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TECHNICAL REPORT

SUBJECT/TASK (title)

ELCOM-90
Application Service Element, Protocol Specification

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RESULT (summary)

This document is one of a series of technical reports which form the complete ELCOM-90 documentation. This is version .03 of the report with minor changes regarding responsible people and references. Future updates and new versions will NOT be published for this reason. New versions will only be submitted when technical changes are made.

Please see SINTEF's homepage at: http://www.sintef.no/ELCOM-90. From here you can download the latest version of all relevant documents as pdf-files for free.

This report specifies the protocol for the ELCOM-90 application services. The ELCOM communication concept is dedicated to transfer of process control information between computers in electric utility control systems.

The services provided are: defining, changing, deleting and inspecting groups of information, and managing the transfer of information groups and commands in an open system environment.

KEYWORDS

SELECTED BY AUTHOR(S)		
	Data communication	Control centres
	Communications protocols	Energy management

SUMMARY

The ELCOM communication concept is a result of a joint project initiated by SINTEF Energy Research, former EFI (Norwegian Electric Power Research Institute). The impetus for the development was the need to exchange information in a hierarchical process control system which consisted of both hardware (computers) and software from different manufacturers.

The ISO Open Systems Interconnection Reference Model forms the basis for the ELCOM protocols.

The services provided by the application layer of ELCOM are designed to satisfy the requirements of communications:

- between computers running different Power Application Software (i.e. SCADA, EMS, planning, power market) within a power utility
- between computers running PAS between different power utilities
- between control systems at different levels.

The following set of facilities define basic ELCOM services:

- **The association establishment facility:**

Used to establish connections for information transfer.

- **The association termination facility:**

Used to release connections.

- **The group facility:**

Used for defining, changing, deleting and inspecting group of information. A group of information objects can be identified by its type and number. The group definition is agreed upon by sender and receiver and stored until changed. Thus transfer overhead is minimised.

- **The information transfer facility:**

Used for request and response to initiations of data transfer and to confirm the reception of data. Interutility real-time data transfer spontaneous data management is included. This facility also provides:

  - The command transfer service, used to transfer SCADA control commands or set-points to be executed by the SCADA system at the partner's side.
  - The mixed data transfer service, used to transfer real-time data. Data can be of any legal type and from any group.

- **The test association facility:**

Used to test that the other part is "alive" and may be reached on a specified connection.

Specific power system oriented protocols are defined for Application and Presentation Layer.

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1 INTRODUCTION

This document contains the protocol-part of the definition to supply power applications with tools facilitating communication.

This document should be read together with [9] where the different classes of application services are defined.

A set of services has been added to the ELCOM-83 protocols to form the ELCOM-90 protocols:

The added services of ELCOM-90 are:

ELCOM-90 - ELCOM-83 compatibility.
Command and setpoint transmission.
Initiator control of cycle times. Priority class.
Version control of group definitions.
Formats for logical breakers.
Mixed data transfer format.
Improvement of security.
Short text messages.

Acknowledgement

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2 SCOPE AND FIELD OF APPLICATION

This definition consists of an Application Protocol to support the ELCOM-90 Application services. The definition includes a formal statement of the nature of the automation giving the necessary behaviour of each of the participating entities. It states:

* The actions to be taken on receiving request and response primitives issued by an Application service user.

* The actions to be taken on receiving indication and confirm primitives issued by the Presentation service provider.

* The actions to be taken as a result of events within the application entity.

The scope of the Application Protocol is limitied to the interconnection of systems. It does not specify or restrict the possible implementation of interfaces within a computer system.

The purpose of the definition is to specify the behaviour which must be exhibited by a system in order to take part in the provision of the ELCOM-90 Application-service.

The Application Protocol Specification refers to two service definitions in order to express the environment within which it is applied. The Application Service defines the aims and the objectives that the protocol must achieve. The Presentation Service defines the set of assumptions about the supporting facilities which the protocol may exploit. See figure 3.0.

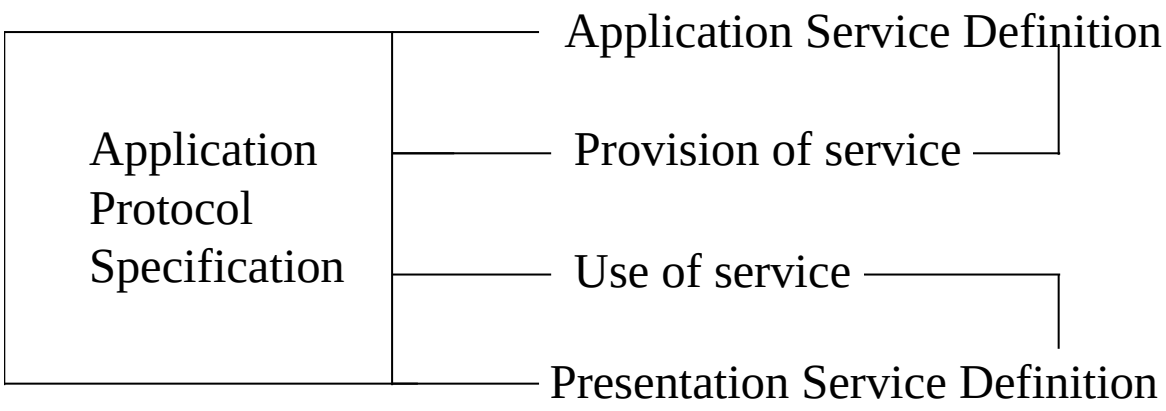

Figure 2.1 The ELCOM-90 Application Protocol environment.

3 ASSOCIATED DOCUMENTS

3.1 ELCOM-83 documents

[1]: TR 3522: **ELCOM-83 Application Service Definition**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-07-05

[2]: TR 3528: **ELCOM-83 Application Protocol Definition**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-07-14

[3]: TR 3523: **ELCOM-83 Definition of Local Application Interface**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-07-05

[4]: TR 3524: **ELCOM-83 Presentation Service Definition**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-07-06

[5]: TR 3527: **ELCOM-83 Presentation Protocol Definition**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-07-13

[6]: TR 3532: **ELCOM-83 Definition of Local Presentation Interface**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1988-09-12

[7]: TR 3649: **ELCOM-83 Conventions**
Norwegian Electric Power Research Institute, Trondheim, Norway, 1989-12-20
ISBN 82-594-0086-3

3.2 ELCOM-90 documents

This document is one of a series of technical reports which form the complete ELCOM-90 documentation. Below you will find the numbers and titles for all the associated technical reports. New versions may be submitted when technical changes are made.
Please see SINTEF's homepage at: http://www.sintef.no//ELCOM-90. From here you can download the latest version of all relevant documents as pdf-files for free.
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[8]: TR 3701: **ELCOM-90 Application Programming Interface Specification**

[9]: TR 3702: **ELCOM-90 Application Service Element. Service Definition**

[10]: TR 3703: **ELCOM-90 Application Service Element. Protocol Specification**

[11]: TR 3704: **ELCOM-90 Presentation Programming Interface Specification**

[12]: TR 3705: **ELCOM-90 Presentation Service Definition**

[13]: TR 3706: **ELCOM-90 Presentation Protocol Specification**

[14]: TR 3825: **ELCOM-90 User Element Conventions**

[15]: TR A3933: **ELCOM-90 Local Conventions**

[16] TR A4687: **PONG. The ELCOM net-watch procedure for TCP/IP networks**

[17] TR A4124: **ELCOM-90 Application Service Element, User's manual.**

[18] TR A6196: **Securing ELCOM-90 with TLS.**

3.3 Other references

[19]: **Microcomputer Architecture and Programming**
John F. Wakerly, John Wiley & Sons. Inc. 1981.

4 DEFINITIONS

Object	:	A physical or logical data source or data sink. A specific type of data is attached to the object. This data may be time dependent. Sensors and breakers are typical objects in this context.
Objid	:	Object identifier.
Objid length	:	Maximum length of object identifier, exclusive length indicator.
Group	:	Set of named data objects of same type, implicitly numbered by their indexes.
Group type	:	Describes type of objects represented in the group.
Group number	:	Identifier for a group.
Group size	:	Maximum number of objects in a group.
Main connection	:	An association established between two A-entities for transfer of data.
Sub-connection	:	An association established between two A-entities dedicated for the transfer of spontaneous data.
DCUT1	:	A timer used by the application entity for supervision of the application service user. Default value 60 sec.
DCLT1	:	A timer used by the application entity for supervision of the remote peer entity. Default value 120 sec.
Initiator	:	The service user responsible for association establishment/group configuration, data transfer, and association termination (e.g. on a background computer as data sink).
Responder	:	The peer service user to the initiator (e.g. on a process computer as data source responding to the requests from the initiator). A Service user may act as initiator and responder at the same time.
Idle state	:	A connected entity waiting for an incoming event is in the idle state.

Initiating entity : An application entity that was in idle state and has received a request event from the upper service user.

Responding entity : An application entity that was in idle state and has received an incoming event from its lower service provider.

Group incarnation : Set of simultaneous values from a given group.

5 ABBREVIATIONS

I	:	Initiator
R	:	Responder
Objlength	:	Objid length
G	:	Group
Gtype	:	Group type
Gnr	:	Group number
Gsize	:	Group size
Gstat	:	Group status
PDU	:	Protocol Data Unit
Mgnt	:	Management
Def	:	Define
Conf-Data	:	Confirm-Data
Spont	:	Spontaneous
G-M	:	Group-Mgnt
D-G	:	Def-Group
G-G	:	Get-Group
I-T	:	Init-Transfer
C-D	:	Conf-Data
S-M	:	Spont-Mgnt
T-C	:	Test-Connection
C-T	:	Command-Transfer

M-D	:	Mixed-Data
M-D-E	:	Mixed-Data-Error
M	:	More-Data
ST...I	:	Denotes the initiating entity's idle state. (Class 0, 1 and 3 of the protocol).
ST...R	:	Denotes the responding entity's idle state. (Class 0, 1 and 3 of the protocol).
T-Unit	:	Time unit
A-	:	Application

6 OVERVIEW OF THE ELCOM-90 A-PROTOCOL

6.1 SERVICE PROVIDED

The protocol provides the A-service defined in [9]. The following facilities are provided:

PREFIX OF NAME OF SERVICE PRIMITIVES	NAME OF ELEMENTARY SERVICE	TYPE OF ELEMENTARY SERVICE
Application-Connection Establishment Facility		
A-Connect	Connection establishment	Confirmed
Application-Connection Termination Facility		
A-Release	Connection release	Confirmed
A-P-Abort	Provider initiated abort	Non-confirmed
Group Facility		
A-Group-Mgnt	Create/delete/change group	Confirmed
A-Def-Group	Define group	Confirmed
A-Get-Group	Get group definition	Confirmed
Information Transfer facility		
A-Init-Transfer	Request information	Non-confirmed
A-Data	Send information (Requested or spontaneous)	Non-confirmed
A-Conf-Data	Confirmed data reception	Non-confirmed
A-Spont-Mgnt	Management of spontaneous data transfer	Confirmed
A-Comm-Transfer	Transfer of commands and setpoints	Confirmed
A-Mixed-Data	Send information (spontaneous)	Non-confirmed
A-Mixed-Data-Error	Send error response (spontaneous)	Non-confirmed
Test Connection Facility		
A-Test-Connection	Test reachability and status	Confirmed

6.2 SERVICE REQUIRED

The protocol uses the Presentation service defined in [12] to provide structured communication between two A-entities. The following facilities are required.

PREFIX OF NAME OF SERVICE PRIMITIVES	NAME OF ELEMENTARY SERVICE	TYPE OF ELEMENTARY SERVICE
Presentation-Connection Establishment Facility		
P-Connect	Connection establishment	Confirmed
Presentation-Connection Termination Facility		
P-Release P-P-Abort	Connection release Provider initiated abort	Confirmed Non-confirmed
Information Transfer Facility		
P-Data	Send information	Non-confirmed

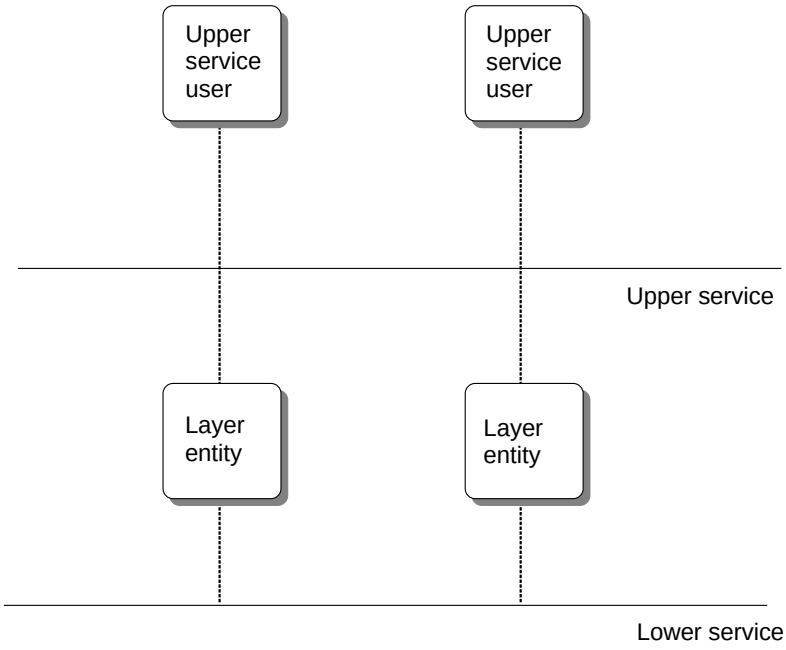
6.3 FUNCTIONS PROVIDED BY THE PROTOCOL

The protocol performs the following functions:

- Representation of the A-service primitives as a sequence of data items for transmission by the Presentation service.
- Ensuring the legal sequence of A-service primitives used.
- Ensuring the progress of the protocol (timer management).

6.4 MODEL USED FOR THE LAYER

The operation of the protocol in the layer is modelled by the interaction of two entities. The two entities communicate by means of the service available at the lower boundary of the layer, in such a way as to provide the service required at the upper boundary of the layer. These concepts are illustrated in figure 6.4.1.



Lower service provider

Figure 6.1 Model of the layer.

The behaviour of an entity is described in terms of

- the Information it maintains,
- the Events it receives and
- the Actions it makes.

See figure 6.2.

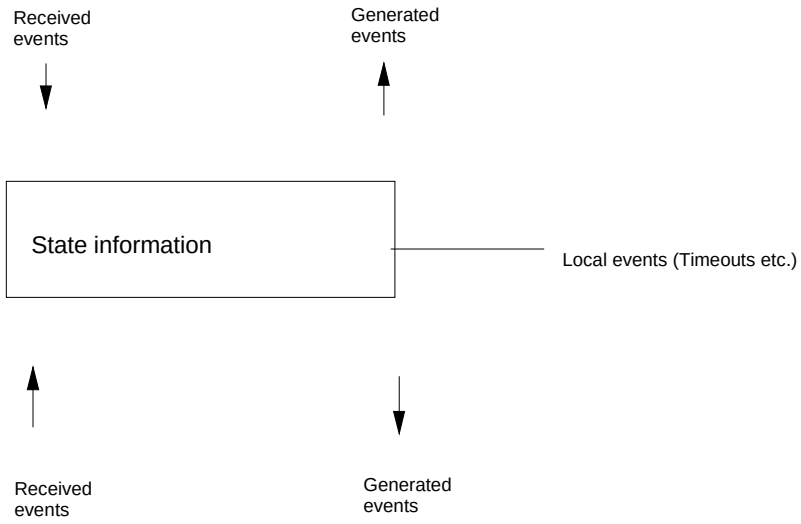


Figure 6.2 Model of an entity.

The information maintained by the entity includes state-information in determining the actions to be taken when an event is received. The information may be:

- information associated with the connection established by the A-service user.

An entity may receive the following events:

- Request or response service primitives from the upper service user.

- Indication or confirm service primitives from the lower service provider. This may take the form of a sequence of data items received as the parameters of P-DATA indication service primitives. For convenience this is referred to as receiving a Protocol Data Unit (PDU).

- The local events of timer expiry or local error indication.

An entity may take the following actions:

- Issue indication or confirm service to the upper service user.

- Issue request or response service primitives to the lower service provider. This action may consist of a sequence of P-DATA request primitives with data items as parameters. For convenience the sequence of data items is considered to form a Protocol Data Unit (PDU) and the actions is referred to as sending a PDU.

- The local action of timer establishment and supervision, and when timers have expired.

7 PROTOCOL DATA UNITS

This clause specifies in tables the data items within each kind of protocol data unit (PDU). The encoding of the data types is given in Appendix A. A sequence of data types received is a protocol data unit of the stated type if and only if it contains all the mandatory items in the order given, and does not contain any items not present in the table.

