransmission)	--->	
…			--->	
N+1	OPEN	<SEQ=X+1><Data><ACK> (N-1 retransmission)	--->	
N+2.	OPEN	<SEQ=X+1><Data><ACK> (N retransmission)	--->	
N+3.	CLOSE -WAIT	<RST><SEQ=201>	--->	
N+4.	CLOSE			

9.2.11.3.2 Initial conditions

- CE enters OPEN state following the step sequences 1 to 3 in test case 7.1.1.1.
- The Test operator shall be informed the maximum number of re-tries by CE for PDUs that require acknowledgement and the value of the Close-wait timer.
- The counter k is used to keep track of the reception of retransmitted ACK PDU. Initial value is 0.

9.2.11.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
0			Test operator issues Send request and encapsulates dummy data	
1	CE→CS	data PDU		. CS shall not acknowledge.
2	CE→CS	data PDU		CE retransmits after timeout of the first data PDU. Set counter k to '1' after receiving this PDU. Increment k each time CS receives data PDU. CS shall wait until k = maximum number of retransmission.
…	CE→CS	data PDU		
N+1	CE→CS	data PDU		
N+2	CE→CS	data PDU		
N+3	CE→CS	RST PDU		
N+4			CE signals "Connection reset".	
N+5			Test operator issue close request to CE.	This close request shall be sent to CE after a period of twice the value of Close-wait timer after step 3.
N+6			CE returns "Error - Connection not opened"	

9.2.11.3.4 Specific message content

9.2.11.3.5 Expected results

Step 1 to N+2: ACK-UNSEG-DATA PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
13 - 14	Acknowledgement Number	Not checked

Step N+3: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	TBD
19	Reason Code	'05'

Step N+4:

Test operator shall check that CE signals connection reset.

Step N+6:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.12 Reception of RST PDU in 'OPEN' state

9.2.12.1 Conformance requirements

CE shall support PDU arrival event process as specified in clause 5.4.2.2.

9.2.12.2 Test purpose

To verify that CE informs upper layer of connection reset and enters CLOSE state.

9.2.12.3 Method of test

9.2.12.3.1 Scenario

```
                         CE                                  CS
   Time     State
   1.       OPEN                              <---    <SEQ=201><RST>
   2.       CLOSE-WAIT
   3.       CLOSE
```

9.2.12.3.2 Initial conditions

Step sequences 1 to 3 in test case 7.1.1.1 are used to bring CE and CS into OPEN state.

Test operator shall be informed the value of the Close-wait timer.

9.2.12.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	RST PDU		
1a			CE signals "Connection reset".	
2			After step 1, test operator waits for a duration equivalent to the Close-wait timer and then issues close request to CE.	
3			CE returns "Error - Connection not opened"	

9.2.12.3.4 Specific message content

Step 1: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'

9.2.12.3.5 Expected results

Step 1a:

Test operator shall check that CE signals "Connection reset".

Step 3:

Test operator shall check that CE signals "Error - Connection not opened".

9.2.13 Reception of SYN PDU in 'OPEN' state

9.2.13.1 Conformance requirements

CE shall support PDU arrival event process as specified in clause 5.4.2.2.

9.2.13.2 Test purpose

To verify that CE issues RST-ACK PDU and enters CLOSE state after it receives SYN PDU in OPEN state.

9.2.13.3 Method of test

9.2.13.3.1 Scenario

```
                          CE                                    CS
Time     State
1.       OPEN                                  <---    <SEQ=201><SYN>
2.       OPEN        <RST,ACK><ACK=201><SEQ=>  --->
3.       CLOSE
```

9.2.13.3.2 Initial conditions

Step sequences 1 to 3 in test case 7.1.1.1 are used to bring CE and CS into OPEN state.

CE is in OPEN state.

9.2.13.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN PDU		
2	CE→CS	RST-ACK PDU		Window size set to '0'.
2a			CE signals "Connection reset".	
3			Test operator issue close request to CE.	
4			CE returns "Error - Connection not opened"	

9.2.13.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'

9.2.13.3.5 Expected results

Step 2: RST-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Not checked
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	'00 00'
19	Reason	'04'

Step 2a:

Test operator checks that CE signals connection reset.

