TECHNICAL REPORT

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ELCOM-90
Application service element service definition

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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 Future updates and new versions will NOT be published for this reason.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 defines services provided by the application layer of the ELCOM-90 data communication concept. ELCOM is dedicated to transfer of process control information between computers in electric power control systems. The services provided are: defining, changing, deleting and inspecting groups of information, managing the transfer of information groups and commands between computer systems in an OSI-environment.

KEYWORDS

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

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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. To handle 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

The services defined in this document supply the power applications with tools facilitating communication.

The main goals for the design of these services are:

- Simplicity
- Adaptability
- Independence of lower layers' architecture. (E.g. allowing the use of ISO-protocols)

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 set-point 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

This document is the result of a joint work where the following persons have contributed:

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2   SCOPE AND FIELD OF APPLICATION

The service primitives defined in the ELCOM-90 Application Service Definition are used to achieve communication between computers running power application software within and between power utilities. The primitives comprise a minimum set able to fulfil the following requirements:

- Allowing the inclusion of standard protocols for all layers.
- Allowing extensions in the services to cope with the future OSI requirements.

3 ASSOCIATED DOCUMENTS

3.1 ELCOM-83 documentation

[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 documentation

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.

[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]   ISO 7498 - 2:   Information Processing Systems - Open Systems Interconnection
                                Security Architecture

[20]   ITU-T X.509 (1988)   The Directory - Authentication framework

[21]   ISO TR3509:   Service Conventions

4 DEFINITIONS AND ABBREVIATIONS

4.1 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.

Group: Set of named data objects of same type, implicitly numbered by their indexes.

Group type: Describes the type of objects represented in the group.

Group number: A unique identifier for one group.

Initiator: The service user responsible for association establishment, group configuration, data transfer, and association termination.

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.

Group descriptor: Parameters describing the properties of a group.

Group descriptor attributes: Parameters describing a specific state of a group.

Group definition: Unique identification of one specific group, as described by its group descriptor.

Service Provider: A physical realisation of the described service elements.

Group configuration: Creating/changing a group by means of its group descriptor.

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

4.2   Abbreviations

Gtype   : Group type identifier
Gnr   : Group number
A-   : Application-
Def   : Define
Init   : Initiate
Spont   : Spontaneous
Mgnt   : Management
Conf   : Confirm
T-Unit   : Time unit
Com.type   : Command type

5   CONVENTIONS

This document has been written using the conventions specified in [19].

In accordance with this report, the following notation is used in parameter tables:

M   The parameter is mandatory.

C   The parameter is not always present. The presence is conditional.

(=)   The value of the parameter is identical to the corresponding parameter in the interaction described by the preceding related service primitive.

U   The use of the parameter is a service-user option.

blank The parameter is not present in the interaction described by the primitive concerned.

6   OVERVIEW AND GENERAL CHARACTERISTICS

This document defines services for transferring, in a structured manner, power system information between computers.

The following services are included:

- Services for defining, changing, deleting and inspecting groups of information.
- Services for managing the transfer of information groups between computer systems.
- Command and set-point data transfer.

7 FACILITIES OF THE SERVICE

The application service definition is partitioned into a number of A-facilities. Each facility is explained below.

7.1 Association Establishment Facility

The association establishment facility enables two service users to establish a connection between them.

Simultaneous attempts by both users to establish an association between them may result in two associations. This is a matter for the users to decide by accepting or rejecting each association. A user of the service provider may always reject an unwanted association.

No architectural restrictions are placed on the number of concurrent associations.

The association establishment service allows the service users to exchange parameters describing the association. An established association requires the service users to be in agreement on which set of parameters to use.

7.2 Association Termination Facility

There are two termination services: the orderly release service and the provider initiated abort service (disruptive release). The following subclauses describe the services in more detail.

- **The orderly Release Service**
The association orderly release service allows each connected service user to release the connection. This is done in a co-operative manner between the two service users without loss of data after all in-transit data have been delivered and accepted by both service users.

- **The Provider Disruptive Release Service**
This service is the means by which the service provider may indicate the release of the connection by reasons internal to the service provider or when the underlying service is not available. The service user is responsible of preventing loss of data.

7.3 Group Facility

This facility enables the user to perform group management, group definition and to request group information.

The following services are provided:

- Space allocation/de-allocation for group descriptors.
- Update of group descriptor attributes.
- Definition of group (grouping logically interdependent objects).
- Readout of group definitions.
- Consistency check of group definitions.

7.4 Information Transfer Facility

The information transfer facility provides the following services:

- Initiation of data transfer.
- Data transmission as a response to an initiation.
- Confirmation of received data.
- Management of spontaneous data transfer.
- Spontaneous data transfer.
- Command and set-point data transfer.
- Text message transfer.