7.1 PDUs of class 0

Table 7.1 Specification of Connect request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"A-Connect request"	Mandatory
Version	From service request	Mandatory
User-data	From service request	

Table 7.2 Specification of Connect response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"A-Connect response"	Mandatory
Version	From service response	Mandatory
User-data	From service response	
Result	From service response or the entity	Mandatory

Table 7.3 Specification of Init-Transfer.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Init-Transfer"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Index 1	From service request	Mandatory
Index 2	From service request	Mandatory
T0	From service request	Mandatory
Dt	From service request	Mandatory
T-unit	From service request	Mandatory
Periods	From service request	Mandatory

Table 7.4 Specification of Data (init),Transmod = Initiated.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Data"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Index 1	From service request	Mandatory
Index 2	From service request	Mandatory
T	From service request	Mandatory
More-D	From service request	Mandatory
Data	From service request	Mandatory
Result	From service request	Mandatory

Table 7.5 Specification of Conf-Data (init), Transmod = Initiated.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Conf-Data"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Transmod	From service request	Mandatory
Result	From service request	Mandatory

Table 7.6 Specification of Test-Connection request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Test-Connection request"	Mandatory

Table 7.7 Specification of Test-Connection response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Test-Connection response	Mandatory
Result	From service response	Mandatory

Table 7.8 Specification of Error.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Error"	Mandatory
Result	From the entity	Mandatory

7.2 PDUs of Class 1

In addition to the PDUs specified for class 0, this class applies the following PDUs:

Table 7.9 Specification of Group-Mgnt request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Group-Mgnt request"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Gstat	From service request	Mandatory
Gsize	From service request	Mandatory
Objlength	From service request	Mandatory
Function	From service request	Mandatory

Table 7.10 Specification of Group-Mgnt response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Group-Mgnt response"	Mandatory
Gtype	From service response	Mandatory
Gnr	From service response	Mandatory
Function	From service response	Mandatory
CF	From service response	Mandatory
Result	From service response	Mandatory

Table 7.11 Specification of Def-Group request..

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Def-Group-request"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Index1	From service request	Mandatory
Index2	From service request	Mandatory
Objid (i)	From service request	Mandatory

Table 7.12 Specification of Def-Group response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Def-Group response"	Mandatory
Gtype	From service response	Mandatory
Gnr	From service response	Mandatory
Index1	From service response	Mandatory
Index2	From service response	Mandatory
CF	From service response	Mandatory
Result (i)	From service response	Mandatory

Table 7.13 Specification of Get-Group request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Get-Group-request"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Index1	From service request	Mandatory
Index2	From service request	Mandatory

Table 7.14 Specification of Get-Group response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Get-Group response"	Mandatory
Gtype	From service response	Mandatory
Gnr	From service response	Mandatory
Gstat	From service response	Mandatory
Gsize	From service response	Mandatory
Objlength	From service response	Mandatory
Index1	From service response	Mandatory
Index2	From service response	Mandatory
Result	From service response	Mandatory
Objid (i)	From service response	Mandatory

Table 7.15 Specification of Spont-Mgnt request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Spont-Mgnt-request"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Function	From service request	Mandatory

Table 7.16 Specification of Spont-Mgnt response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Spont-Mgnt response"	Mandatory
Gtype	From service response	Mandatory
Gnr	From service response	Mandatory
Function	From service response	Mandatory
Result	From service response	Mandatory

Table 7.17 Specification of Data (spont), Transmod = Spontaneous.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Data"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Transmod	From service request	Mandatory
Index1	From service request	Mandatory
Index2	From service request	Mandatory
T	From service request	Mandatory
More-D	From service request	Mandatory
Data	From service request	Mandatory
Result	From service request	Mandatory

Table 7.18 Specification of Conf-Data (spont), Transmod = Spontaneous.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Conf-Data"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Transmod	From service request	Mandatory
Result	From service request	Mandatory

7.3 PDUs of class 2

All PDUs specified for class 0 and class 1 belong to this class too.

7.4 PDUs of class 3

In addition to the PDUs specified for class 2, this class applies the following PDUs:

Table 7.19 Specification of Command Transfer request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Command-Transfer request"	Mandatory
Gtype	From service request	Mandatory
Gnr	From service request	Mandatory
Index1	From service request	Mandatory
Index2	From service request	Mandatory
T	From service request	Mandatory
Time mode	From service request	Mandatory
Com.type	From service request	Mandatory
Data	From service request	Mandatory

Table 7.20 Specification of Command Transfer response.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Command-Transfer response"	Mandatory
Gtype	From service response	Mandatory
Gnr	From service response	Mandatory
Index1	From service response	Mandatory
Index2	From service response	Mandatory
T	From service response	Mandatory
Time mode	From service response	Mandatory
Com.type	From service response	Mandatory
Data	From service response	Mandatory
Result	From service response	Mandatory

Table 7.21 Specification of Mixed Data request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Mixed Data request"	Mandatory
T	From service response	Mandatory
Data	From service response	Mandatory

Table 7.22 Specification of Mixed Data Error request.

DATA ITEM	VALUE/SOURCE WHEN SENDING	STATUS
PDU-type	"Mixed Data Error request"	Mandatory
Result	From service request	Mandatory

8 INFORMATION MAINTAINED BY THE ENTITY

The entity maintains state-information used in determining the action to be used when an event is received.

8.1 Entity-Information of Class 0

The states concerning connection establishment and termination are shown in Table 8.1.

Table 8.1 States concerning connection establishment and termination.

STATE DESCRIPTION	STATE CODE
Ready for connect	STC0
Establishing on request	STC1
Disestablishing on request	STC2
Establishing on indication	STC3
Disestablishing on indication	STC4
Connected	STC10

For class 0 of the protocol the groups are created and predefined at system-generation time. The states concerning information transfer and test connection are shown in Table 8.2.

Table 8.2 States concerning information transfer and test connection.

STATE DESCRIPTION	STATE CODE
Idle (connected)/Initiating entity	ST0I
Idle (connected)/Responding entity	ST0R
Data (init) PDU pending	ST1
A-Data (init) request pending	ST2
Conf-Data (init) PDU pending	ST3
A-Conf-Data (init) request pending	ST4
Test-Connection response PDU pending	ST100
A-Test-Connection response pending	ST101

8.2 Entity-information of Class 1

In addition to the states specified for class 0, the entity maintain states concerning group management- and definition, and spontaneous management. See Table 8.3.

Table 8.3 States concerning group management, group definition and spontaneous management.

STATE DESCRIPTION	STATE CODE
Group-Mgnt response PDU pending	ST10
A-Group-Mgnt response pending	ST11
Def-Group response PDU pending	ST12
A-Def-Group response pending	ST13
Get-Group response PDU pending	ST14
A-Get-Group response pending	ST15
Spont-Mgnt response PDU pending	ST16
A-Spont-Mgnt response pending	ST17

States concerning spontaneous information transfer are treated as belonging to a subconnection. The states are showed in Table 8.4.

Table 8.4 Substates concerning spontaneous information transfer.

STATE DESCRIPTION	STATE CODE
Idle (Initiating entity)	STS0I
Idle (Responding entity)	STS0R
Data (spont) PDU pending	STS1
A-Data (spont) request pending	STS2
A-Conf-Data (spont) request pending	STS3
Conf-Data (spont) PDU pending	STS4

8.3 Entity-Information of Class 2

All states shown in Table 8.1, Table 8.2, Table 8.3 and Table 8.4 belong to this class too.

However, in this class there will be no difference between the initiator's and responder's service provider. Therefore the idle states ST...I and ST...R denotes the same state.

8.4 Entity-information of Class 3

In addition to the states specified for class 2 the entity maintain states concerning command and setpoint transfer.

Table 8.5 States concerning command transfer.

STATE DESCRIPTION	STATE CODE
Command-Transfer response PDU pending A-Command-Transfer response pending	ST18 ST19

9 THE EVENTS THAT ACTIVATES THE ENTITY

9.1 Events of Class 0

Events concerning connection establishment and termination are shown in table 9.1.

The groups are predefined at system generation time, and the events concerning data transfer and test connection are shown in Table 9.2.

Table 9.1 Events of connection establishment and termination.

EVENT DESCRIPTION	EVENT CODE
Request events	
A-Connect request	EC01
A-Release request	EC02
Incoming events	
Connect request PDU	EC11
P-Release indication	EC12
Connect response PDU	EC13
P-Release confirmation	EC14
P-P-Abort indication	EC15
Response events	
A-Connect response	EC21
A-Release response	EC22

Table 9.2 Events of data transfer and test connection.

EVENT DESCRIPTION	EVENT CODE
Request	
A-Init-Transfer request	E005
A-Data (init) request	E006
A-Conf-Data (init) request	E007
A-Test-Connection request	E008
Incoming PDU events	
Init-Transfer PDU	E109
Data (init) PDU	E110
Conf-Data (init) PDU	E111
Test-Connection response PDU	E112
Test-Connection request PDU	E113
Error PDU	E114
Response events	
A-Test-Connection response	E205
Local events	
Expiry of timer DCLT1	ELL1
Expiry of timer DCUT1	ELU1

9.2 Events of Class 1

In addition to the events specified for class 0, the entity will treat events concerning group management and definition, and spontaneous information transfer. See Table 9.3.

Events concerning spontaneous information transfer are treated as belonging to a subconnection. See Table 9.4.

Table 9.3 Events of group management, group definition and spontaneous information transfer.

EVENT DESCRIPTION	EVENT CODE
Request events	
A-Group-Mgnt request	E001
A-Def-Group request	E002
A-Get-Group request	E003
A-Spont-Mgnt request	E004
Incoming PDU events	
Group-Mgnt response PDU	E101
Group-Mgnt request PDU	E102
Def-Group response PDU	E103
Def-Group request PDU	E104
Get-Group response PDU	E105
Get-Group request PDU	E106
Spont-Mgnt response PDU	E107
Spont-Mgnt request PDU	E108
Response events	
A-Group-Mgnt response	E201
A-Def-Group response	E202
A-Get-Group response	E203
A-Spont-Mgnt response	E204

Table 9.4 Events of spontaneous information transfer.

EVENT DESCRIPTION	EVENT CODE
Request events	
A-Data (spont) request	ES01
A-Data-Conf(spont) request	ES02
Incoming PDU events	
Data (spont) PDU	ES11
Conf-Data (spont) PDU	ES12

9.3 Events of Class 2

All events shown in Table 9.1, Table 9.2, Table 9.3 and Table 9.4 are legal in this class too.

9.4 Events of Class 3

In addition to the events specified for class 2, the entity will treat events concerning command and setpoint transfer.

Table 9.5 Events of command and setpoint transfer.

EVENT DESCRIPTION	EVENT CODE
Request events	
A-Command-Transfer request	E009
A-Mixed-Data request (spontaneous)	E010
A-Mixed-Data Error request (spontaneous)	E011
Incoming PDU events	
Command-Transfer response PDU	E115
Command-Transfer request PDU	E116
A-Mixed-Data Error request PDU (spontaneous)	E117
A-Mixed-Data request PDU (spontaneous)	E118
Response events	
A-Command-Transfer response	E206

10 ENTITY ACTIONS

When the entity receives any of the events specified in clause 9, this will initiate an action depending on current state information and the type of the event received.

The entity will generate new indications or confirms to the upper service user or generate and send PDUs to its peer entity using lower service primitives. When the action is completed, the entity will normally move from one state to another. State-diagrams are shown in Appendix B and decision tables in Appendix C.

10.1 Actions of Class 0

10.1.1 Connection Establishment and Termination

10.1.1.1 Initiating entity actions

10.1.1.1.1 Action initiated by event EC01 while in the STC0-state

On receiving an A-Connect request service primitive from the A-service user while in the "Ready for connect"-state the entity shall:

- Send the sequence of data items that constitutes a Connect request PDU as a P-Connect request primitive.

10.1.1.1.2 Action initiated by event EC13 while in the STC1-state

On receiving a Connect response PDU while in the "Establishing on request"-state, the entity shall:

- Issue an A-Connect confirm service primitive to the A-service user with parameters derived from data items received.

- If the P-RESULT code indicates error, the following rules applies: If P-RESULT is different from both A-R0 and A-RC14, then use P-RESULT as RESULT-code to A service user. If P-RESULT equals A-RC14, then use A-RESULT as RESULT-code to A service user.

10.1.1.1.3 Action initiated by event EC15 while in the STC10-state

On receiving a P-P-Abort indication service primitive while in the "Connected"-state, the entity shall:

- Issue an A-P-Abort indication service primitive to the A-service user with Reason-parameter derived from the P-P-Abort indication service primitive.

10.1.1.1.4 Action initiated by event EC02 while in the ST0I-state

On receiving an A-Release request primitive from the A-service user while in the "connected" (Idle)-state the entity shall:

- Send a P-Release request.

10.1.1.1.5 Action initiated by event EC14 while in the STC2-state

On receiving a P-Release confirm service primitive while in the "Disestablishing on request"-state, the entity shall:

- Issue an A-Release confirm service primitive to the A-service user.

10.1.1.1.6 Action initiated by event EC15 while in the STC2-state

On receiving a P-P-Abort indication service primitive while in the "Disestablishing on request"-state, the entity shall:

- Issue an A-P-Abort indication service primitive to the A-service user with Reason parameter derived from the P-P-Abort indication service primitive.

10.1.1.2 Responding entity actions

10.1.1.2.1 Action initiated by event EC11 while in the STC0-state

On receiving an incoming Connect request PDU while in the "Ready for connect"-state, the entity shall:

- Issue an A-Connect indication service primitive to the A-service user with parameters derived from the data items received.

10.1.1.2.2 Action initiated by event EC21 while in the STC3-state

On receiving an A-Connect response service primitive from the A-service user while in the "Establishing on indication"-state, the entity shall:

- Send the sequence of data items that constitutes a Connect response PDU as a P-Connect response.

- If A-result is different from A-R0, then P-results is set to A-RC14.

10.1.1.2.3 Action initiated by event EC15 while in the STC10-state

On receiving a P-P-Abort indication service primitive while in the "Connected"-state, the entity shall:

- Issue an A-P-Abort indication service primitive to the A-service user with Reason parameter derived from the P-P-Abort indication service primitive.

10.1.1.2.4 Action initiated by event EC12 while in the ST0R-state

On receiving an P-Release indication service primitive while in the "Connected" (Idle)-state, the entity shall:

- Issue an A-Release indication service primitive to the A-service user.

10.1.1.2.5 Action initiated by event EC22 while in the STC4-state

On receiving an A-Release response service primitive from the A-service user while in the "Disestablishing on indication"-state, the entity shall:

- Send a P-Release response.

10.1.1.2.6 Action initiated by event EC15 while in the STC4-state

On receiving a P-P-Abort indication service primitive while in the "Disestablishing on indication"-state, the entity shall:

- Issue an A-P-Abort indication service primitive to the A-service user with Reason-parameter derived from the P-P-Abort indication service primitive.

10.1.2 Information transfer

10.1.2.1 Initiating entity actions

10.1.2.1.1 Action initiated by event E005 while in the ST0I-state

On receiving an A-Init-Transfer request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes an Init-Transfer PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1.

- Restart the timer for DCLT1.

10.1.2.1.2 Action initiated by event E110 while in the ST1-state

On receiving an incoming Data (init) PDU while in the "Data (init) PDU pending"-state, the entity shall:

- Issue an A-Data (init) indication service primitive to the a-service user with parameters derived from data items received.

- If MORE-D = TRUE or the subconnection in the STS1-state, then restart the timer for DCLT1 else cancel the timer for DCLT1.

- If MORE-D = FALSE then restart the timer for DCUT1.

10.1.2.1.3 Action initiated by event E007 while in ST1-state

On receiving an A-Conf-Data (init) request service primitive while in the "Data (init) PDU pending"-state and if A-Conf-Data (init). Result <>OK, the entity shall:

- Send the sequence of data items which constitutes a Conf-Data (init) PDU as a P-DATA request.

- If the subconnection in the STS3 or STS0-state then cancel the timer for DCLT1.

10.1.2.1.4 Action initiated by event E114 while in ST1-state

On receiving an incoming Error PDU while in the "Data (init) PDU pending"-state, the entity shall:

- Issue an A-Data (init) indication service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.1.2.1.5 Action initiated by event ELL1 while in ST1-state

On expiry of the timer for DCLT1 while in the "Data (init) PDU pending"-state, the entity shall:

- Issue an A-Data (init) indication service primitive to the a-service user with Result = "No-answer-from-remote-part-of-provider".

10.1.2.1.6 Action initiated by event E007 while in ST4-state

On receiving an A-Conf-Data (init) request service primitive while in the "A-Conf-Data (init) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Conf-Data (init) PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.1.2.1.7 Action initiated by event ELU1 while in ST4-state

On expiry of the timer for DCUT1 while in the "A-Conf-Data (init) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

10.1.2.2 Responding entity actions

10.1.2.2.1 Action initiated by event E109 while in ST0R-state

On receiving an incoming Init-Transfer PDU while in the "IDLE"-state, the entity shall:

- Issue an A-Init-Transfer indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer for DCUT1.