Step 4:

Test operator checks that CE signals "Error - Connection not opened".

9.2.14 Reception of SYN-ACK PDU in 'OPEN' state

9.2.14.1 Conformance requirements

CE shall support PDU arrival event process as specified in clause 5.4.2.2.

9.2.14.2 Test purpose

To verify that CE issues RST PDU and enters CLOSE state after it receives SYN-ACK PDU in OPEN state.

9.2.14.3 Method of test

9.2.14.3.1 Scenario

```
                                    CE                                     CS
    Time     State
    1.       OPEN                                       <---    <SYN,ACK><SEQ=201><ACK=X+1>
    2.       OPEN       <SEQ=X+2><RST>                  --->
    3.       CLOSE
```

9.2.14.3.2 Initial conditions

Step sequences 1 to 3 in test case 7.1.1.1 are used to bring CE and CS into OPEN state.

9.2.14.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN-ACK PDU		
2	CE→CS	RST PDU		
2a			CE signals "Connection reset"	
3			Test operator issue close request to CE.	
4			CE returns "Error - Connection not opened".	

9.2.14.3.4 Specific message content

Step 1: SYN-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X+1

9.2.14.3.5 Expected results

Step 2: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+2
13 - 14	Acknowledgment Number	'00 C9'
19	Reason	'04'

Step 2a:

Test operator checks that CE signals connection reset.

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.2.15 Reception of ACK PDU in CLOSE state

9.2.15.1 Conformance requirements

If no connection exists at all, the CLOSED state PDU arrival events processing is optional as specified in clause 5.3.1.3.1. CE shall handle PDU arrival event process as specified in clause 5.4.2.1.

9.2.15.2 Test purpose

To verify that CE handles ACK PDU in CLOSE state in accordance with TS 102 127 [1].

9.2.15.3 Method of test

9.2.15.3.1 Scenario

```
Step   State        CE                              CS
1.     CLOSE                                <--     <ACK><ACK=301>
2.     CLOSE        <RST><SEQ=302> (optional)   -->
```

9.2.15.3.2 Initial conditions

CE is in CLOSE state.

9.2.15.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	ACK PDU		
2	CE→CS	RST PDU		Sending of this PDU is optional.
3			Test operator issue close request to CE	.
4			CE returns "Error - Connection not opened"	

9.2.15.3.4 Specific message content

Step 1: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	X

9.2.15.3.5 Expected results

Step 2: RST

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
19	Reason	'04'

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.2.16 Reception of SYN PDU in CLOSE state

9.2.16.1 Conformance requirements

If no connection exists at all, the CLOSED state PDU arrival events processing is optional as specified in clause 5.3.1.3.1. CE shall handle PDU arrival event process as specified in clause 5.4.2.1.

9.2.16.2 Test purpose

To verify that CE handles SYN PDU in CLOSE state in accordance with TS 102 127 [1].

9.2.16.3 Method of test

9.2.16.3.1 Scenario

```
Step   State        CE                                              CS
1.     CLOSE                                          <--     <SEQ=200><ACK=insignificant><SYN>
2.     CLOSE        <SEQ=insignificant><ACK=201><RST,ACK>  -->
                    (optional)
```

9.2.16.3.2 Initial conditions

CE is in CLOSE state.

9.2.16.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	SYN PDU		
2	CE→CS	RST-ACK PDU		Window size set to '0'. Sending of this PDU is optional.
3			Test operator issue close request to CE.	
4			CE returns "Error - Connection not opened".	

9.2.16.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A.