7.5 Test Association Facility

This facility enables the user to test the reachability and liveness of the remote application process.

7.6   Summary of Basic Facilities and their Services

Prefix of Name of Service Primitives	Name of Elementary Service	Type of Elementary Service

Application-Association Establishment Facility		
A-connect	Connection establishment	Confirmed
Application-Association Termination Facility		
A-Release	Connection release	Confirmed
A-P-Abort	Provider initiated abort	Non-confirmed
Group Facility		
A-Group-Mgnt	Create/delete/Change	Confirmed
A-Def-Group	Define group	Confirmed
A-Get-Group	Get group description	Confirmed
Information Transfer Facility		
A-Init-Transfer	Request information	Non-confirmed
A-Data	Send information (requested or spontaneous)	Non-confirmed
A-Conf-Data	Confirm data reception	Non-confirmed
A-Spont-Mgnt	Management of spontaneous data transfer	Confirmed
A-Command-Transfer	Send commands and set-points	Confirmed
A-Mixed-Data	Send information	Non-confirmed
A-Mixed-Data-Error	Report mixed data error	Non-confirmed
Test Association Facility		
A-Test-Connection	Test reachability and status	Confirmed

8   PROTOCOL VERSIONS AND CLASSES OF SERVICE

All classes of service provides the association establishment and association termination facilities.

8.1   Version 0

Version 0 of the protocol is named ELCOM-83 and is defined in [1], [2], [3], [4], [5] and [6].

8.2   Version 1

Version 1 of the protocol is named ELCOM-90 and defined in [8], [9], [10], [11], [12] and [13].

8.3   Class 0

This class supports only one way data transfer. This means that an end service user must act as INITIATOR or RESPONDER depending on the service primitives offered by the remote service provider.

One way transfer
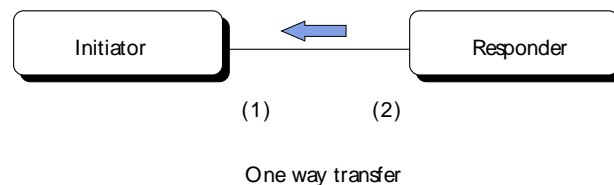
1. The service provider only offers primitives to users acting as INITIATORS.
2. The service provider only offers primitives to users acting as RESPONDERS.

This class offers the following service primitives:

    A-Init-Transfer
    A-Data
    A-Conf-Data
    A-Test-Connection

Restrictions:

- A-Init-Transfer.
  - Shall only be issued from INITIATOR.
  - Only one request can be issued before a confirmation is received (Per connection).

- A-Data.
  - Shall only be issued from RESPONDER.

- A-Conf-Data.
  - Shall only be issued from INITIATOR.

8.4 Class 1

As class 0 this class only supports one way transfer.

The class offers the service primitives from class 0 in addition to the following service primitives:

A-Group-Mgnt
A-Def-Group
A-Get-Group
A-Spont-Mgnt

Restrictions:

- Restrictions given for class 0.
- A-Group-Mgnt:
  - Shall only be requested from INITIATOR.
  - Only one request shall be issued before a confirmation is received (per connection).
- A-Def-Group:
  - Shall only be requested from INITIATOR.
  - Only one request shall be issued before a confirmation is received (per connection).
- A-Get-Group:
  - Shall only be requested from INITIATOR.
  - Only one request shall be issued before a confirmation is received (per connection).
- A-Spont-Mgnt:
  - Shall only be requested from INITIATOR.
  - Only one request shall be issued before a confirmation is received (per connection).

8.5   Class 2

This class supports Two Way Simultaneous transfer (TWS).

This means that an end service user may act simultaneously as INITIATOR and RESPONDER. The service provider offers service primitives to users both acting as INITIATORS and RESPONDER.

Two way simultaneous transfer
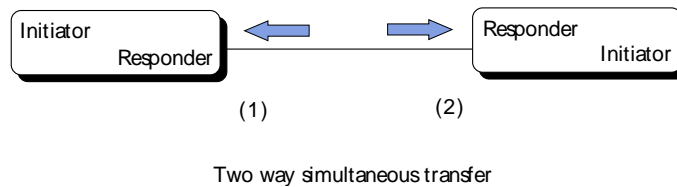
1. The service provider offers primitives to users acting simultaneously as INITIATORS AND RESPONDERS.

Restrictions:

- Restrictions given for class 1.

8.6   Class 3

This class offers the service primitives from class 2 in addition to the following service primitives:

        A-Command-Transfer
        A-Mixed-Data
        A-Mixed-Data-Error

Restrictions:

- Restrictions given for class 2.
- A-Command-Transfer: Only one request shall be issued before a confirmation is received.
- A-Mixed-Data: Spontaneous transmission only.
- A-Mixed-Data-Error: Spontaneous transmission only.