10.1.2.2.2 Action initiated by event E006 while in ST2-state

On receiving an A-Data (init) request service primitive from the A-service user while in "A-Data (init) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Data (init) PDU as a P-DATA request.

- If MORE-D = TRUE or the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

- If MORE-D = FALSE then restart the timer for DCLT1.

10.1.2.2.3 Action initiated by event E111 while in ST2-state

On receiving a Conf-Data (init) incoming PDU while in "A-Data (init) request pending"-state and if Conf-Data(init) PDU.Result<>OK, the entity shall:

- Issue an A-Conf-Data (init) indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4 or STS0 - state then cancel the timer for DCUT1.

10.1.2.2.4 Action initiated by event ELU1 while in the ST2-state

On expiry of the timer for DCUT1 while in the "A-Data (init) request pending" - state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

- Issue an A-Conf-Data (init) indication service primitive to the A-service user with Result = "Misbehaviour of local service user".

10.1.2.2.5 Action initiated by event E111 while in the ST3-state

On receiving a Conf-Data (init) incoming PDU while in "Conf-Data (init) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (init) indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.1.2.2.6 Action initiated by event E114 while in the ST3-state

On receiving an incoming Error PDU while in the "Conf-Data (init) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (init) indication service primitive to the A-service user with Result = Error PDU.Result.

- Cancel the timer for DCLT1.

10.1.2.2.7 Action initiated by event ELL1 while in the ST3-state

On receiving an incoming Error PDU while in the "Conf-Data (init) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (init) indication service primitive to the A-service user with Result = Error PDU.Result.
- Cancel the timer for DCLT1.

10.1.3 Test-Connection

10.1.3.1 Initiating entity actions

10.1.3.1.1 Action initiated by event E008 while in the ST0I-state

On receiving an A-Test-Connection request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Test-Connection request PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1.

- Restart the timer for DCLT1.

10.1.3.1.2 Action initiated by event E112 while in the ST100-state

On receiving an incoming Test-Connection response PDU while in the "Test-Connection response PDU pending"-state, the entity shall:

- Issue an A-Test-Connection confirm service primitive to the A-service user with parameters derived from data items received.

- If the subconnection in the STS1-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.1.3.1.3 Action initiated by event E114 while in the ST100-state

On receiving an incoming Error PDU while in the "Test-Connection response PDU pending"-state, the entity shall:

- Issue an A-Test-Connection confirm service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.1.3.1.4 Action initiated by event ELL1 while in the ST100-state

On expiry of the timer for DCLT1 while in the "Test-Connection response PDU pending"-state, the entity shall:

- Issue an A-Test-Connection confirm service primitive to the A-service user with result = "No-answer-from-remote-part-of-provider".

10.1.3.2 Responding entity actions

10.1.3.2.1 Action initiated by event E113 while in the ST0R-state

On receiving an incoming Test-Connection request PDU while in the "Idle"-state, the entity shall:

- Issue an A-Test-Connection indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer DCUT1.

10.1.3.2.2 Action initiated by event E205 while in the ST101-state

On receiving an A-Test-Connection response service primitive from the A-service user while in "A-Test-Connection response pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Test-Connection response PDU as a P-DATA request.

- If the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.1.3.2.3 Action initiated by event ELU1 while in the ST101-state

On expiry of the timer for DCUT1 while in the "A-Test-Connection response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote service-user unavailable".

10.2 Actions of Class 1

10.2.1 Group Management

10.2.1.1 Initiating entity actions

10.2.1.1.1 Action initiated by event E001 while in the ST0I-state

On receiving an A-Group-Mgnt request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Group-Mgnt request PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1.

- Restart the timer for interval DCLT1.

10.2.1.1.2 Action initiated by event E101 while in the ST10-state

On receiving an incoming Group-Mgnt response PDU while in the "Group-Mgnt response PDU pending"-state, the entity shall:

- Issue an A-Group-Mgnt confirm service primitive to the A-service user with parameters derived from data items received.

- If the subconnection in the STS1-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.2.1.1.3 Action initiated by event E114 while in the ST10-state

On receiving an incoming Error PDU while in the "Group-Mgnt response PDU pending"-state, the entity shall:

- Issue an A-Group-Mgnt confirm service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.2.1.1.4 Action initiated by event ELL1 while in the ST10-state

On expiry of the timer for DCLT1 while in the "Group-Mgnt response PDU pending"-state, the entity shall:

- Issue an A-Group-Mgnt confirm service primitive to the A-service user with Result = "No-answer-from-remote-part-of-provider".

10.2.1.2 Responding entity actions

10.2.1.2.1 Action initiated by event E102 while in the ST0R-state

On receiving an incoming Group-Mgnt request PDU while in the "Idle" state, the entity shall:

- Issue an A-Group-Mgnt indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer for DCUT1.

10.2.1.2.2 Action initiated by event E201 while in the ST11-state

On receiving an A-Group-Mgnt response service primitive from the A-service user while in the "A-Group-Mgnt response pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Group-Mgnt response PDU as a P-DATA request.

- If the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.2.1.2.3 Action initiated by event ELU1 while in the ST11-state

On expiry of the timer for DCUT1 while in the "A-Group-Mgnt response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-Data request with Result = "Remote-service-user-unavailable".

10.2.2 Define Group

10.2.2.1 Initiating entity actions

10.2.2.1.1 Action initiated by event E002 while in the ST0I-state

On receiving an A-Def-Group request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Def-Group request PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1.

- Restart the timer for DCLT1.

10.2.2.1.2 Action initiated by event E103 while in the ST12-state

On receiving an incoming Def-Group response PDU while in the "Def-Group response PDU pending"-state, the entity shall:

- Issue an A-Def-Group confirm service primitive to the A-service user with parameters derived from data items received.

- If the subconnection in the STS1-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.2.2.1.3 Action initiated by event E114 while in the ST12-state

On receiving an incoming Error PDU while in the "Def-Group response PDU pending"-state, the entity shall:

- Issue an A-Def-Group confirm service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.2.2.1.4 Action initiated by event ELL1 while in the ST12-state

On expiry of the timer for DCLT1 while in the "Def-Group-response PDU pending"-state, the entity shall:

- Issue an A-Def-Group confirm service primitive to the A-service user with Result = "No-answer-from-remote-part-of-provider".

10.2.2.2 Responding entity actions

10.2.2.2.1 Action initiated by event E104 while in the ST0R-state

On receiving an incoming Def-Group request PDU while in the "Idle" state, the entity shall:

- Issue an A-Def-Group indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer for DCUT1.

10.2.2.2.2 Action initiated by event E202 while in the ST13-state

On receiving an A-Def-Group response service primitive from the A-service user while in "A-Def-Group response pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Def-Group response PDU as a P-Data request.

- If the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.2.2.2.3 Action initiated by event ELU1 while in the ST13-state

On expiry of the timer for DCUT1 while in the "A-Def-Group response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

10.2.3 Get Group

10.2.3.1 Initiating entity actions

10.2.3.1.1 Action initiated by event E003 while in the ST0I-state

On receiving an A-Get-Group request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Get-Group request PDU as a P-DATA request.

- If the subconnection in the STS3-state then restart the timer for DCUT1.

- Restart the timer for DCLT1.

10.2.3.1.2 Action initiated by event E105 while in the ST14-state

On receiving an incoming Get-Group response PDU while in the "Get-Group response PDU pending"-state, the entity shall:

- Issue an A-Get-Group confirm service primitive to the A-service user with parameters derived from data items received.

- If the subconnection in the STS1-state, then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.2.3.1.3 Action initiated by event E114 while in the ST14-state

On receiving an incoming Error PDU while in the "Get-Group response PDU pending"-state, the entity shall:

- Issue an A-Get-Group confirm service primitive to the A-service user with Result = Error PDU.Result.

- Cancel the timer for DCLT1.

10.2.3.1.4 Action initiated by event ELL1 while in the ST14-state

On expiry of the timer for DCLT1 while in the "Get-Group response PDU pending"-state, the entity shall:

- Issue an A-Get-Group confirm service primitive to the A-service user with Result = "No-answer-from-remote-part-of-provider".

10.2.3.2 Responding entity actions

10.2.3.2.1 Action initiated by event E106 while in the ST0R-state

On receiving an incoming Get-Group request PDU while in the "Idle"-state, the entity shall:

- Issue A-Get-Group indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer for DCUT1.

10.2.3.2.2 Action initiated by event E203 while in the ST15-state

On receiving an A-Get-Group response service primitive from the A-service user while in "A-Get-Group response pending"-state, the entity shall:

- Send the sequence of data items, which constitutes a Get-Group response PDU as a P-DATA request.

- If the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.2.3.2.3 Action initiated by event ELU1 while in the ST15-state

On expiry of the timer for DCUT1 while in the "A-Get-Group response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote service-user-unavailable".

10.2.4 Spontaneous Management

10.2.4.1 Initiating entity actions

10.2.4.1.1 Action initiated by event E004 while in the ST0I-state

On receiving an A-Spont-Mgnt request service primitive from the A-service user while in the "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Spont-Mgnt request PDU as a P-DATA request.

- If the subconnection in the STS3-state, then restart the timer for DCUT1.

- Restart the timer for DCLT1.

10.2.4.1.2 Action initiated by event E107 while in the ST16-state

On receiving an incoming Spont-Mgnt response PDU while in the "Spont-Mgnt response PDU pending"-state, the entity shall:

- Issue an A-spont-Mgnt confirm service primitive to the A-service user with parameters derived from data items received.

- If the subconnection in the STS1-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.2.4.1.3 Action initiated by event E114 while in the ST16-state

On receiving an incoming Error PDU while in the "Spont-Mgnt response PDU pending"-state, the entity shall:

- Issue an A-Spont-Mgnt confirm service primitive to the A-service user with Result = Error PDU.Result.

- Cancel the timer for DCLT1.

10.2.4.1.4 Action initiated by event ELL1 while in the ST16-state

On expiry of the timer for DCLT1 while in the "Spont-Mgnt-response PDU pending"-state, the entity shall:

- Issue an A-Spont-Mgnt confirm service primitive to the A-service user with Result = "No-answer-from-remote part of provider".

10.2.4.2 Responding entity actions

10.2.4.2.1 Action initiated by event E108 while in the ST0R-state

On receiving an incoming Spont-Mgnt request PDU while in the "Idle"-state, the entity shall:

- Issue A-Spont-Mgnt indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection in the STS4-state then restart the timer for DCLT1.

- Restart the timer for DCUT1.

10.2.4.2.2 Action initiated by event E204 while in the ST17-state

On receiving an A-Spont-Mgnt response service primitive from the A-service user while in "A-Spont-Mgnt response pending"-state, the entity shall:

- Send the sequence of data items, which constitutes a Spont-Mgnt response PDU as a P-DATA request.

- If the subconnection in the STS2-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.2.4.2.3 Action initiated by event ELU1 while in the ST17-state

On expiry of the timer for DCUT1 while in the "A-Spont-Mgnt response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

10.2.5 Spontaneous information transfer

10.2.5.1 Initiating entity actions

10.2.5.1.1 Action initiated by event ES01 while in STS0R-state

On receiving an A-Data (spont) request service primitive from the A-service user while in "Idle"-state, the entity shall:

- Send the sequence of data items, which constitutes a Data (spont) PDU as a P-DATA request.

- If MORE-D = TRUE or the main connection different from the ST0 and ST3-state then restart the timer for DCUT1.

- If MORE-D = FALSE then restart the timer for DCLT1.

10.2.5.1.2 Action initiated by event ES01 while in STS2-state

On receiving an A-Data (spont) request service primitive from the A-service user while in "A-Data (spont) request pending"-state, the entity shall:

- Send the sequence of data items, which constitutes a Data (spont) PDU as a P-DATA request.

- If MORE-D = TRUE or the main connection different from the ST0 and ST3-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

- If MORE-D = FALSE then restart the timer for DCLT1.

10.2.5.1.3 Action initiated by event ES12 while in STS2-state

On receiving a Conf-Data (spont) incoming PDU while in "A-Data (spont) request pending"-state and Conf-Data (spont) PDU.Result<>OK, the entity shall:

- Issue an A-Conf-Data (spont) indication service primitive to the A-service user with parameters derived from the data items received.

- If the main connection in the ST0 or ST3-state then cancel the timer for DCUT1.

10.2.5.1.4 Action initiated by event ELU1 while in STS2-state

On expiry of the timer for DCUT1 while in the "A-Data (spont) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

- Issue an A-Conf-Data (spont) indication service primitive to the A-service user with Result = "Misbehaviour-of-local-service-user".

10.2.5.1.5 Action initiated by event ES12 while in STS4-state

On receiving a Conf-Data (spont) incoming PDU while in "Conf-Data (spont) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (spont) indication service primitive to the A-service user with parameters derived from the data items received.

- If the main connection in the ST3-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

10.2.5.1.6 Action initiated by event E114 while in STS4-state

On receiving an incoming Error PDU while in the "Conf-Data (spont) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (spont) indication service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.2.5.1.7 Action initiated by event ELL1 while in the STS4-state

On expiry of the timer for DCLT1 while in the "Data-Conf (spont) PDU pending"-state, the entity shall:

- Issue an A-Conf-Data (spont) indication service primitive to the A-service user with Result = "No-answer-from-remote-part-of-provider".

10.2.5.2 Responding entity actions

10.2.5.2.1 Actions initiated by event ES11 while in the STS0I-state

On receiving an incoming Data (spont) PDU while in the "Idle"-state, the entity shall:

- Issue an A-Data (spont) indication service primitive to the A-service user with parameters derived from data items received.

- If MORE-D = TRUE or the main connection different from the ST0 and ST4-state then restart the timer for DCLT1.

- If MORE-D = FALSE then restart the timer for DCUT1.

10.2.5.2.2 Action initiated by event ES11 while in the STS1-state

On receiving an incoming Data (spont) PDU while in the "Data (spont) PDU pending"-state, the entity shall:

- Issue an A-Data (spont) indication service primitive to the A-service user with parameters derived from data items received.

- If MORE-D = TRUE or the main connection different from the ST0 and ST4-state then restart the timer for DCLT1, else cancel the timer for DCLT1.

- If MORE-D = FALSE then start the timer for DCUT1.

10.2.5.2.3 Action initiated by event ES02 while in the STS1-state

On receiving an A-Conf-Data (spont) request service primitive while in the "Data (spont) PDU pending"-state and A-Conf-Data (spont) PDU.Result<>OK, the entity shall:

- Send the sequence of data items, which constitutes a Conf-Data (spont) PDU as a P-DATA request.

- If the main connection in the ST0 or ST4-state then cancel the timer for DCLT1.

10.2.5.2.4 Action initiated by event E114 while in the STS1-state

On receiving an incoming Error PDU while in the "Data (spont) PDU pending"-state, the entity shall:

- Issue an A-Data (spont) indication service primitive to the A-service user with Result = Error PDU. Result.

- Cancel the timer for DCLT1.

10.2.5.2.5 Action initiated by event ELL1 while in the STS1-state

On expiry of the timer for DCLT1 while in the "Data (spont) PDU pending"-state, the entity shall:

- Issue an A-Data (spont) indication service primitive to the A-service user with Result = "No-answer-from-remote part-of-provider".

10.2.5.2.6 Action initiated by event ES02 while in STS3-state

On receiving an A-Conf-Data (spont) request service primitive while in the "A-Conf-Data (spont) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes a Conf-Data (spont)PDU as a P-DATA request.

- If the main connection in the ST4-state then restart the timer for DCUT1, else cancel the timer for DCUT1.

10.2.5.2.7 Action initiated by event ELU1 while in STS3-state

On expiry of the timer for DCUT1 while in the "A-Conf-Data (spont) request pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable".

10.3 Actions of Class 2

The actions in this class are the same as specified for class 0 and class 1. In addition the initiating actions and the responding actions will run together in the same part of the provider.

10.4 Actions of Class 3

The actions in this class are the same as class two with addition of those required for commands and setpoints.

10.4.1 Command Transfer, Initiating entity actions

10.4.1.1 Actions initiated by event E009 while in ST0I state

On receiving an A-Command-Transfer request service primitive from the A-service user while in "Idle"-state, the entity shall:

- Send the sequence of data items which constitutes a Command-Transfer request PDU as a P-DATA request.

- If the subconnection is in the STS3 state then restart timer for DCUT1.

- Start the timer for DCLT1.

10.4.1.2 Actions initiated by event E115 while in the ST18-state

On receiving an incoming Command-Transfer response PDU while in Command-Transfer response PDU pending state, the entity shall:

- Issue an A-Command-Transfer confirm service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection is in the state STS1, then restart timer for DCLT1, else cancel the DCLT1 timer.

10.4.1.3 Actions initiated by event ELL1 while in the ST18-state

On expiry of the timer for DCLT1 while in the "Command Transfer response PDU pending"-state, the entity shall:

- Issue an A-Command-Transfer confirm service primitive to the A-service user with Result = "No-answer-from-remote-part-of-provider".