9.2.16.3.5 Expected results

Step 2: RST-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Insignificant
13 - 14	Acknowledgment Number	'00 C8'
19	Reason	'02'

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.2.17 Reception of SYN PDU for 'Unopened' connection

9.2.17.1 Conformance requirements

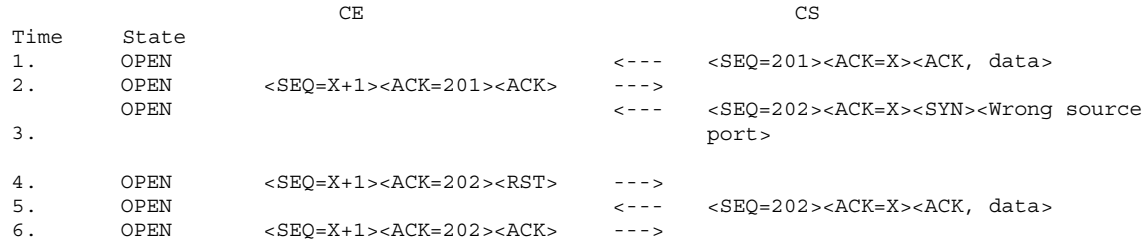
For PDUs addressing connection currently not existing or ports not open, the CLOSED state applies and CE shall handled the PDU according to clauses 5.3.1.3.1 and 5.4.2.1.

9.2.17.2 Test purpose

To verify that CE handles SYN PDU for non-existing connection in a manner similar to that of PDU arrival in 'CLOSE' state.

9.2.17.3 Method of test

9.2.17.3.1 Scenario



9.2.17.3.2 Initial conditions

CE and CS are in OPEN state following the sequence described in annex B.

9.2.17.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	ACK-UNSEG-DATA PDU		
2	CE→CS	ACK PDU		
3	CE←CS	SYN PDU		Incorrect source port specified.
4	CE→CS	RST PDU		
5	CE←CS	ACK-UNSEG-DATA PDU		
6	CE→CS	ACK PDU		

9.2.17.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgement Number	'X'

Step 3: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
5 - 6	Source Port	Unknown to CE
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgement Number	'X'

Step 5: ACK-UNSEG-DATA PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 CA'
13 - 14	Acknowledgement Number	'X'

9.2.17.3.5 Expected results

Step 2: ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	'00 C9'

Step 4: RST PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
7 - 8	Destination Port	'FF FF
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	'00 CA'
19	Reason	'03'

Step 6: ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	'00 CA'

9.2.18 Reception of SYN-ACK PDU with unsupported version

9.2.18.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.4.2.4 and 5.10.

9.2.18.2 Test purpose

To verify that CE is in CLOSE state after it receives SYN-ACK PDU with unsupported version in SYN-SENT state.

9.2.18.3 Methods of test

9.2.18.3.1 Scenario

```
                          CE                                   CS
Time     State
1.       CLOSE       <SEQ=X><SYN>              --->
2.       SYN-SENT                              <---    <SEQ=200><ACK=X><SYN,ACK>
3.       SYN-SENT    <SEQ=X+1><RST>            --->
4.       CLOSE
```

9.2.18.3.2 Initial conditions

The Active open generic initial conditions apply.

9.2.18.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		*Version Number different from 0*
3	CE --> CS	RST PDU.		
4			*CLOSE REQUEST*	*To check that CE actual state is CLOSE state, the test operator send this message.*
5			Signal: Error - Connection not opened	CE shall return this message if it is in CLOSE state.

9.2.18.3.4 Specific message content

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
1	Header = <SYN,ACK>	'C1'

9.2.18.3.5 Expected results

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 3: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
19	Reason	'06'

9.2.19 Reception of RST PDU in CLOSE state

9.2.19.1 Conformance requirements

If no connection exists at all, the CLOSED state PDU arrival events processing is optional as specified in clause 5.3.1.3.1. CE shall handle PDU arrival event process as specified in clause 5.4.2.1.

9.2.19.2 Test purpose

To verify that CE handles RST-ACK PDU in CLOSE state in accordance with TS 102 127 [1].

9.2.19.3 Method of test

9.2.19.3.1 Scenario

```
Step   State        CE                          CS
1.     CLOSE                               <--  <SEQ=200><RST>
2.     CLOSE        <ACK=200><RST,ACK>     -->
                    (optional)
```

9.2.19.3.2 Initial conditions

CE is in CLOSE state.

9.2.19.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE←CS	RST PDU		
2	CE→CS	RST-ACK PDU		Window size set to '0'. Sending of this PDU is optional.
3			Test operator issue close request to CE.	
4			CE returns "Error - Connection not opened".	