9 MODEL OF THE SERVICE

The model used conforms to the service conventions specified in [19].

A connection end-point identification mechanism must be provided to allow a basic service user and the provider to distinguish between several connections at the same service access point.

All the basic primitives must use this identification mechanism to identify the connection. This implicit identification is not shown in the service primitives and must not be mixed up with the address parameters of the connect primitives.

10 PERFORMANCE CHARACTERISTICS

(The need of data for this section is for further study.)

11 SEQUENCES FOR PRIMITIVES

11.1 Global Sequences for Primitives

This clause defines the interrelationships between the services and the service primitives of the application layer. These relationships are illustrated in Figure 11.1.1 following. Any item listed at the same vertical line can be performed in any sequence with respect to any other item listed at the same vertical line.

A-Connect must be performed before the other service elements can be performed.

Note that A-P-Abort service elements can occur at any time after the presentation connection has been established. The A-P-Abort service procedure disrupts all other service procedures. The presentation connection will then be disconnected.

The A-Data service procedure is disrupted by the A-Conf-Data service procedure.

FACILITIES	SERVICE PRIMITIVES		
Establishment	A-Connect		
Group	A-Group-Mgnt		
		A-Def-Group	
		A-Get-Group	
Information Transfer	A-Init-Transfer		
		A-Data *	
			A-Conf-Data
	A-Spont-Mgnt (Start)		
		A-Data *	
			A-Conf-Data
	A-Spont-Mgnt (Stop)		
	A-Mixed-Data		
	A-Mixed-Data-Error		
	A-Command-Transfer		
Termination	A-Release		
	A-P-Abort		

*) One or more activations of which the last has More-D = False. The responder is responsible for the sequence of the data transmitted. Spontaneous and initiated transfer can be mixed. Data shall be delivered in the requested sequence.

Figure 11.1.1 Application layer services and service primitive relationships.

11.2   Local Sequences for Primitives

Each of the following time-sequence diagrams is partitioned by two vertical lines into three fields.

The central field represents the service provider. The two side fields represent the two service users.

Sequences of primitives are positioned along lines representing the passage of time, increasing downwards.

Arrows, placed in the areas representing the service user, indicate the direction of propagation of primitives.

Necessary sequence relations between peer service users are controlled by user conventions and not by the service provider. Dashed lines in the time sequence diagram emphasise an example of a necessary convention to control the sequence relations to realise the management of spontaneous data transfer.

Initator	Provider	Responder
A-Connect request →		
		← A-Connect indication →
		← A-Connect response
← A-Connect confirm		
A-Release request →		
		A-Release indication →
		← A-Release response
← A-Release confirm		
← A-P-Abort indication		A-P-Abort indication →
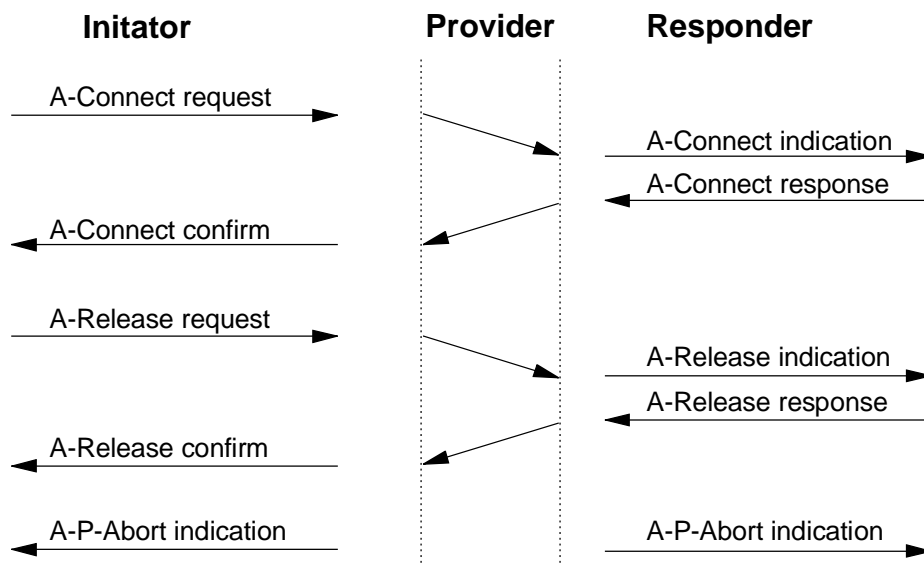
Figure 11.2.1 Time-sequence diagram. Association establishment and termination.