10.4.1.4 Actions initiated by event E114 while in the ST18-state

On receiving an incoming Error PDU while in the "Command-Transfer response PDU pending"-state, the entity shall:

- Issue an A-Command-Transfer Confirm service primitive to the A-service user with Result = Error PDU.Result.

- Cancel the timer for DCLT1.

10.4.2 Command Transfer, Responding entity actions

10.4.2.1 Actions initiated by event E116 while in the ST0R-state

On receiving an incoming Command-Transfer request PDU while in "idle"-state, the entity shall:

- Issue an A-Command-Transfer indication service primitive to the A-service user with parameters derived from the data items received.

- If the subconnection is in the STS4 state then restart the timer for DCLT1.

- Start the DCUT1 timer.

10.4.2.2 Actions initiated by event E206 while in the ST19-state

On receiving an A-Command-Transfer response while in "A-Command-Transfer response pending"- state, the entity shall:

- Send the sequence of data items which constitutes an A-Command-Transfer response PDU as a P-DATA request.

- If the subconnection is in the state STS2 then restart timer for DCUT1 else cancel DCUT1 timer.

10.4.2.3 Actions initiated by event ELU1 while in ST19-state

On expiry of the timer for DCUT1 while in the "A-Command Transfer response pending"-state, the entity shall:

- Send the sequence of data items which constitutes an Error PDU as a P-DATA request with Result = "Remote-service-user-unavailable"

10.4.3 Mixed data, initiating entity actions

10.4.3.1 Actions initiated by event E010 while in the STS0R state

On receiving an A-Mixed-Data request service primitive from the A-service user while in the "Idle" state, the entity shall:

- Send the sequence of data items which constitutes a Mixed-Data request PDU as a P-DATA request.

10.4.3.2 Actions initiated by event E011 while in the STS0I-state

On receiving an A-Mixed-Data-Error request service primitive from the A-service user while in the "Idle" state, the entity shall:

- Send the sequence of data items which constitutes a Mixed-Data-Error request PDU as a P-DATA request.

10.4.4 Mixed-Data, responding entity actions

10.4.4.1 Actions initiated by event E118 while in the STS0I state

On receiving an incoming Mixed-Data request PDU while in the "Idle" state, the entity shall:

- Issue an A-Mixed-Data indication service primitive to the A-service user with parameters derived from the data items received.

10.4.4.2 Actions initiated by event E117 while in the STS0R state

On receiving an incoming Mixed-Data-Error request PDU while in the "Idle" state, the entity shall:

- Issue an A-Mixed-Data-Error indication service primitive to the A-service user with parameters derived from the data items received.

A P P E N D I X A

Encoding of PDU's

CONTENTS

A.1 Summary

		Classes 0 1 2 3	Sect.	PDU-ID
I-T	Init Transfer	x x x x	A.3	00 011 000
DATA	Send Data	x x x x	A.4	00 100 000
C-D	Confirm Data	x x x x	A.5	00 100 001
T-C-REQ	Test Connection Request	x x x x	A.6	01 000 000
T-C-RSP	Test connection Response	x x x x	A.7	01 000 001
G-M-REQ	Group Management Request	x x x	A.8	00 000 001
G-M-RSP	Group Management Response	x x x	A.9	00 000 010
D-G-REQ	Define Group Request	x x x	A.10	00 001 000
D-G-RSP	Define Group Response	x x x	A.11	00 001 001
G-G-REQ	Get-Group Request	x x x	A.12	00 001 010
G-G-RSP	Get Group Response	x x x	A.13	00 001 011
S-M-REQ	Spont-Mgnt Request	x x x	A.14	00 010 000
S-M-RSP	Spont-Mgnt Response	x x x	A.15	00 010 001
ERROR	Error PDU	x x x x	A.16	11 111 111
C-REQ	Connect Request	x x x x	A.17	00 000 100
C-RSP	Connect Response	x x x x	A.18	00 000 101
C-T-REQ	Command-Transfer Request	x	A.19	00 101 110
C-T-RES	Command-Transfer Response	x	A.20	00 101 111
M-D-REQ	Send Mixed-Data Request	x	A.21	00 100 010
M-D-E-REQ	Send Mixed-Data Error Request	x	A.22	00 100 011

A.1.1 Connection Establishment and Termination

The services A-Connect-Request and A-Connect-Response are represented with their own APDUs, and their own parameters. The PDU-type, Version, User-Data (and Result) parameters are mapped onto the User-Data field in the P-Connect primitives. The rest of the parameters in the A-Connect primitives are mapped in their respective fields in the P-Connect primitives.

Mapping of ACONRQ/ACONRS PDUs into the PCONRQ/PCONRS PDUs:

The User Data Length is mapped into the first octet of the PCONRQ/PCONRS User Data fields. This length field indicates the number of octets in the rest of the User Data field.

Layout of PCONRQ, User Data field:

n	n+1	n+2	n+3 m
User Data Length	ACONRQ PDU-ID	Version	A-User data…..

(User Data Length = m-n, where n is the first octet in User Data field, and m is the last used octet in A-User Data).

Layout of PCONRS, User Data field:

n	n+1	n+2	n+3	n+4 m
User Data Length	ACONRS PDU-ID	Version	Result	A-User data…..

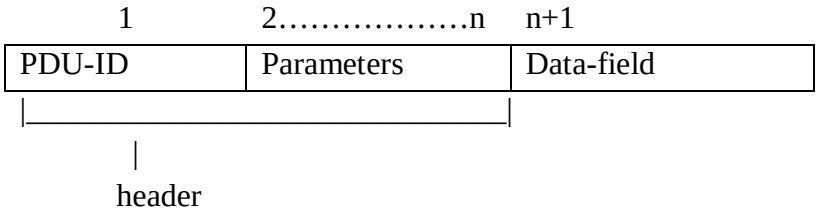
(User Data Length = m-n, where n is the first octet in User Data field, and m is the last used octet in A-User Data).

A-Release Request and A-Release Response are not represented as APDUs. They are mapped directly onto the P-Release Request and P-release Response PDUs.

A.2 Structure and notation

A.2.1 Structure

All Application Protocol Data Units (APDU) shall contain an integral number of octets. The octets in an APDU are numbered starting from 1 and increasing in order of transmission. The bits in an octet are numbered from 0 to 7, where bit 0 is the low-ordered bit.



Integer values represented in two octets have their least significant part stored in the octet with the highest octet no.

A.2.2 Integer representation

One-octet integer values are unsigned and two-octet integer values are signed when nothing else is stated. For signed values two complement representation[1] is used.

[1] This is a representation of signed integers on digital computers. If we use n bits to represent an integer, the numbers in the range 0 .. (2^{n-1}-1) are represented in the obvious way. The represent the negative of any representable positive number we take what is called the twos complement of the representation of the positive number. Taking the twos complement of the representation of a negative number yields the representation of the corresponding positive number. See any basic book on computer architecture for the details. e.g. Chapter 4 in [17].

A.2.3 Notation

All octets are numbered in decimal. All values are given in decimal when nothing else is stated. Codes are given in binary.

All arrays are octet arrays.

A.3 Init Transfer (I-T)

1	2	3,4	5,6	7,8	9-16	17	18	19,20
I-T 00 011 000	Gtype	Gnr	Index1	Index2	T0	Dt	T-unit	Periodes

I-T : Init Transfer Code : 00 011 000
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Lower Object Index. 0 <= value <= 32767
Index2 : Higher Object Index. 0 <= value <= 32767
T0 : Array T0(8). Point of time for oldest requested group incarnation.
T0(1) = Year 0 <= value <= 254 or value=255
(255 means latest incarnation of group, Year=-1 in API)
T0(2) = Month 1 <= value <= 12
T0(3) = Day 1 <= value <= 31
T0(4) = Hour 0 <= value <= 24
T0(5) = Minute 0 <= value <= 59
T0(6) = Second 0 <= value <= 59
T0(7),
T0(8) = Millisec. 0 <= value <= 999
Dt : Time-slice between two consecutive group incarnations.
1 <= value <= 255
T-unit : Time-unit for Dt. 1 <= value <= 7
Periodes : Number of group incarnations requested.
1 <= value <= 32767

A.4 Send Data (DATA)

1	2	3,4	5,6	7,8	9-16	17	18	19	20-n
DATA 00 100 000	Gtype	Gnr	Index1	Index2	T	Trans- mod	More-D	Result	Data

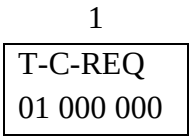
DATA : Send Data Code : 00 100 000
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Lower Object Index. 0 <= value <= 32767
Index2 : Higher Object Index. 0 <= value <= 32767
T : Array T(8).
T(1) = Year 0 <= value <= 254
T(2) = Month 1 <= value <= 12
T(3) = Day 1 <= value <= 31
T(4) = Hour 0 <= value <= 24
T(5) = Minute 0 <= value <= 59
T(6) = Second 0 <= value <= 59
T(7),
T(8) = Millisecond 0 <= value <= 999
Transmod : Mode of transmission. 1 < = value < = 2
More-D : Boolean indicator. True when more data to follow.
00 000 000 : More = False
00 000 001 : More = True
Result : Result Code. 0 < = value <= 255
Data : User defined octet string. [14] Appendix A

A.5 Confirm Data (C-D)

1	2	3,4	5	6
C-D 00 100 001	Gtype	Gnr	Transmod	Result

C-D	: Confirm Data Code	: 00 100 001
Gtype	: Group Type.	0 <= value <= 255
Gnr	: Group Number.	0 <= value <= 32767
Transmod	: Mode of transmission.	1 <= value <= 2
Result	: Result Code.	0 <= value <= 255

A.6 Test Connection Request (T-C-REQ)



T-C-REQ : Test Connection Request Code : 01 000 000

A.7 Test Connection Response (T-C-RSP)

1	2
T-C-RSP 00 000 001	Result

T-C-RSP : Test Connection Response Code : 01 000 001
Result : Result code 0 <=value <= 255

A.8 Group Management Request (G-M-REQ)

1	2	3,4	5	6	7	8
G-M-REQ 00 000 001	Gtype	Gnr	Gstat	Gsize	0bjlength	Function

G-M-REQ : Group Management Request Code : 00 000 001
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Gstat : Group Status.
Bit no. 0 : Persist.
1 = TRUE (i.e. group not deleteable)
0 = FALSE (i.e. group deleteable)
Bit no. 1 : Static.
1 = TRUE (i.e. group not redefineable)
0 = FALSE (i.e. group redefineable)
Bit no. 2-5: Priority class. 0 <= value <= 15.
0 = class with lowest priority
15= class with highest priority
The remaining bits of the octet shall all be zero.
Gsize : Maximum number of objects. 0 <= value <= 255.
Objlength : Maximum length of object identifier,
exclusive length indicator. Given in octets.
0 <= value <= 255
Function : Function key. 1 <= value <= 4

A.9 Group Management Response (G-M-RSP)

1	2	3,4	5	6-17	18
G-M-RSP 00 000 010	Gtype	Gnr	Function	CF	Result

G-M-RSP : Group Management Response Code : 00 000 010
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Function : Function key. 1 <= value <= 4
CF : Array CF(12). Control Field for group configuration consistency check. CF (1-8) is used to transfer the time when the configuration was accepted and stored in the responding system.
CF(1) = Year 0 <= value <= 254
CF(2) = Month 1 <= value <= 12
CF(3) = Day 1 <= value <= 31
CF(4) = Hour 0 <= value <= 24
CF(5) = Minute 0 <= value <= 59
CF(6) = Second 0 <= value <= 59
CF(7),
CF(8) = Millisec. 0 <= value <= 999
Result : Result code. 0 <= value <= 255

A.10 Define Group Request (D-G-REQ)

1	2	3,4	5,6	7,8	9-n
D-G-REQ 00 001 000	Gtype	Gnr	Index1	Index2	Objid

D-G-REQ : Define Group Request Code : 00 001 000
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index. 0 <= value <= 32767
Objid : Object Identifier string.
Data format is described in [8].

A.11 Define Group Response (D-G-RSP)

1	2	3,4	5,6	7,8	9-20	21-n
D-G-RSP 00 001 001	Gtype	Gnr	Index1	Index2	CF	Result

D-G-RSP : Define Group Response Code : 00 001 001
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index. 0 <= value <= 32767
CF : Array CF(12). Control Field for group configuration consistency check. CF (1-8) is used to transfer the time when the configuration was accepted and stored in the responding system.
CF(1) = Year 0 <= value <= 254
CF(2) = Month 1 <= value <= 12
CF(3) = Day 1 <= value <= 31
CF(4) = Hour 0 <= value <= 24
CF(5) = Minute 0 <= value <= 59
CF(6) = Second 0 <= value <= 59
CF(7),
CF(8) = Millisec. 0 <= value <= 999
Result : Result code. 0 <= value <= 255

A.12 Get Group Request (G-G-REQ)

1	2	3,4	5,6	7,8
G-G-REQ 00 001 010	Gtype	Gnr	Index1	Index2

G-G-REQ : Get Group Request Code : 00 001 010
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index 0 <= value <= 32767

A.13 Get Group Response (G-G-RSP)

1	2	3,4	5	6	7	8,9	10,11	12	13-n
G-G-RSP 00 001 011	Gtype	Gnr	Gstat	Gsize	Object length	Index1	Index2	Result	Objid (I)

G-G-RSP : Get Group Response Code : 00 001 011
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Gstat : Bit no. 0 : Persist.
1 = TRUE (i.e. Group not deleteable)
0 = FALSE (i.e. Group deleteable)
Bit no. 1 : Static.
1 = TRUE (i.e. Group not redefineable)
0 = FALSE (i.e. Group redefineable)
Bit no. 2 - 5 : Priority Class.
0 <= value <= 15
0 = class with lowest priority
15= class with highest priority
The remaining bits of the octet shall all be zero.
Gsize : Maximum number of objects. 0 <= value <= 255
Objlength : Maximum length of object identifier,
exclusive length indicator. Given in octets.
0 <= value <= 255
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index. 0 <= value <= 32767
Result : Result code. 0 <= value <= 255
Objid : Object Identifier string.

A.14 Spontaneous-Management Request (S-M-REQ)

1	2	3,4	5
S-M-REQ 00 010 000	Gtype	Gnr	Function

S-M-REQ : Spontaneous-Management Request Code : 00 010 000
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Function : Function key. 1 <= value <= 2

A.15 Spontaneous-Management Response (S-M-RSP)

1	2	3,4	5	6
S-M-RSP 00 010 001	Gtype	Gnr	Function	Result

S-M-RSP : Spontaneous-Management Response Code : 00 010 001
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Function : Function key. 1 <= value <= 2
Result : Result code. 0 <= value <= 255

A.16 Error PDU (ERROR)

1	2
ERROR 11 111 111	Result

ERROR : Error PDU Code : 11 111 111
Result : Result code. 0 <= value <= 255

A.17 Connect Request (C-REQ)

1	2	3-82
C-REQ 00 000 100	Version	User-Data

C-REQ : Connect Request Code : 00 000 100
Version : Version indicator.
00 000 000 Class 0, version 0 implemented
00 000 001 Class 1, version 0 implemented
00 000 010 Class 2, version 0 implemented
00 010 010 Class 2, version 1 implemented
00 010 011 Class 3, version 1 implemented
User-Data : User defined octet string.

The PDU-type, Version and User-Data are mapped onto the User-Data field in the P-Connect-Request primitive. The rest of the parameters in the A-Connect Request primitive are mapped on their respective fields in the P-Connect-Request primitive.

A.18 Connect Response (C-RSP)

1	2	3	4-82
C-RSP 00 000 101	Version	Result	User-Data

C-RSP : Connect Response Code : 00 000 101
Version : Version Number
00 000 000 Class 0, version 0 implemented
00 000 001 Class 1, version 0 implemented
00 000 010 Class 2, version 0 implemented
00 010 010 Class 2, version 1 implemented
00 010 011 Class 3, version 1 implemented
Result : Result code. 0 <= value <= 255
User-Data : User defined octet string.

The PDU-type, Version, Result and User-Data are mapped onto the User-Data field in the P-Connect-Response primitive. The rest of the parameters in the A-Connect Response primitive are mapped on their respective fields in the P-Connect-Response primitive.

A.19 Command Transfer Request (C-T-REQ)

1	2	3,4	5,6	7,8	9-16	17	18	19-n
C-T-REQ 00 101 110	Gtype	Gnr	Index1	Index2	T	Time mode	Comm. mode	Data

C-T-REQ : Command Transfer request Code : 00 101 110
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index. 0 <= value <= 32767
T : Array T(8).
Point of time dependent of Time mode argument.
T(1) = Year 0 <= value <= 254
T(2) = Month 1 <= value <= 12
T(3) = Day 1 <= value <= 31
T(4) = Hour 0 <= value <= 24
T(5) = Minute 0 <= value <= 59
T(6) = Second 0 <= value <= 59
T(7),
T(8) = Millisec. 0 <= value <= 999
Time mode : Determines the interpretation of T. Value: 0, 2 or 3
Comm. mode : Command mode. Value: 1,2,3, or 252
Data : User defined octet string. [14] Appendix A.