9.2.19.3.4 Specific message content

Step 1: RST PDU

Refer to annex A.

9.2.19.3.5 Expected results

Step 2: RST-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Insignificant
13 - 14	Acknowledgment Number	'00 C8'
19	Reason	'04'

Step 4:

Test operator checks that CE returns "Error - Connection not opened".

9.2.20 Reception of SYN-ACK PDU with invalid Max PDU Size value

9.2.20.1 Conformance requirements

CE shall support the connection establishment as specified in clause 5.4.2.4.

9.2.20.2 Test purpose

To verify that CE is in CLOSE state after it receives SYN-ACK PDU with invalid Max PDU size value in SYN-SENT state.

9.2.20.3 Methods of test

9.2.20.3.1 Scenario

```
                          CE                                    CS
    Time     State
    1.       CLOSE      <SEQ=X><SYN>            --->
    2.       SYN-SENT                           <---    <SEQ=200><ACK=X><SYN,ACK>
    3.       SYN-SENT   <SEQ=X+1><RST>          --->
    4.       CLOSE
```

9.2.20.3.2 Initial conditions

The Active open generic initial conditions apply.

9.2.20.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE --> CS	SYN PDU		
2	CE <-- CS	SYN-ACK PDU.		*Max PDU size < '00 17'*
3	CE --> CS	RST PDU.		
4			*CLOSE REQUEST*	*To check that CE actual state is CLOSE state, the test operator send this message.*
5			Signal: Error - Connection not opened	CE shall return this message if it is in CLOSE state.

9.2.20.3.4 Specific message content

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'
19 - 20	Max PDU Size	'00 16'

9.2.20.3.5 Expected results

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	'X'

Step 3: RST PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	X+1
19	Reason	'01'

9.2.21 Damaged PDU reception when CE in CLOSE state

9.2.21.1 Conformance requirements

CE shall perform all validity checks on incoming PDU as specified in clause 5.4.2.1

9.2.21.2 Test purpose

To verify that CE discards the incoming damaged PDU and stays in CLOSE state.

9.2.21.3 Methods of test

9.2.21.3.1 Scenario

```
                          CE                                    CS
    Time     State
    1.       CLOSE                            <---    Damaged PDU
    2.       CLOSE
```

With damaged PDU:

- Invalid PDU types (e.g. SYN and RST both set);
- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);
- PDU length as received from the lower layer does not match sum of header and data length;
- Wrong checksum;
- Size of PDU exceeds maximum acceptable PDU size (RCV_PDU_SIZE_MAX).

9.2.21.3.2 Initial conditions

CE is in CLOSE state.

9.2.21.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	Damaged PDU		*CE discards the PDU*
2			Test operator issue close request to CE.	
3			CE returns "Error - Connection not opened".	

9.2.21.3.4 Specific message content

Step 1: Damaged PDU

- Invalid PDU types (e.g. SYN and RST both set);

SYN PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
1	Header	'90'

- Incorrect header length (e.g. odd number of bytes for EACK information) or data length field (e.g. NUL or RST PDU with non-zero data length field);

ACK-EACK PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
4	Header Length	Odd number
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1

NUL-ACK PDU and RST PDU

Refer to annex A with following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	Different from 0
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1 or insignificant for RST

- PDU length as received from the lower layer does not match sum of header and data length;

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'08'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	'0123'

- Wrong checksum;

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	'02'
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
17 - 18	Checksum	Different from the correct checksum
19 - 20	Data	'0123'

- Size of PDU exceeds maximum acceptable PDU size RCV_PDU_SIZE_MAX (only applicable when Max PDU Size announced by CE is smaller than 'FFFF').

ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
9 - 10	Data Length	To be adapted according to the Max PDU Size announced by CE during the open connection
11 - 12	Sequence Number	'CA'
13 - 14	Acknowledgment Number	X+1
19 - 20	Data	Data to be sent

9.2.21.4.5 Expected results

Step 3:

Test operator checks that CE returns "Error - Connection not opened".

9.2.22 Reception of SYN PDU with unsupported version

9.2.22.1 Conformance requirements

CE shall support the connection establishment as specified in clauses 5.3.1.7, 5.4.2.3 and 5.10.