Initator　　　　　　**Provider**　　**Responder**

A-Group-Mgnt request

A-Group-Mgnt indication

A-Group-Mgnt response

A-Group-Mgnt confirm

A-Def-Group request

A-Def-Group indication

A-Def-Group response

A-Def-Group confirm

A-Get-Group request

A-Get-Group indication

A-Get-Group response
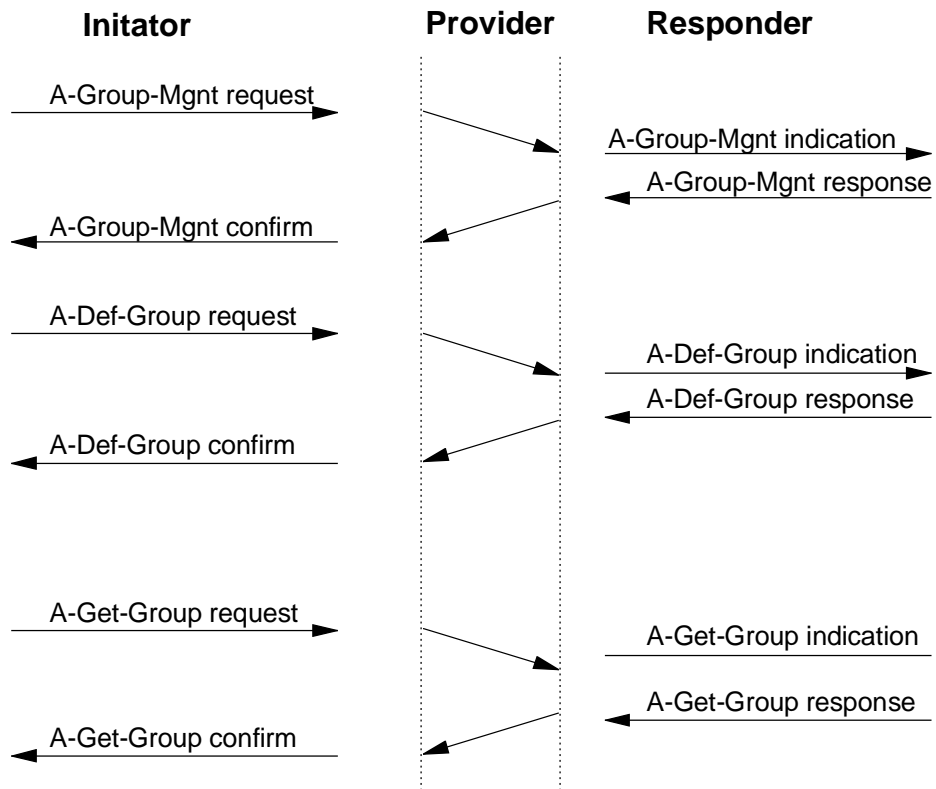
A-Get-Group confirm

Figure 11.2.2 Time-sequence diagram. Group configuration.
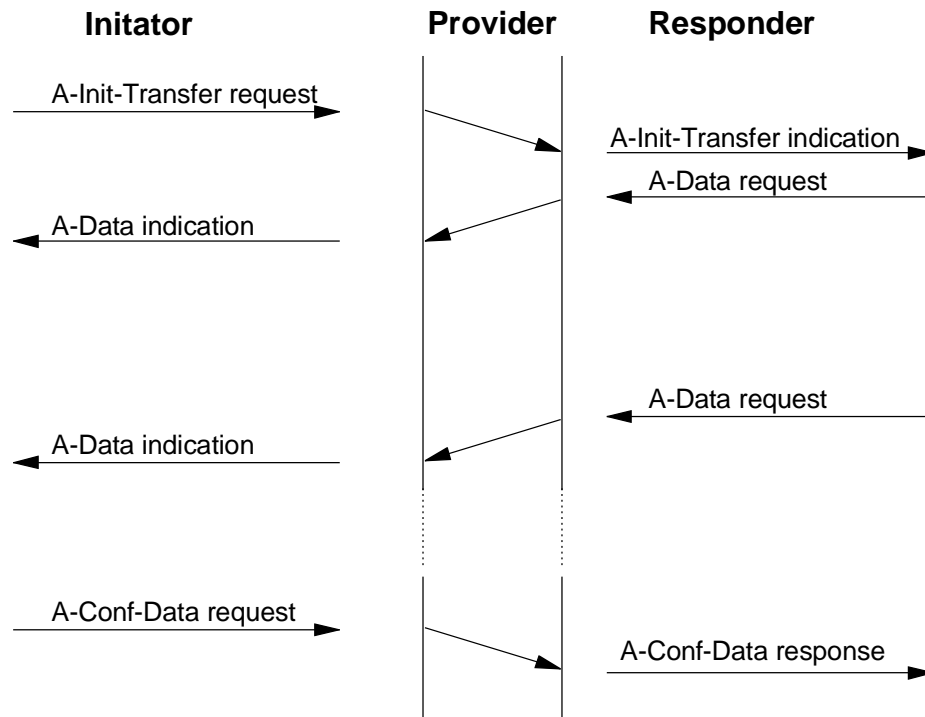
Figure 11.2.3 Time-sequence diagram. Information Transfer, initiated.