A.20 Command Transfer Response (C-T-RES)

1	2	3,4	5,6	7,8	9-16	17	18	19	20-n
C-T-RES 00 101 111	Gtype	Gnr	Index1	Index2	T	Time mode	Comm. mode	Result	Data

C-T-RES : Command Transfer response Code : 00 101 111
Gtype : Group Type. 0 <= value <= 255
Gnr : Group Number. 0 <= value <= 32767
Index1 : Starting Object Index. 0 <= value <= 32767
Index2 : Ending Object Index. 0 <= value <= 32767
T : Array T(8). Point of time dependent of Time mode argument.
T(1) = Year 0 <= value <= 254
T(2) = Month 1 <= value <= 12
T(3) = Day 1 <= value <= 31
T(4) = Hour 0 <= value <= 24
T(5) = Minute 0 <= value <= 59
T(6) = Second 0 <= value <= 59
T(7),
T(8) = Millisec. 0 <= value <= 999
Time mode : Determines the interpretation of T.
0 <= value <= 1
Comm. mode : Command mode. Value: 4,5,6
Result : Result Code. 0 <= value <= 255
Data : User defined octet string. [14] Appendix A.

A.21 Send Mixed Data Request (M-D-REQ)

1	2-9	10-n
M-D-REQ 00 100 010	T	Data

M-D-REQ : Send Mixed Data request code : 00 100 010

T : Array T(8). Point of view for the first data element in the Data string.

T(1) = Year	0 <= value <= 254
T(2) = Month	1 <= value <= 12
T(3) = Day	1 <= value <= 31
T(4) = Hour	0 <= value <= 24
T(5) = Minute	0 <= value <= 59
T(6) = Second	0 <= value <= 59
T(7),	
T(8) = Millisec.	0 <= value <= 999

Data : User defined octet string. [14] Appendix A

A.22 Send Mixed Data Error Request (M-D-E-REQ)

1	2,3	4
M-D-E-REQ 00 100 011	Gnr	Result

M-D-E-REQ : Send Mixed Data Error request code : 00 100 011
Gnr : Group Number. 0 <= value <= 32767
Result : Result code. 0 <= value <= 255

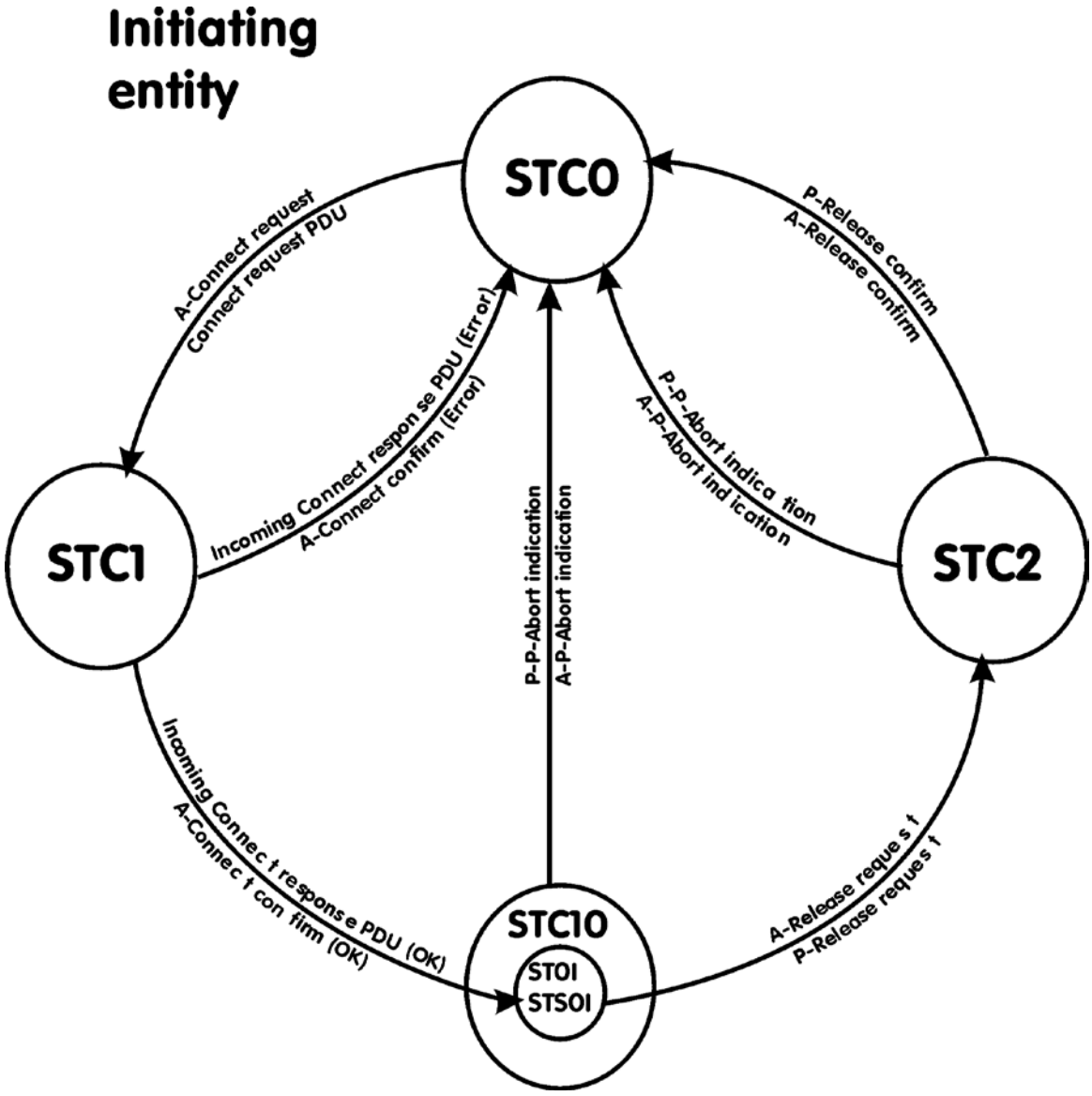
A P P E N D I X B

State Diagrams

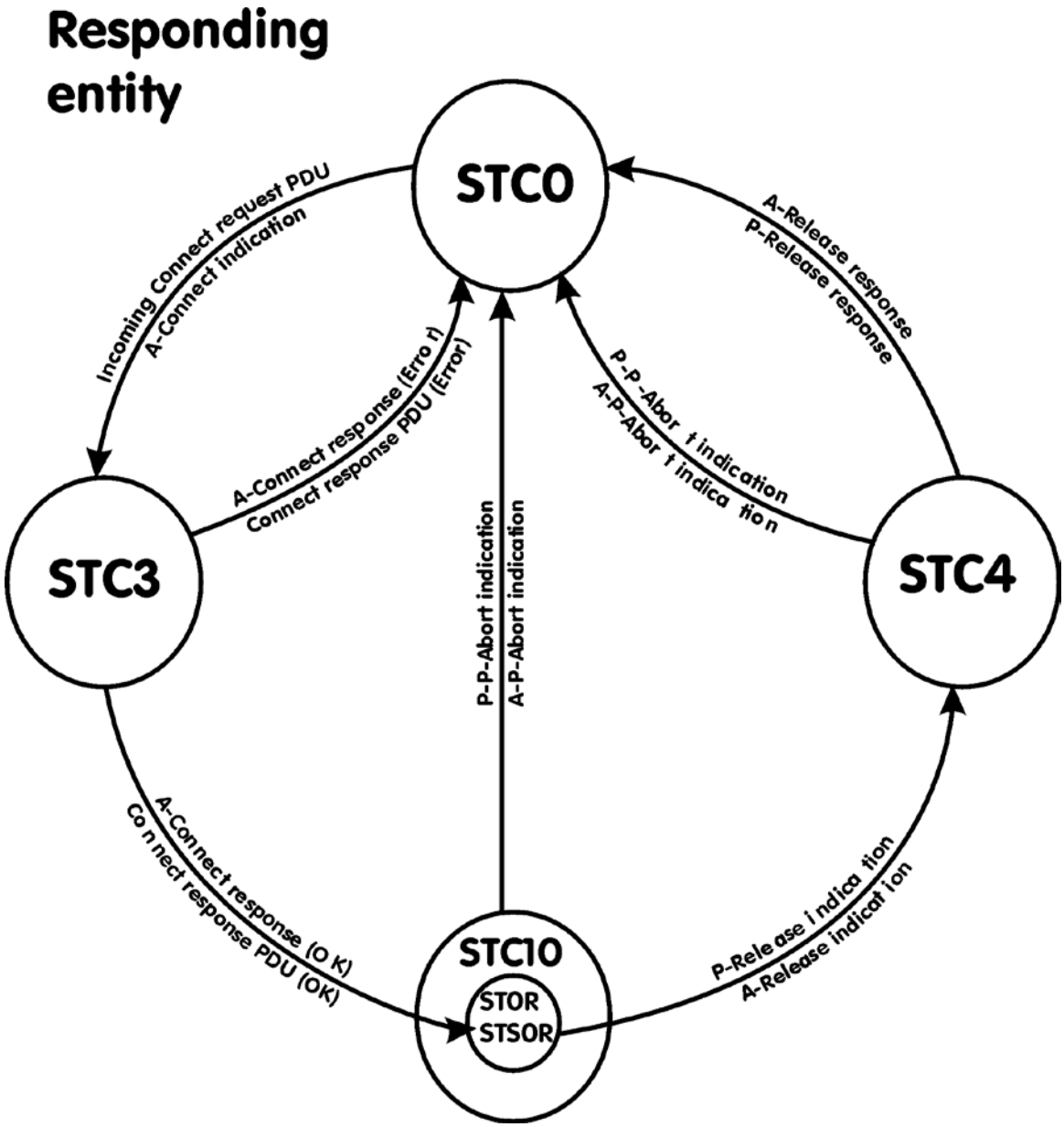
CONTENTS

B.1 Class 0 - Diagrams

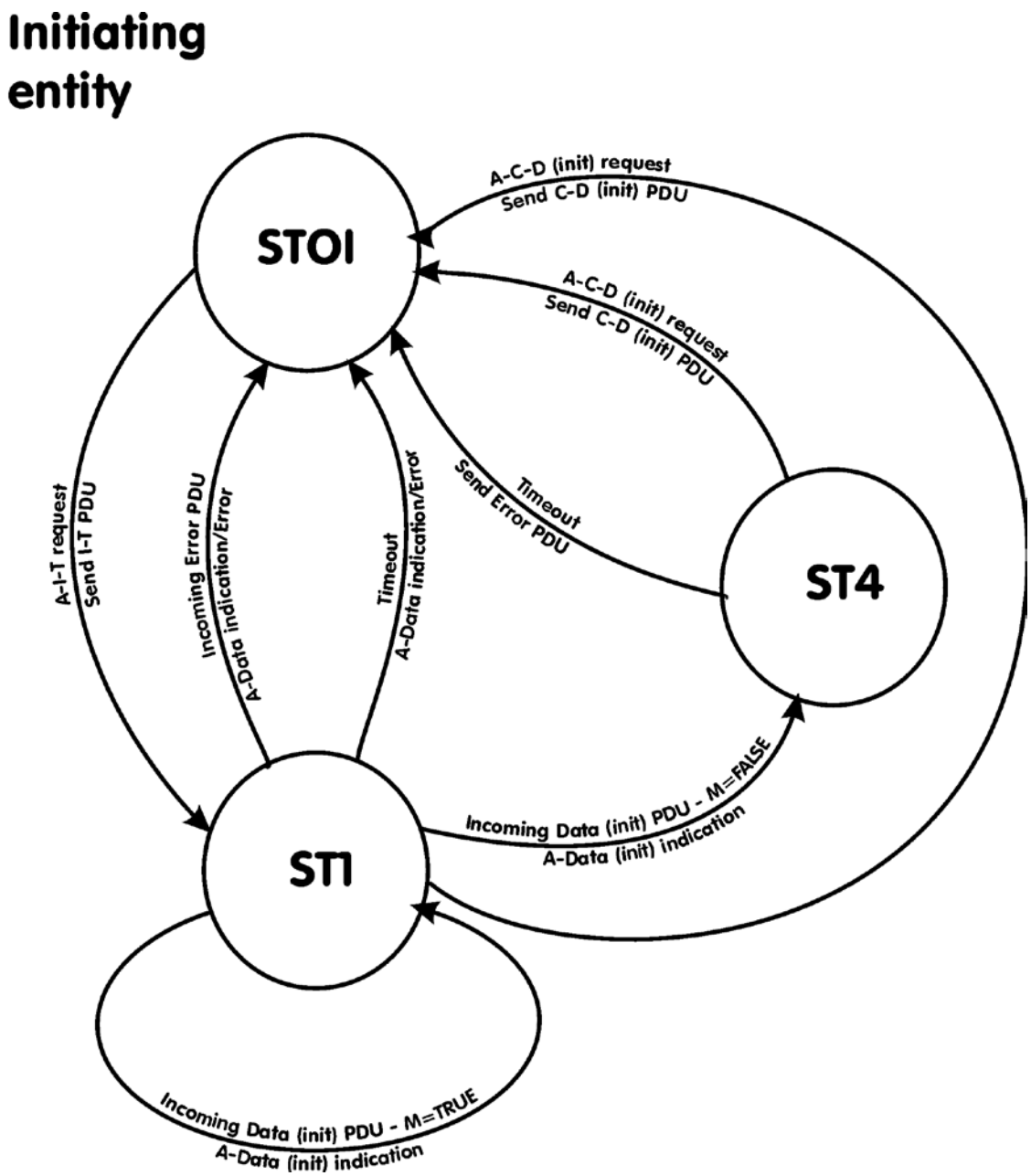
B.1.1 Connection Establishment and Termination (Initiating entity)



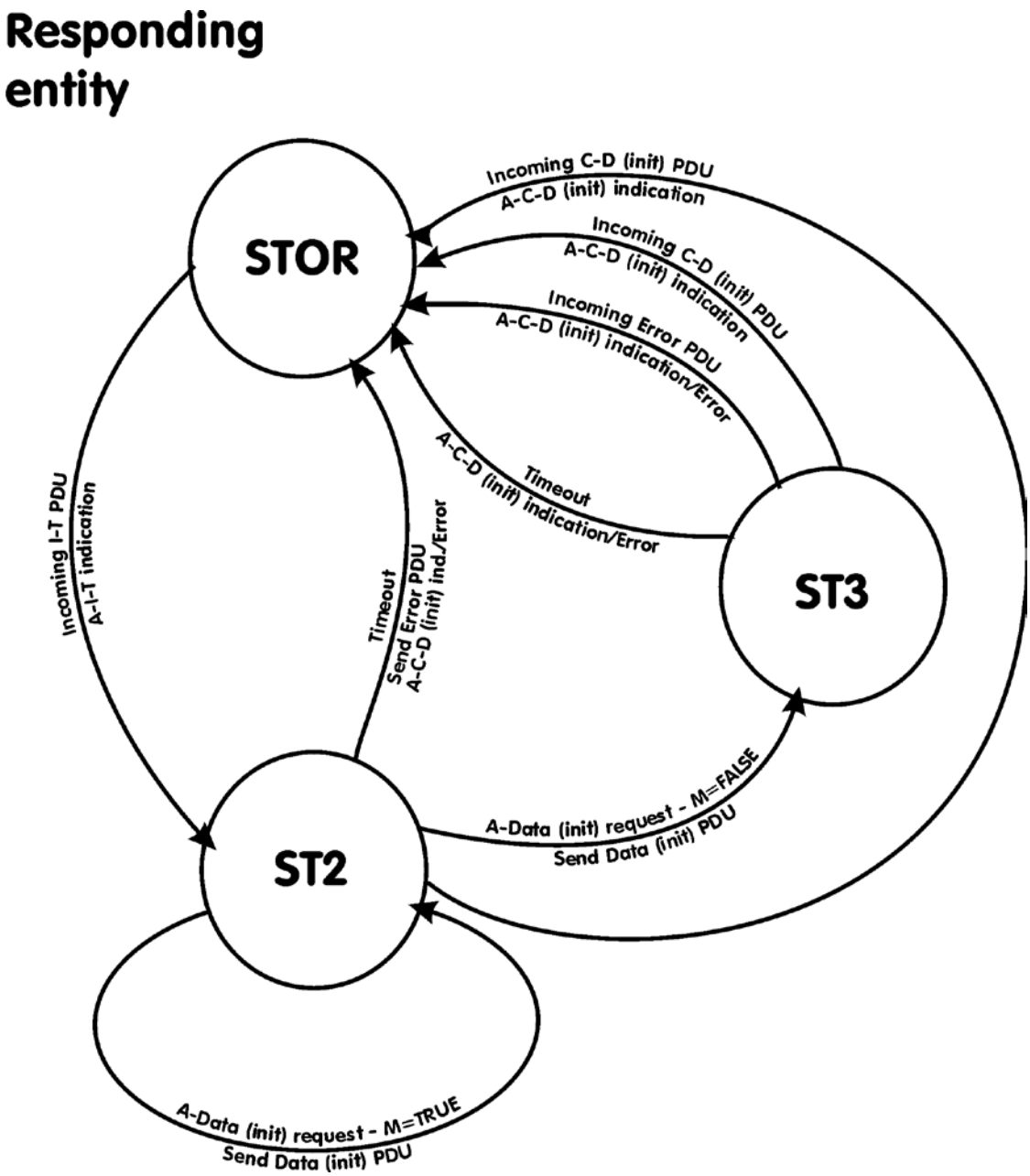
B.1.2 Connection Establishment and Termination (Responding entity)