9.2.22.2 Test purpose

To verify that CE supporting only version number 00 returns a SYN-ACK PDU with its own supported version (00) after it receives a SYN PDU with version number greater than 00 in LISTEN state.

9.2.22.3 Methods of test

9.2.22.3.1 Scenario

```
                          CE                                     CS
Time     State
1.       LISTEN                                 <---    <SEQ=200><SYN>
2.       SYN-RCVD   <SEQ=X><ACK=200><SYN,ACK>   --->
```

9.2.22.3.2 Initial conditions

The Passive open generic initial conditions apply.

9.2.22.3.3 Procedure

Step	Direction	PDU types	Upper layer interactions	Comments
1	CE <-- CS	SYN PDU		*Version Number different from 00*
2	CE --> CS	SYN-ACK PDU.		

9.2.22.3.4 Specific message content

Step 1: SYN PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
1	Header = <SYN>	'81'

9.2.22.3.5 Expected results

Step 2: SYN-ACK PDU

Refer to annex A, with the following exceptions.

Byte (s)	Description	Expected Value
11 - 12	Sequence Number	Not checked

9.2.23 Reception of RST PDU when CE's window size = 0

9.2.23.1 Conformance requirements

- Flow control and window management clause 5.3.3
- OPEN state PDU arrival event processing clause 5.4.2.2

9.2.23.2 Test purpose

To verify that CE stops the exchange of data upon receiving a RST PDU when its window size of 0:

9.2.23.3 Methods of test

9.2.23.3.1 Scenario

```
                                  CE                                       CS
Time     State
1.       OPEN                                                  <---    <SEQ=201><ACK=X><ACK, Data><SEG=0>
2.       OPEN    <SEQ=X+1><ACK=201/W><ACK>                     --->
3.       OPEN    Repeat step 1 and 2 until W=0
4.                                                             <---    <SEQ=201+N><ACK=X><RST,ACK>
5.       CLOSE
```

9.2.23.3.2 Initial conditions

CE shall be in OPEN state.

9.2.23.3.3 Procedure

Step	Direction	PDU type	Upper layer interactions	Comments
1	CE <- CS	ACK-UNSEG-DATA PDU		
2	CE -> CS	ACK PDU		
3				*Repeat step 1 until window size of CE is 0*
4	CE <- CS	RST-ACK PDU		
5			CE returns "Connection reset"	
6			Test operator issues a close request	*This step is used to test that CE is in CLOSE state*
7			CE returns "Error - Connection not opened"	

9.2.23.3.4 Specific message content

Step 1: ACK-UNSEG-DATA PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9'
13 - 14	Acknowledgment Number	'X'

Step4: RST-ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'00 C9+N'
13 - 14	Acknowledgment Number	'X'
19	Reason Code	'00'

9.2.23.3.5 Expected results

Step 2: ACK PDU

Refer to annex A with the following exceptions.

Byte (s)	Description	Value
11 - 12	Sequence Number	'X+1'
13 - 14	Acknowledgment Number	'00 C9'
15 - 16	Window Size	'W'

Step 5: CE shall signal "Connection reset".

Step 7: Test operator checks that CE signals 'Error- Connection not opened'.

Annex A (normative): Default message content

This annex introduces some possible PDU types and their default content which may be sent/received by CS during the test cases. Under the "Value" column, default values that are used by the CS are provided, while the "Expected value" column indicates whether or not the corresponding bytes need to be checked. Values provided under the "Expected value" column means that CE is to set the values of the bytes according to the value provided.