Comment: One "A-Conf-Data"-request may confirm several "A-Data indications".

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| Initator | Provider | Responder |
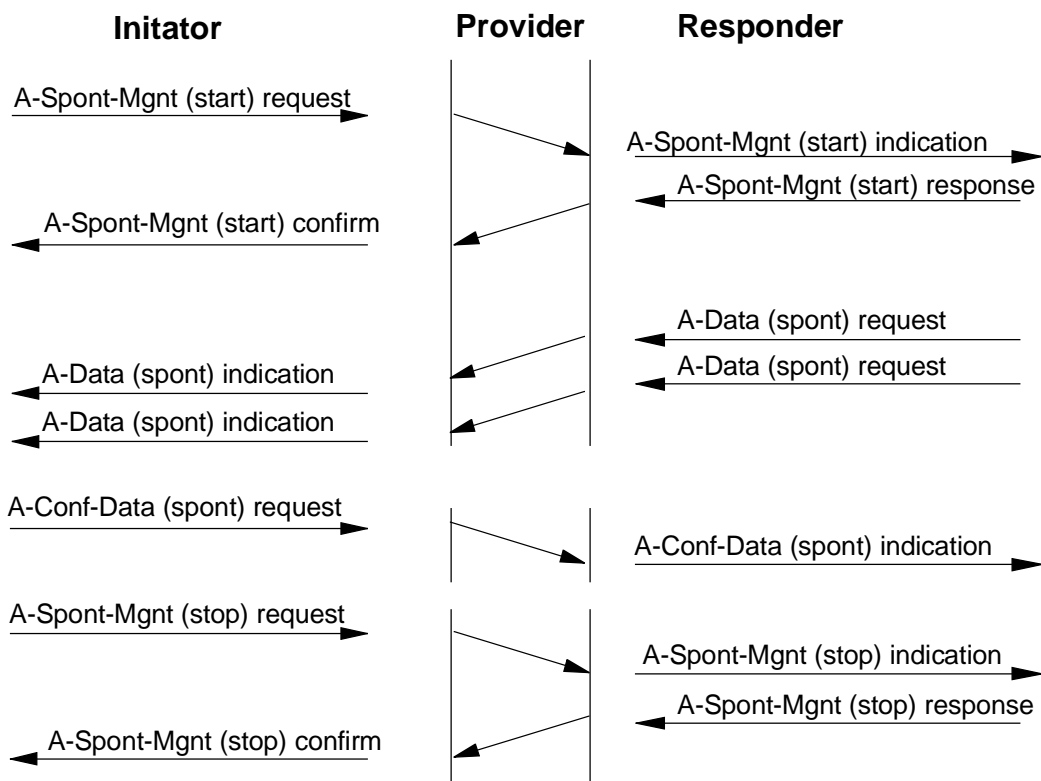
Figure 11.2.4 Time-sequence diagram. Information Transfer, spontaneous.