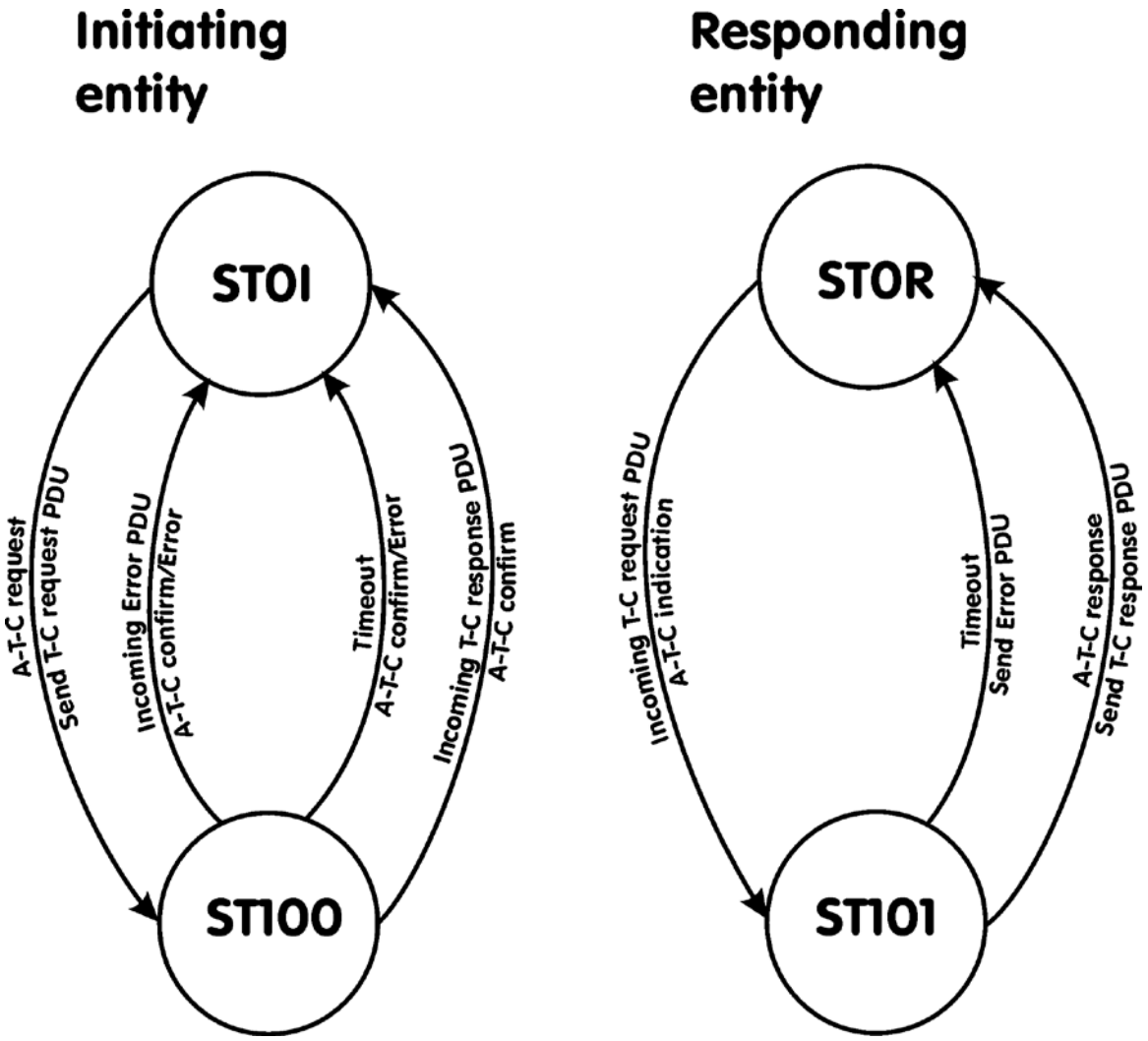
B.1.3 Information Transfer (Initiating entity)



B.1.4 Information Transfer (Responding entity)