A.1 SYN PDU

Byte (s)	Description	Value	Expected value
1	Header = <SYN>	'80'	'80'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'17'	'17' + L
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	'00 C8'	X
13 - 14	Acknowledgment Number	Insignificant	Not checked
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - 20	Max PDU Size	'01 F4'	To be checked
21 - 22	Max SDU Size	'03 E8'	Not checked
23	Identification	'00'	
23 - 23+L			Not checked

A.2 SYN-ACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <SYN, ACK>	'C0'	'C0'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'17'	'17'+L
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	'00 C8'	X
13 - 14	Acknowledgment Number	X	'00 C8'
15 - 16	Window Size	Default	To be checked
17 - 18	Checksum	See Note 1	To be checked
19 - 20	Max PDU Size	'01 F4'	FFS
21 - 22	Max SDU Size	'03 E8'	Not checked
23	Identification	'00'	
23 - 23+L			Not checked

A.3 ACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK>	'40'	'40'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'12'	'12'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See Note 1	To be checked

A.4 ACK-SEG-DATA PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK, Seg>	'44'	'44'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'12'	'12'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	L	L
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - 18+L	Data	pattern data choosen by test operator according to memory capabilities	pattern data choosen by test operator according to memory capabilities (data given in parameter of send data request have to be equal to data of this PDU)

A.5 ACK-UNSEG-DATA PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK >	'40'	'40'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'12'	'12'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	L	L
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - 18+L	Data	pattern data choosen by test operator according to memory capabilities	pattern data choosen by test operator according to memory capabilities (data given in parameter of send data request have to be equal to data of this PDU)

A.6 ACK-EACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK, EACK>	'60'	'60'
2-3	RFU	Insignificant	Insignificant
4	Header Length	TBD	TBD
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - X	Sequence Number (for out of sequence entries)	Refers to test case	To be checked

A.7 ACK-EACK-UNSEG-DATA PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK, EACK>	'60'	'60'
2-3	RFU	Insignificant	Insignificant
4	Header Length	TBD	TBD
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	L	L
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - X	Sequence Number (for out of sequence entries)	Refers to test case	To be checked
X+1 - X+L	Data	pattern data choosen by test operator according to memory capabilities	pattern data choosen by test operator according to memory capabilities (data given in parameter of send data request have to be equal to data of this PDU)

A.8 NUL-ACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <ACK, NUL>	'48'	'48'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'12'	'12'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked

A.9 RST PDU

Byte (s)	Description	Value	Expected Value
1	Header = <RST>	'10'	'10'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'13'	'13'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Insignificant	Insignificant
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19	Reason Code	Refers to test case	To be checked

A.10 RST-ACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <RST, ACK>	'50'	'50'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'13'	'13'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	'00 00'	'00 00'
17 - 18	Checksum	See note 1	To be checked
19	Reason Code	Refers to test case	To be checked

A.11 NUL-EACK PDU

Byte (s)	Description	Value	Expected Value
1	Header = <EACK, NUL>	'28'	'28'
2-3	RFU	Insignificant	Insignificant
4	Header Length	'12'	'12'
5 - 6	Source Port	'04 00'	CE_PORT
7 - 8	Destination Port	CE_PORT	'04 00'
9 - 10	Data Length	'00 00'	'00 00'
11 - 12	Sequence Number	Refers to test case	Refers to test case
13 - 14	Acknowledgment Number	Refers to test case	Refers to test case
15 - 16	Window Size	Default	Not checked
17 - 18	Checksum	See note 1	To be checked
19 - X	Sequence number	Refers to test case	To be checked

NOTE 1: CAT_TP shall use the 16-bit TCP checksum, which is specified in clause 5.3.2.2 in [1].

NOTE 2: The default window size of CS is up to the test operator.

Annex B (normative): Default connection establishment

The following scenarios are the basic connections establishment used by clause 8 and 9.

- *Active*

```
                              CE                                        CS
Step     State
                  Test operator sends an active open request
1.       CLOSE    <SEQ=X><SYN>              --->
2.       SYN-SENT                           <---   <SEQ=200><ACK=X><SYN,ACK>
3.       SYN-SENT <SEQ=X+1><ACK=200><ACK>   --->
4.       OPEN
```

- *Passive*

```
                              CE                                        CS
Step     State
                  Test operator sends a passive open request
1.       LISTEN                             <---   <SEQ=200><SYN>
2.       SYN-RCVD <SEQ=X><ACK=200><SYN,ACK> --->
3.       SYN-RCVD                           <---   <SEQ=201><ACK=X><ACK>
4.       OPEN
```

History

Document history		
V7.0.0	August 2007	Publication