Comment: One "A-Conf-Data-request" may confirm several "A Data indications".
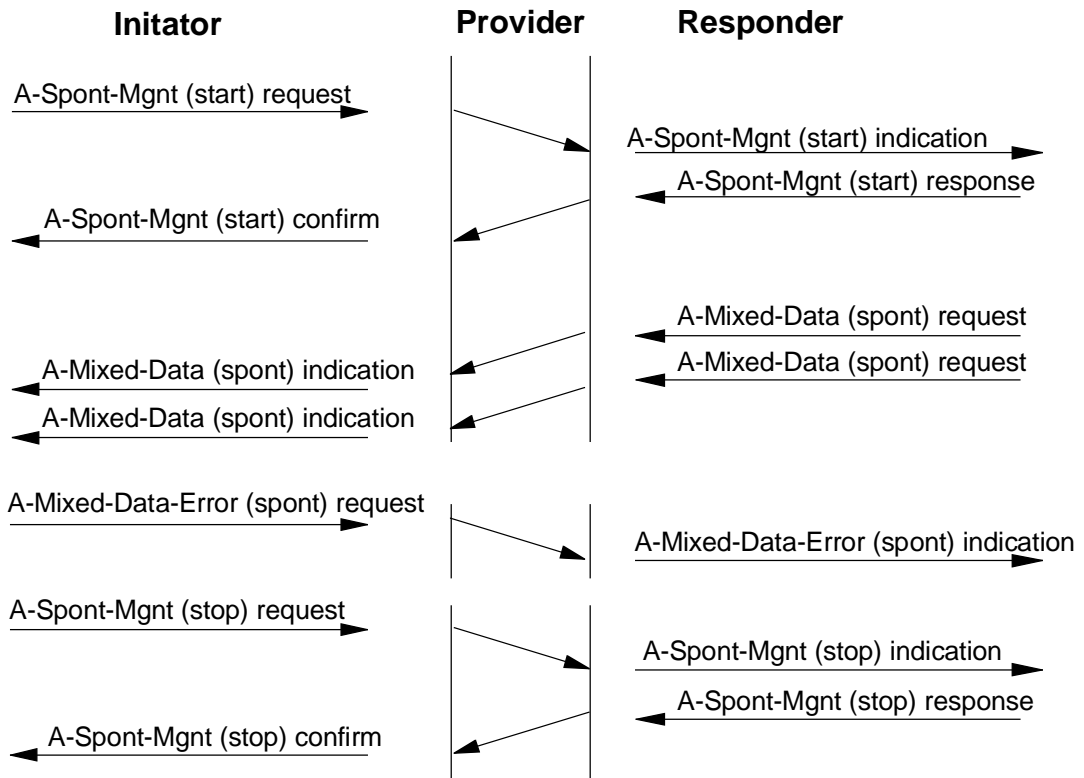
Figure 11.2.5 Time-sequence diagram. Mixed Data, Information Transfer, Spontaneous.

Comment: A-Mixed-Data-Error service is to be used by the initiator only to indicate a problem with the data received.

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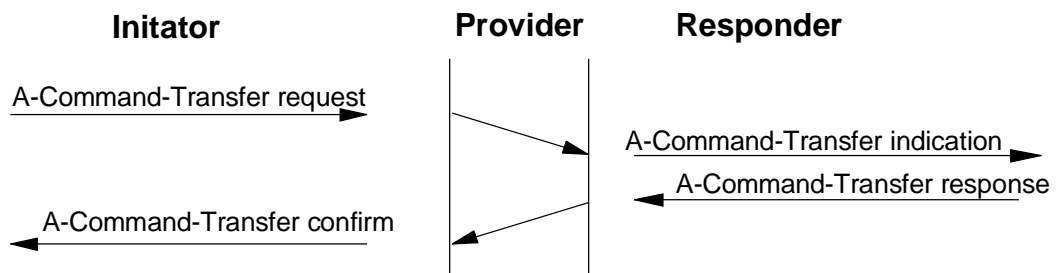
Figure 11.2.6 Time-sequence diagram. Command transfer.
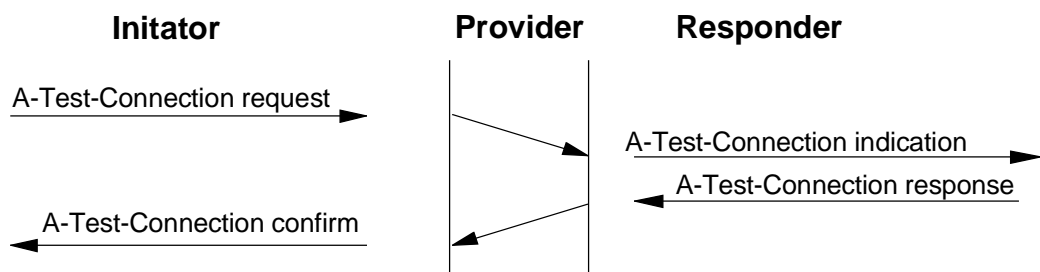
Figure 11.2.7 Time-sequence diagram. Test association.

12 DEFINITION OF PRIMITIVES

12.1 Association Establishment

12.1.1 A-Connect

12.1.1.1 Function

This primitive allows two users to establish an association between them. The same primitive can be used regardless of the protocols used at lower levels.

The primitive allows information interchange between the A-service users.

12.1.1.2 Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Version	See note 1	M	(=)	M	(=)
Initiator Address		M	(=)	(=)	(=)
Acceptor Address		M	(=)	(=)	(=)
User data	See note 2	M	(=)	M	(=)
Result	Success/ Failure			M	M

Version =   Class 0 implemented/
Class 1 implemented/
Class 2 implemented/
Class 3 implemented
Version 0 of protocol (Elcom 83)/
Version 1 of protocol (Elcom 90)

Note 1: The responding user entity shall when possible match the version indicated in the A-Connect indication. When a match is not possible, the version available shall be returned in the response, and the result shall be set to incompatible versions. In this case no connection is established.