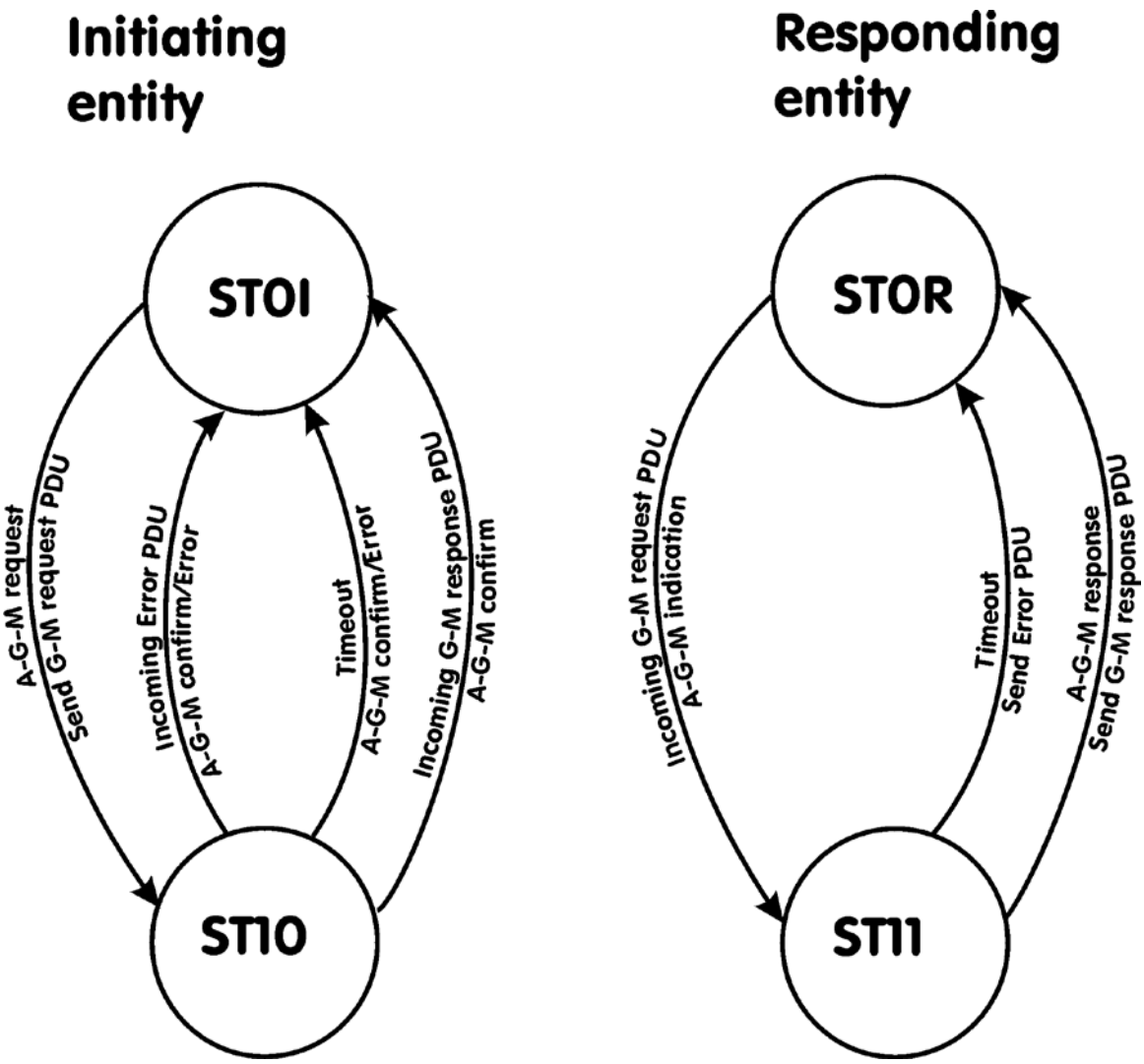


B.1.5 Test-Connection

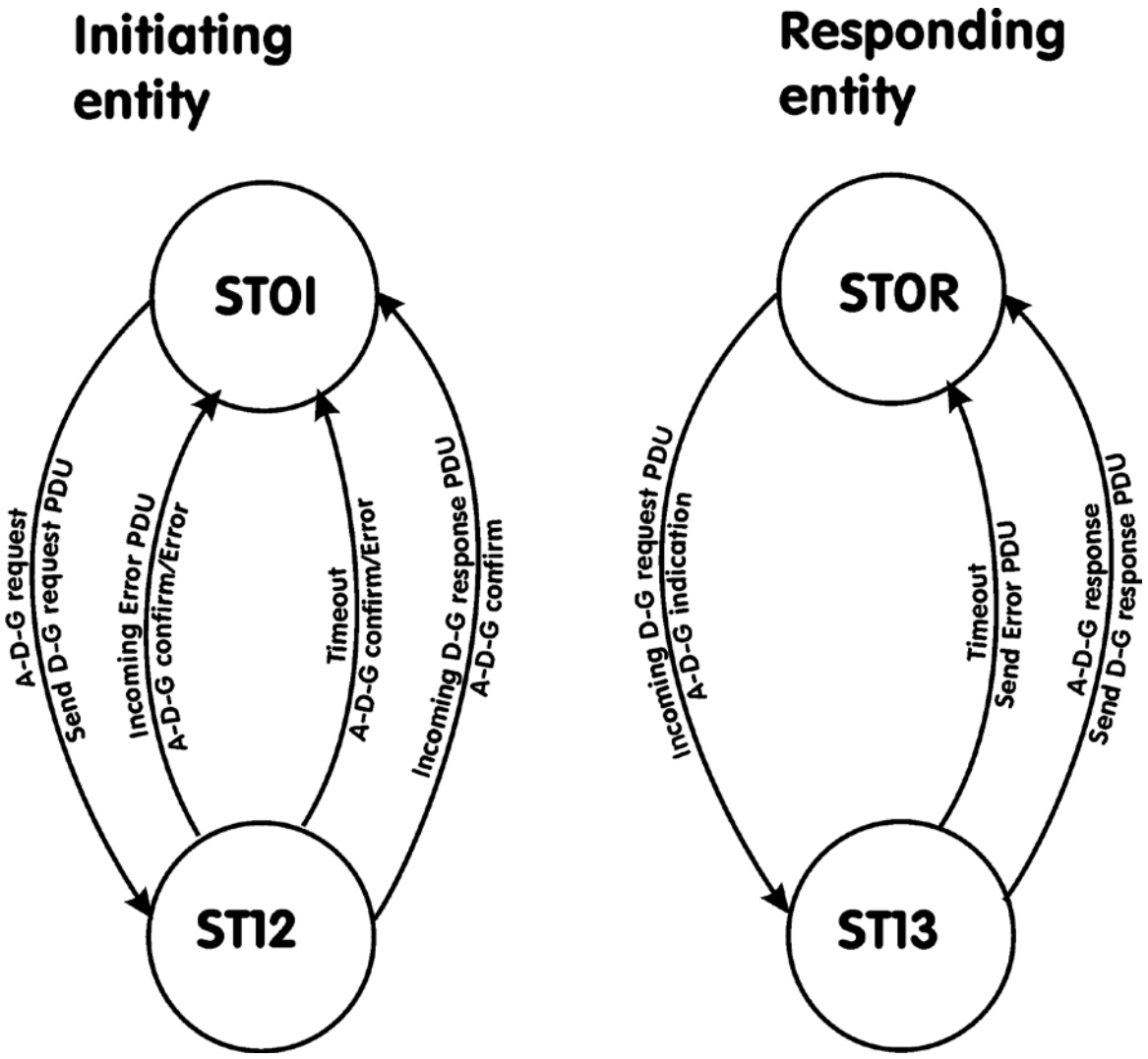


B.2 Class 1 - Diagrams

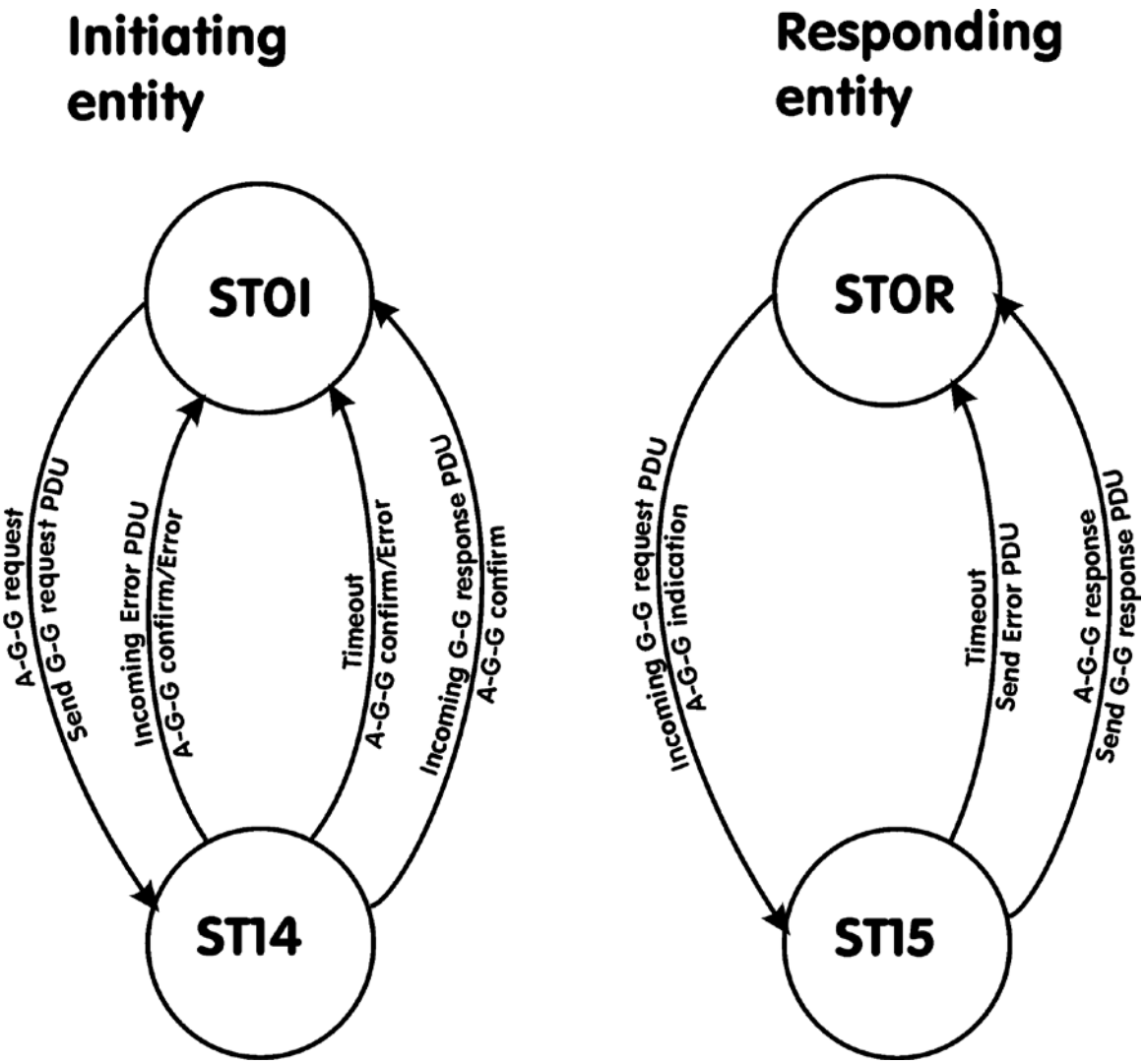
B.2.1 Group-Management



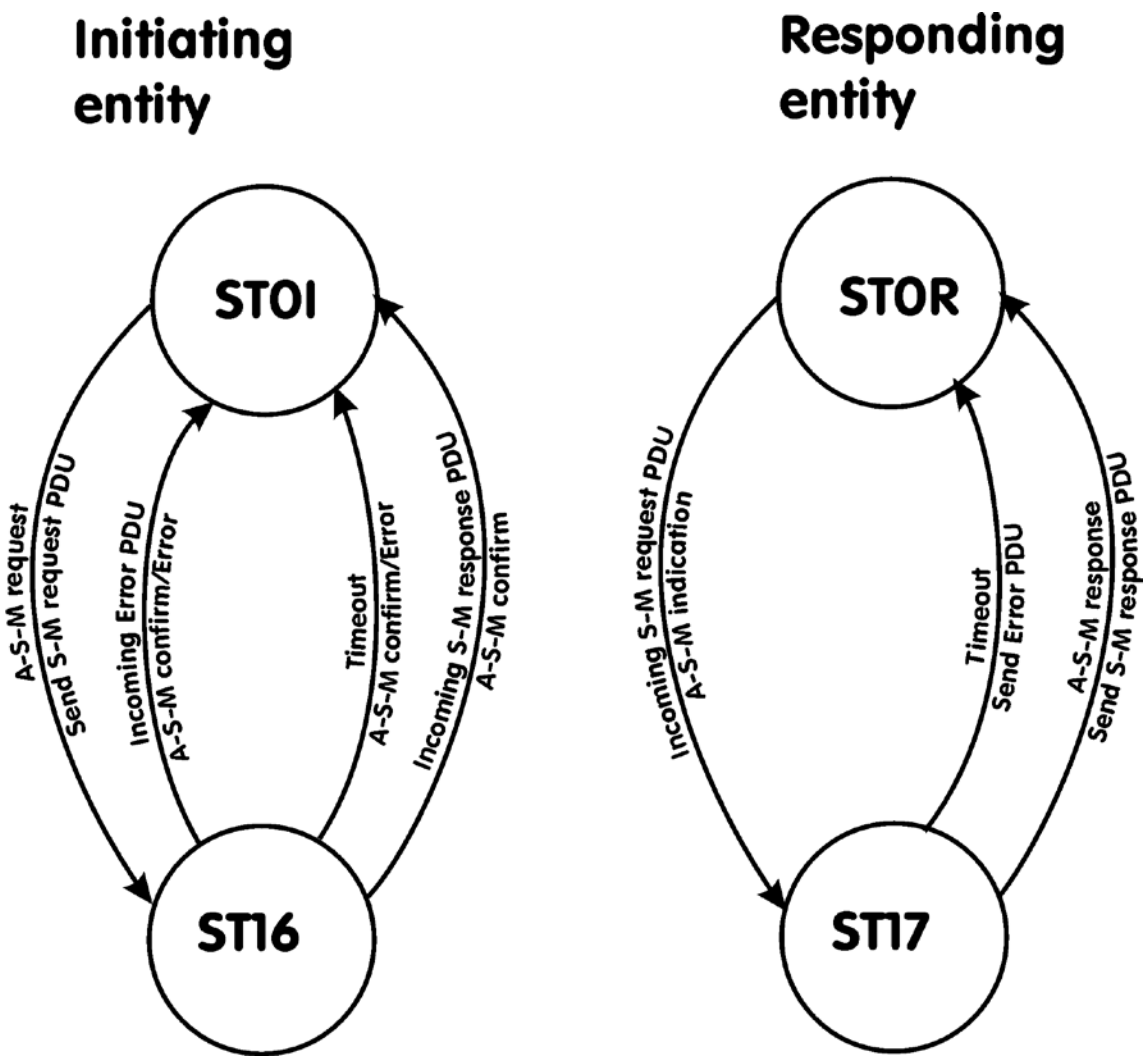
B.2.2 Define-Group



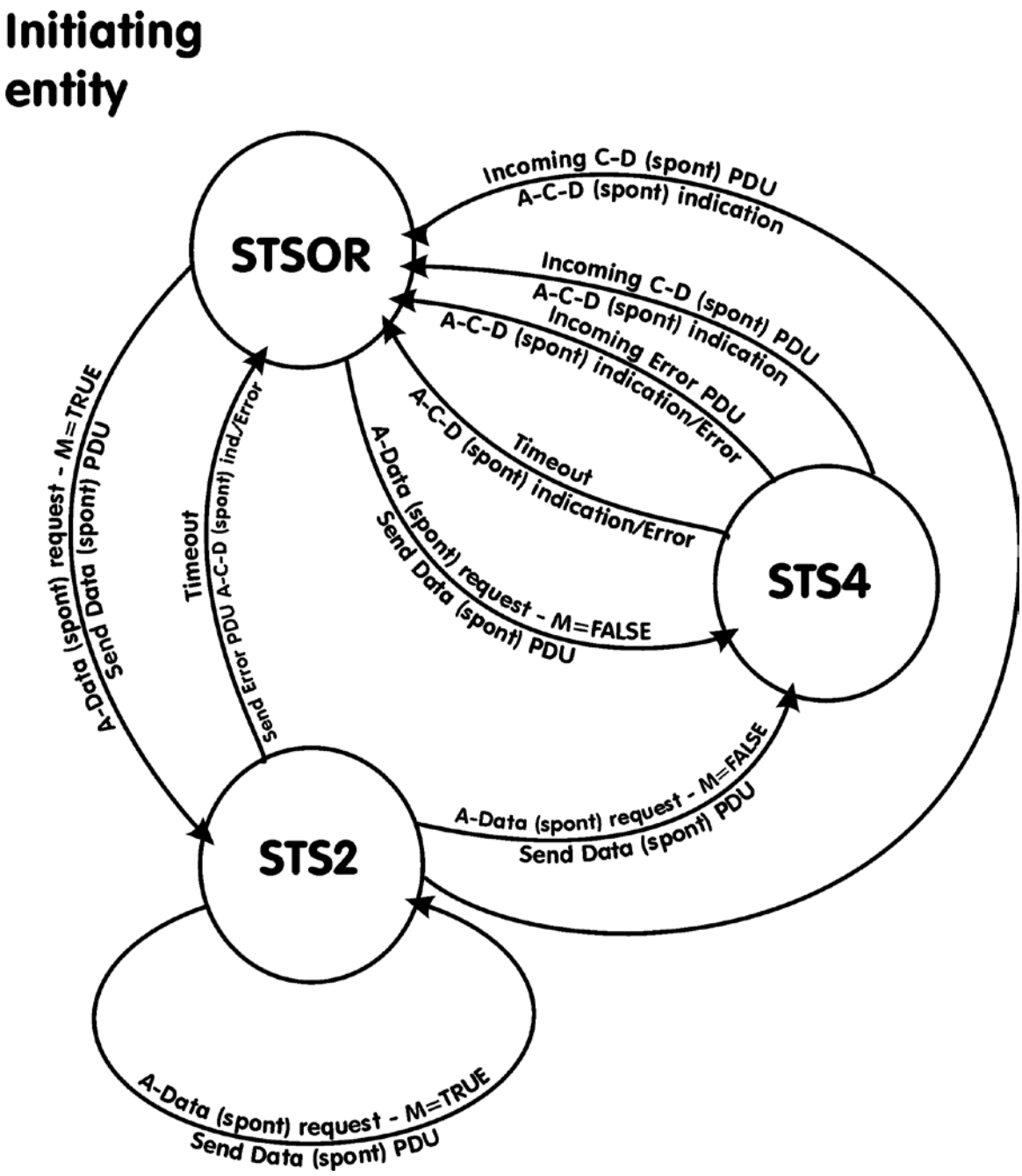
B.2.3 Get-Group



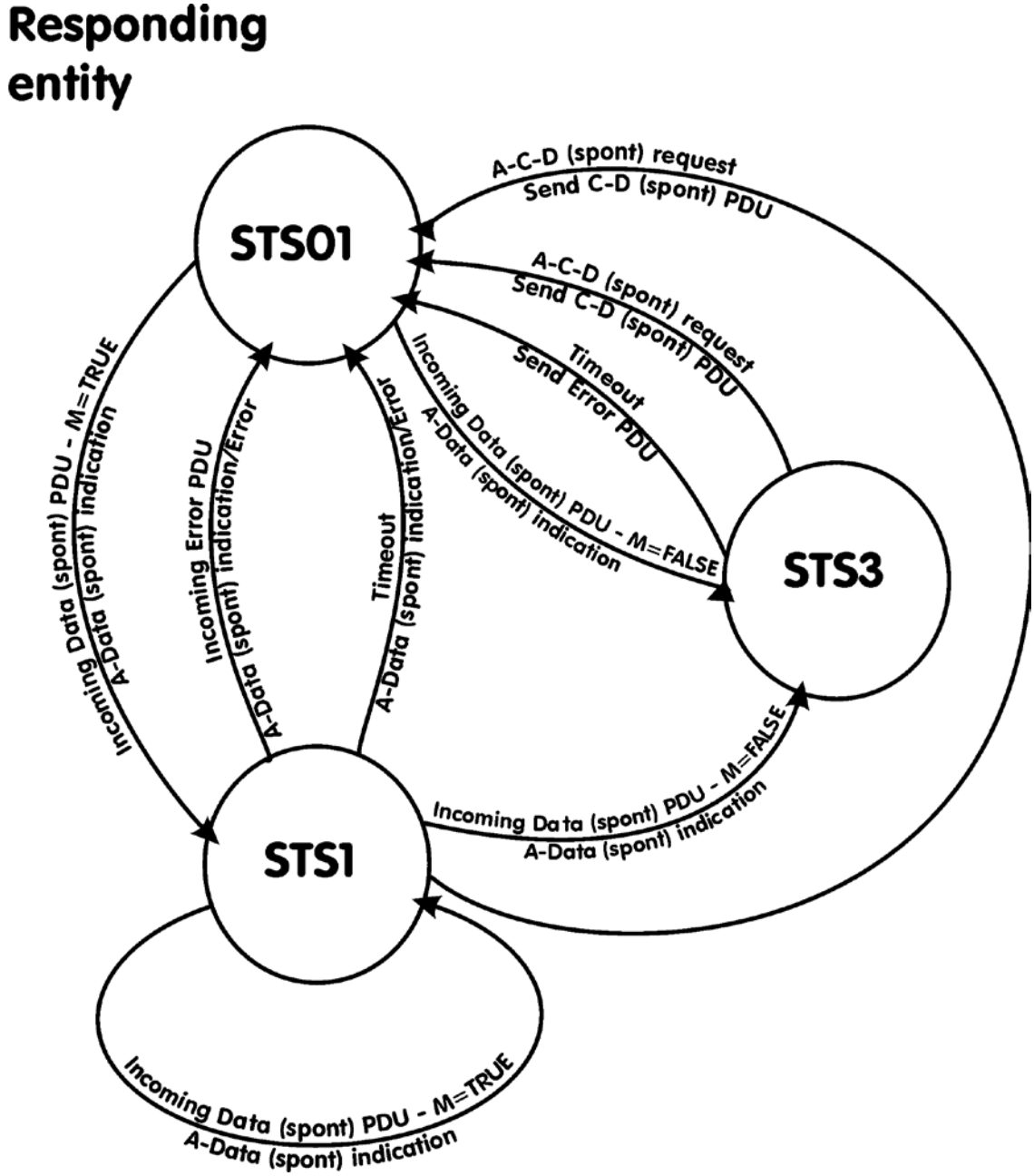
B.2.4 Spontaneous Management



B.2.5 Spontaneous Information Transfer (Initiating entity)



B.2.6 Spontaneous Information Transfer (Responding entity)



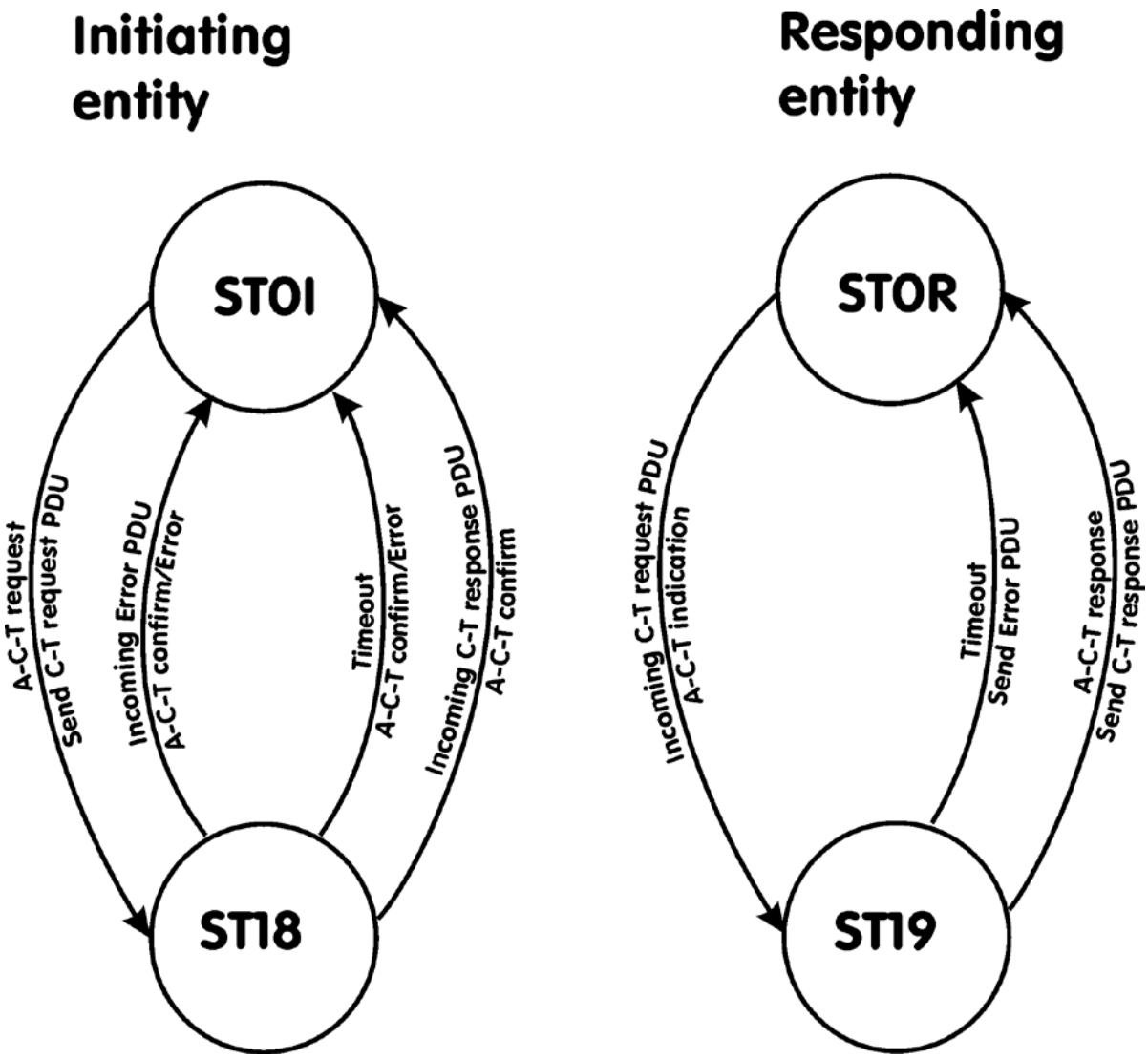
B.3. Class 2 - Diagrams

The diagrams for this class are the same as for class 0 and class 1 with the following distinction:

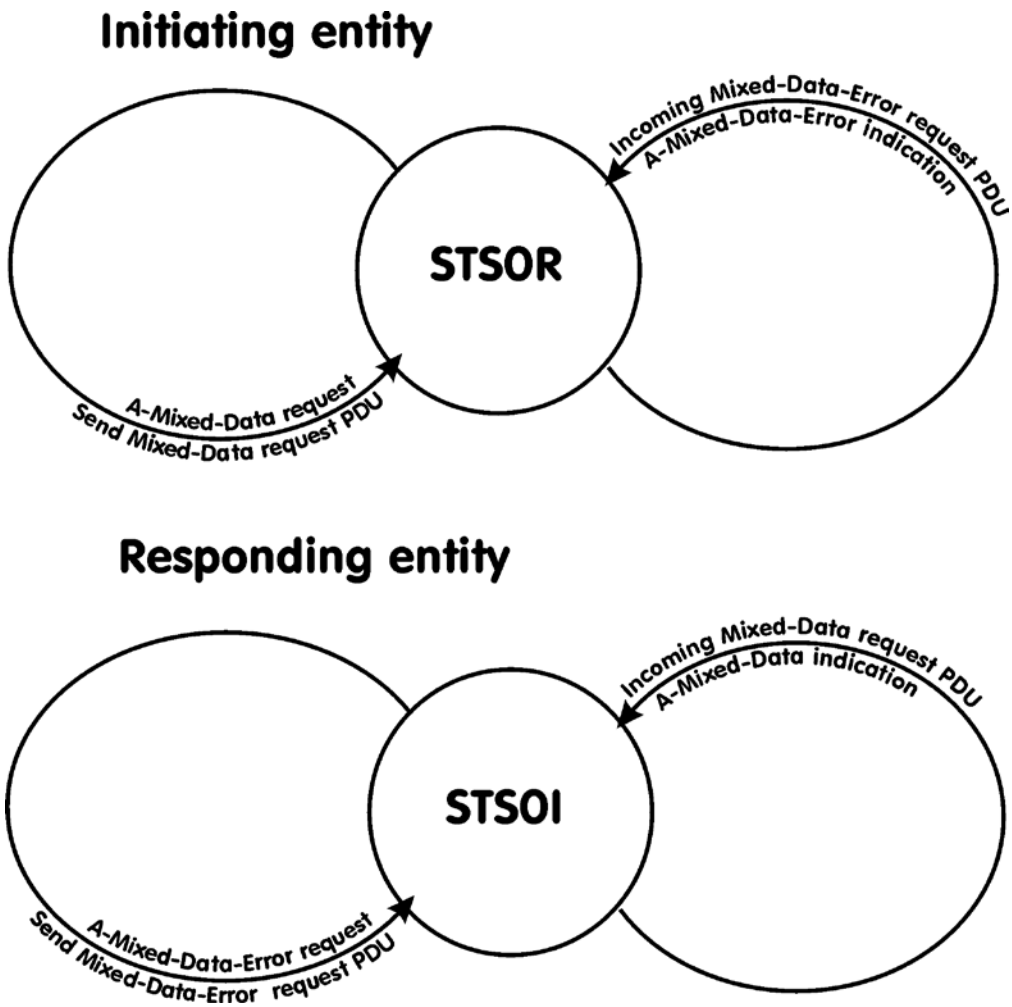
The idle-states denoted by ST...I are the same as those denoted by ST...R. This means that the peer entities supports the same events in both parts of the provider.