Initiator Address = Octet string uniquely describing the initiating service user.

Acceptor Address = Octet string uniquely describing the responding service user.

User data = Data which are transparently transferred between the A-service users. The User data sent from the initiator contains information concerning periodic transmission. The User data returned from the responder contains information used by the A-service user to determine the version of the group definition.

The User data may include information concerning the selection of security mechanisms to be used, as well.

Note 2: A part of User data matches the CF parameter of the A-Def-Group-Conf primitive. See also [10], Appendix A for details.

Result = Result ok/
Local lack of resources/
Remote lack of resources/
No answer from remote system/
Remote service user unavailable/
Called user unknown/
Misbehaviour of local service user/
Misbehaviour of remote service user/
Misbehaviour of local part of provider/
Misbehaviour of remote part of provider/
Incompatible versions/
No available lower level connection/
Security is not supported by A service user/
Incompatible security options requested/
Authentication failure/
System implementation dependent reason/
Unknown reason

12.2 Association Termination

12.2.1 A-Release

12.2.1.1 Function

Orderly release of the association with no loss of previously issued data.

Parameter	Comment	Request	Indication	Response	Confirm
User reason		M	(=)		
Result				M	M

User reason = Invalid Message Authentication Code received/Decipherment error.

Result = Result ok/
Collision

12.2.2 A-P-Abort

12.2.2.1 Function

This primitive is used by the service provider to inform the user of abnormal termination of the association.

12.2.2.2 Parameters

Parameter	Comment	Indication
Reason		M

Reason =	Quality of service below minimum level/
	No answer from remote system/
	Misbehaviour of local service user/
	Misbehaviour of remote service user/
	Misbehaviour of local part of provider/
	Misbehaviour of remote part of provider/
	No available lower level connection/
	System implementation dependent reason/
	Unknown reason

12.3   Group

12.3.1   A-Group-Mgnt

12.3.1.1 Function

- Allocation of group descriptors.
- De-allocation of group descriptors.
- Change of group descriptor attributes (Persist, Static, Priority Class.)

12.3.1.2 Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Function		M	(=)	(=)	(=)
Gtype		M	(=)	(=)	(=)
Gnr		M	(=)	(=)	(=)
CF				M	(=)
Gsize		M	(=)		
Objlength		M	(=)		
Persist	Boolean	M	(=)		
Static	Boolean	M	(=)		
Priority Class		M	(=)		
Result				M	M

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Function	=	G-Create/
		G-Change/
		G-Delete/
		Delete-all-groups
Gtype	=	Measurement group/
		Status group/
		Discrete group/
		Logical breaker status group/
		Binary command group/
		Analogue set-point group/
		Digital set-point group/
		Text message group
Gnr	=	Group number
CF	=	Control Field. Used to return a parameter to be stored by the initiator for later version control of the group configuration at the responder side. This parameter corresponds to a part of the user data field of the A-Connect primitive. The CF parameter contains a date, time field and a checksum field.
Gsize	=	Maximum number of objects.
Objlength	=	Maximum length of object identifier, exclusive length indicator, given in octets.
Persist	=	True => group not deletable.
Static	=	True => group not redefineable.
Priority Class =		Value of priority class for this group. Only valid for spontaneous transmission.
Result	=	Result ok/
		Gtype out of range/
		Gnr out of range/
		Gsize out of range/
		Objlength out of range/
		No memory/
		Group exists/

Not deletable/
No answer from remote part of provider/
Remote service user unavailable/
Misbehaviour of remote service user/
Misbehaviour of remote part of provider/
Priority class out of range

12.3.2   A-Def-Group

12.3.2.1   Function

Definition or redefinition of objects in groups.

The primitive may have to be called a number of times to complete the configuration of the entire group by configuring subgroups indicated by the Index1 and Index2 parameters.

12.3.2.2   Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Gtype		M	(=)	(=)	(=)
Gnr		M	(=)	(=)	(=)
Index1		M	(=)	(=)	(=)
Index2		M	(=)	(=)	(=)
CF				M	(=)
Objid (I)	See note 1	M	(=)		
Result (I)	See note 1			M	M

Gtype

=
Measurement group/
Status group/
Discrete group/
Logical breaker status group/
Binary command group/
Analogue set-point group/
Digital set-point group/
Text message group

Gnr   =   Group number

Index1,Index2 =   Index in the range Index1 to Index2, bounds included, in specified group are to be defined. One group can be configured by several A-Def-Group requests, each with a different index range.