B.4. Class 3 - Diagrams

B.4.1 Command Transfer



B.4.2 Spontaneous Mixed Data transfer



A P P E N D I X C

Decision Tables

CONTENTS

C.0 Abbreviations and Definitions

SCS : Sub-(end)-Connection-State.

MCS : Main-(end)-Connection-State.

Illegal use : Means that the service primitive should not be used in this state.

Illegal : Means that the event should not occur in this state. The event shall be ignored.

C.1 Decision Tables of class 0

C.1.1 Connection Establishment and Termination

Initiating entity

STATE EVENT	STC0 Ready for connection	STC1 Establishing on request	STC2 Disestablishing on request	STC10 Connected
EC01 A-Connect request	Send Connect request PDU STC1	Illegal use	Illegal use	Illegal use
EC13 Incoming Connect response PDU (OK/ERROR	Illegal	Issue A-Connect confirm OK: STC10 (ST0I, STS0I) ERROR: STC0	Illegal	Illegal
EC15 P-P-Abort indication	Illegal	Illegal	Issue A-P-Abort indication Reason:= P-P-Abort. Reason STC0	Issue A-P-Abort indication Reason:= P-P-Abort. Reason STC0
EC02 A-Release request	Illegal use	Illegal use	Illegal use	Issue P-Release request STC2
EC14 P-Release confirm	Illegal	Illegal	Issue A-Release confirm STC0	Illegal

Responding entity

STATE EVENT	STC0 Ready for connection	STC3 Establishing on indication	STC4 Disestablishing on indication	STC10 Connected
EC11 Incoming Connect request PDU	Issue A-Connect indication STC3	Illegal	Illegal	Illegal
EC21 A-Connect response (OK/ERROR	If substate STS1 Send Connect Response PDU, Clear substate. Otherwise: Illegal use	Send Connect response PDU OK: STC10 (ST0R, STS0R) ERROR: STC0	Illegal use	Illegal use
EC15 P-P-Abort indication	Illegal	Issue A-P-Abort indication Reason:= P-P-Abort. Reason STC0~~Illegal~~/substate STS1.	Issue A-P-Abort indication Reason:= P-P-Abort. Reason STC0	Issue A-P-Abort indication Reason:= P-P-Abort. Reason STC0
EC12 P-Release indication	Illegal	Illegal	Illegal	Issue A-Release indication STC4
EC22 A-Release response	Illegal use	Illegal use	Send P-Release response STC0	Illegal use

C.1.2 Information Transfer

Initiating entity

STATE EVENT	ST0I Idle	ST1 Data (init) PDU pending	ST4 A-Conf-Data (init) request pending
E005 A-Init Transfer	Send Init-Transfer PDU - If SCS = STS3 then restart DCUT1 Restart DCLT1 - ST1	Illegal use	Illegal use
E110 Incoming Data (init) PDU	Illegal	Issue A-Data (init) indication - If M=TRUE or SCS=STS1 then restart DCLT1 else cancel DCLT1 - If M=FALSE then restart DCUT1 - If M=FALSE then ST4 else ST1	Illegal
E007 A-Conf-Data (init) request (OK/ERROR)	Illegal use	ERROR: Send Conf-Data (init) PDU - If SCS=STS3 or SCS=STS0I then cancel DCLT1 - ST0I OK: Illegal use	ERROR: OK Send Conf-Data (init) PDU - If SCS=STS3 then restart DCUT1 else cancel DCUT1 - ST0I

Initiating entity (cont.)

STATE EVENT	ST0I Idle	ST1 Data (init) PDU pending	ST4 A-Conf-Data (init) request pending
E114 Incoming Error PDU	Illegal	Issue A-Data (init) indication Result:=Error PDU. Result - Cancel DCLT1 - ST0I	Illegal
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Data (init) indication Result:= “No-answer-from-remote-part-of-provider” - ST0I	Illegal
ELU1 Expiry of the timer for DCUT1	Illegal	Illegal	Send Error PDU Result:= “Remote-service-user-unavailable” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST2 A-Data (init) request pending	ST3 Conf-Data (init) PDU pending
E109 Incoming Init-Transfer PDU	Issue A-Init-Transfer PDU - If SCS = STS4 then restart DCLT1 Restart DCUT1 - ST2	Illegal	Illegal
E006 A-Data (init) request	Illegal use	Send Data (init) PDU If M:=TRUE or SCS=STS2 then restart DCUT1 else cancel DCUT1 - If M= FALSE then restart DCLT1 - If M= FALSE then ST3 else ST2	Illegal use
E111 Incoming Conf-Data (init) PDU (OK/ERROR)	Illegal	ERROR: Issue A-Conf-Data (init) indication - If SCS=STS4 or SCS=STS0R then cancel DCUT1 - ST0R OK: Illegal	OK: ERROR: Issue A-Conf-Data (init) indication - If SCS=STS4 then restart DCLT1 else cancel DCLT1 - ST0R

Responding entity (cont.)

STATE EVENT	ST0R Idle	ST2 A-Data (init) request pending	ST3 Conf-Data (init) PDU pending
ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:= “Remote-service-user unavailable - Issue A-Conf-Data (init) Result:= “Misbehaviour of local service user” - ST0R	Illegal
E114 Incoming Error PDU	Illegal	Illegal	Issue A-Conf-Data (init) indication Result: = Error PDU.result - Cancel DCLT1 SCS:STS0R - ST0R
ELL1 Expiry of the timer for DCLT1)	Illegal	Illegal	Issue A-Conf-Data (init) indication Result:= “No-answer-from-remote-part-of-provider” - ST0R

C.1.3 Test Connection

Initiating entity

STATE EVENT	ST0I Idle	ST100 Test-connection response PDU pending
E008 A-Test-Connec-tion request	Send Test-Connection request PDU - If SCS=STS3 then restart DCUT1 Restart DCLT1 - ST100	Illegal use

E112
Incoming Test-Connection response PDU
	Illegal	Issue A-Test-Connection confirm
		-
		If SCS=STS1 then
		restart DCLT1
		else
		cancel DCLT1
		-
		ST0I

E114 Incoming Error PDU	Illegal	Issue A-Test-Connec-tion confirm Result:=Error PDU.Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Test-Connec-tion confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST101 A-Test-connection response pending
E113 Incoming test-Connection request PDU	Issue A-Test-Connection indication - If SCS=STS4 then restart DCLT1 Restart DCUT1 - ST101	Illegal

E205
A-Test-Connection response
	Illegal use	Send Test-Connection response PDU
		-
		If SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		-
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user-unavailable” - ST0R

C.2 Decision Tables of class 1

C.2.1 Group Management

Initiating entity

STATE EVENT	ST0I Idle	ST10 Group-Mgnt response PDU pending
E001 A-Group-Mgnt request	Send Group-Mgnt request PDU - If SCS=STS3 then restart DCUT1 Restart DCLT1 - ST10	Illegal use

E101
Incoming Group-Mgnt response PDU
	Illegal	Issue A-Group-Mgnt confirm
		-
		If SCS=STS1 then
		restart DCLT1
		else
		cancel DCLT1
		-
		ST0I

E114 Incoming error PDU	Illegal	Issue A-Group-Mgnt confirm Result:=Error PDU.Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Group-Mgnt confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST11 A-Group-Mgnt response pending
E102 Incoming Group-Mgnt request PDU	Issue A-Group-Mgnt indication - If SCS=STS4 then restart DCLT1 Restart DCUT1 - ST11	Illegal

E201
A-Group-Mgnt response
	Illegal use	Send Group-Mgnt response PDU
		-
		If SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		-
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user unavailable” - ST0R

C.2.2 Define Group

Initiating entity

STATE EVENT	ST0I Idle	ST12 Def-Group response PDU pending
E002 A-Def-Group request	Send Def-Group request PDU - If SCS=STS3 then restart DCUT1 Restart DCLT1 - ST12	Illegal use

E103
Incoming Def-Group response PDU
	Illegal	Issue A-Def-Group confirm
		-
		If SCS=STS1 then
		restart DCLT1
		else
		cancel DCLT1
		-
		ST0I

E114 Incoming Error PDU	Illegal	Issue A-Def-Group confirm Result:=Error PDU.Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Def-Group confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST13 A-Def-Group response pending
E104 Incoming Def-Group request PDU	Issue A-Def-Group indication - If SCS=STS4 then restart DCLT1 Restart DCUT1 - ST13	Illegal

E202
A-Def-Group response
	Illegal use	Send Def-Group response PDU
		-
		If SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		-
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user unavailable” - ST0R

C.2.3 Get Group

Initiating entity

STATE EVENT	ST0I Idle	ST14 Get-Group response PDU pending
E003 A-Get-Group request	Send Get-Group request PDU - If SCS=STS3 then restart DCUT1 Restart DCLT1 - ST14	Illegal use
E105 Incoming Get-Group response PDU	Illegal	Issue A-Get-Group confirm - If SCS=STS1 then restart DCLT1 else cancel DCLT1 - ST0I
E114 Incoming Error PDU	Illegal	Issue A-Get-Group confirm Result:=Error PDU.Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Get-Group confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST15 A-Get-Group response pending
E106 Incoming Get-Group request PDU	Issue A-Get-Group indication - If SCS=STS4 then restart DCLT1 Restart DCUT1 - ST15	Illegal

E203
A-Get-Group response
	Illegal use	Send Get-Group response PDU
		-
		If SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		-
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user unavailable” - ST0R

C.2.4 Spontaneous Management

Initiating entity

STATE EVENT	ST0I Idle	ST16 Spont-Mgnt response PDU pending
E004 A-Spont-Mgnt request	Send Spont-Mgnt request PDU - If SCS=STS3 then restart DCUT1 Restart DCLT1 - ST16	Illegal use

E107
Incoming Spont-Mgnt response PDU
	Illegal	Issue A-Spont-Mgnt confirm
		-
		If SCS=STS1 then
		restart DCLT1
		else
		cancel DCLT1
		-
		ST0I

E114 Incoming Error PDU	Illegal	Issue A- Spont-Mgnt confirm Result:=Error PDU.Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Spont-Mgnt confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST17 A-Spont-Mgnt response pending
E108 Incoming Spont-Mgnt request PDU	Issue A-Spont-Mgnt indication - If SCS=STS4 then restart DCLT1 Restart DCUT1 - ST17	Illegal

E204
A-Spont-Mgnt response
	Illegal use	Send Spont-Mgnt response PDU
		-
		If SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		-
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user unavailable” - ST0R

C.2.5 Spontaneous Information Transfer

Tables in this section define the protocol for the spontaneous subconnection.

Initiating entity

STATE EVENT	STS0R Idle	STS2 A-Data (spont) request pending	STS4 Conf-Data (spont) PDU pending
ES01 A-Data (spont) request	Send Data (spont) PDU - If M=TRUE or (MCS<>ST0R and MCS<>ST3) then restart DCUT1 - If M=FALSE then restart DCLT1 - IF M=TRUE then STS2 else STS4	Send Data (spont) PDU If M=TRUE or (MCS<>ST0R and MCS<>ST3) then restart DCUT1 else cancel DCUT1 - If M=FALSE then restart DCLT1 - IF M=TRUE then STS2 else STS4	Illegal
ES12 Incoming Conf-Data (spont) PDU (OK/ERROR)	Illegal	ERROR: Issue A-Conf-Data (spont) indication - If MCS=ST0R or MCS=ST3 then cancel DCUT1 - STS0R OK: Illegal	ERROR: OK Issue A-Conf-Data (spont) indication - If MCS=ST3 then restart DCLT1 else cancel DCLT1 - STS0R

Initiating entity (cont.)

STATE EVENT	STS0R Idle	STS2 A-Data (spont) request pending	STS4 Conf-Data (spont) PDU pending
ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:= “Remote-service-user unavailable” - Issue A-Conf-Data (spont) Result:= “Misbehaviour of local service user” STS0R	Illegal
E114 Incoming Error PDU	Illegal	Illegal	Issue A-Conf-Data (spont) indication - Result:=Error PDU.result - Cancel DCLT1 - STS0R
ELL1 Expiry of the timer for DCLT1	Illegal	Illegal	Issue A-Conf-Data (spont) indication - Result:= “No-answer-from-remote-part-of-provider” - STS0R

Responding entity

STATE EVENT	STS0I Idle	STS1 Data (spont) PDU pending	STS3 A-Conf-Data (spont) request pending
ES11 Incoming Data (spont) PDU	Issue A-Data (spont) indication - If M=TRUE or (MCS<>ST0I and MCS<>ST4) then restart DCLT1 - If M=FALSE then restart DCUT1 - If M=TRUE then STS1 else STS3	Issue A-Data (spont) indication If M=TRUE or (MCS<>ST0I and MCS<>ST4) then restart DCLT1 else cancel DCLT1 If M=FALSE then restart DCUT1 - If M=TRUE then STS1 else STS3	Illegal
ES02 A-Conf-Data (spont) request (OK,ERROR)	Illegal use	ERROR: Send Conf-Data (spont) PDU - If MCS=ST0I or MCS=ST4 then cancel DCUT1 - STS0I OK: Illegal use	OK: ERROR: Send Conf-Data (spont) PDU - If MCS=ST4 then restart DCUT1 else cancel DCUT1 - STS0I

Responding entity (cont.)

STATE EVENT	STS0I Idle	STS1 Data (spont) PDU pending	STS3 A-Conf-Data (spont) request pending
ES114 Incoming Error PDU	Illegal	Issue A-Data (spont) indication Result:=Error PDU.result - Cancel DCLT1 - STS0I	Illegal
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Data (spont) indication Result:=- “No answer-from-remote-part-of-provider” - STS0I	Illegal
ELU1 Expiry of the timer for DCUT1	Illegal	Illegal	Send Error PDU Result:= “Remote-service-user-unavailable” - STS0I

Decision Tables of class 2.

The Decision Tables for this class are the same as for class 0 and class 1 but with the following distinction:

The idle states denoted by ST...I are the same as those denoted by ST..R. This means that the peer entities support the same events in both parts of the provider.

C.4. Decision Tables of class 3.

C.4.1 Command Transfer

Initiating entity

STATE EVENT	ST0I Idle	ST18 Command-Transfer response PDU pending
E009 A-command-Transfer request	Send Command-Transfer request PDU - if SCS=STS3 then restart DCUT1 restart DCLT1 - ST18	Illegal use

E115
Incoming Command-Transfer response PDU
	Illegal	Issue A-Command-Transfer confirm
		-
		if SCS=STS1 then
		restart DCLT1
		else
		cancel DCLT1
		-
		ST0I

E114 Incoming Error PDU	Illegal	Issue A-Command-Transfer confirm Result:=Error PDU-Result - Cancel DCLT1 - ST0I
ELL1 Expiry of the timer for DCLT1	Illegal	Issue A-Command-Transfer confirm Result:=”No-answer-from-remote-part-of-provider” - ST0I

Responding entity

STATE EVENT	ST0R Idle	ST19 A-Command-Transfer response pending
E116 Incoming Command-Transfer request PDU	Issue A-Command-Transfer indication if SCS=STS4 then restart DCLT1 restart DCUT1 - ST19	Illegal

E206
A-Command-Transfer response
	Illegal use	Send Command-Transfer response PDU
		
		if SCS=STS2 then
		restart DCUT1
		else
		cancel DCUT1
		ST0R

ELU1 Expiry of the timer for DCUT1	Illegal	Send Error PDU Result:=”Remote-service-user-unavailable”

C.4.2 Spontaneous Mixed Data Transfer

STATE EVENT	STS0R
E010 A-Mixed-Data request	Send Mixed Data Request PDU STS0R
E117 Incoming Mixed Data Error request PDU	Issue A-Mixed-Data Error indication STS0R

STATE EVENT	STS0I
E011 A-Mixed-Data-Error request	Send Mixed Data Error Request PDU STS0I
E118 Incoming Mixed Data request PDU	Issue A-Mixed-Data indication STS0I