CF = Control Field. Used to return a parameter to be stored by the initiator for later version control of the group configuration at the responder side. This parameter corresponds to a part of the user data field of the A-Connect primitive. The CF parameter contains a date and time field and a checksum field.

Objid = Object identifier or sequence of object identifiers. See note 1.

Result = Result ok/
Gtype out of range/
Gnr out of range/
Objlength out of range/
Index out of range/
Objid unknown/
Config buffer overflow/
Not reconfigurable/
No answer from remote part of provider/
Remote service user unavailable/
Misbehaviour of remote service user/
Misbehaviour of remote part of provider

Note 1: Objid and Result can each consist of more than one element. Result (I) regards Objid (I) or all objects.

12.3.3   A-Get-Group

12.3.3.1   Function

This primitive enables the user to request the remote part for information regarding a group.

The primitive may have to be called a number of times to complete the transmission of the complete group by requesting subgroups indicated by Index1 and Index2 parameters.

12.3.3.2   Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Gtype		M	(=)	(=)	(=)
Gnr		M	(=)	(=)	(=)
Persist				M	(=)
Static				M	(=)
Priority Class				M	(=)
Gsize				M	(=)
Index1		M	(=)	(=)	(=)
Index2		M	(=)	(=)	(=)
Objlength				M	(=)
Objid (I)	See note 1			M	(=)
Result				M	M

Gtype   =   Measurement group/
                      Status group/
                      Discrete group/
                      Logical breaker status group/
                      Binary command group/
                      Analogue set-point group/
                      Digital set-point group/
                      Text message group

Gnr   =   Group number.

Persist = True => group not deletable.

Static = True => group not redefineable.

Priority Class = Value of priority class for this group. Only valid for spontaneous transmission.

Gsize = Maximum number of objects.

Index1, Index2 = Index in the range Index1 to Index2, bounds included, in specified group are to be defined. One group can be configured by several A-Def-Group requests, each with a different index range.

Objlength = Maximum length of object identifier, exclusive length indicator, given in octets.

Objid = (Sequence of) object identifier(s).

Result = Result ok/
Gtype out of range/
Gnr out of range/
Index out of range/
No answer from remote part of provider/
Remote service user unavailable/
Misbehaviour of remote service user/
Misbehaviour of remote part of provider

Note 1: Objid can consist of more than one element.

12.4 Information Transfer

12.4.1 A-Init-Transfer

12.4.1.1 Function

This primitive enables the user to request the remote part for data. Only one request can be made before a response is received in return.

12.4.1.2 Parameters

Parameter	Comment	Request	Indication
Gtype		M	(=)
Gnr	See note 1	M	(=)
Index1	"	M	(=)
Index2	"	M	(=)
T0	"	M	(=)
Dt	"	M	(=)
T-Unit	"	M	(=)
Periods	"	M	(=)

Gtype = Measurement group/
Status group/
Discrete group/
Logical breaker status group/
Binary command group/
Analogue set-point group/
Digital set-point group/
Text message group

Gnr = Group number

Index1, Index2 = Objects in the range Index1 to Index2, bounds included, from specified group(s) are requested. Index1 = Index2 = 0 is equivalent to requesting the complete group.

T0	=	Point of time for oldest group incarnation requested in the form of Year, Month, Day, Hour, Minute, Second, Millisecond.
Dt	=	Time-slice between two consecutive group incarnations. Dt shall be specified in the unit indicated by T-Unit.
T-Unit	=	Year/Month/Day/Hour/Minute/Second/Millisecond.
Periods	=	Number of group incarnations requested.
Note 1:		The use of the parameters T0, Dt, T-Unit and Periods should be dummy if the Gtype = Text message group. In addition, use of the parameters Gnr, Index1 and Index2 is subject to local or global conventions.

12.4.2   A-Data

12.4.2.1   Functions

This primitive transfers data between the service users. One group is transferred for each activation of the primitive. When more than one incarnation are requested (historical data) then the oldest incarnation shall be transferred first. Only one incarnation shall be transferred for each activation of the primitive. The primitive also reports erroneous initiation of data transfer and time-out during data reception.

12.4.2.2   Parameters

Parameter	Comment	Request	Indication
Gtype	See note 1	M	(=)
Gnr	"	M	(=)
Transmod		M	(=)
Index1	See note 1	M	(=)
Index2	"	M	(=)
T		M	(=)
More-D		M	(=)
Data		M	(=)
Result		M	M

Transmod   =   Initiated/Spontaneous

Index1, Index2   =   Object range.

T   =   Time stamp of this incarnation (Year, Month, Day, Hour, Minute, Second, Millisecond).

Gtype   =   Measurement group/
                                       Status group/
                                       Discrete group/
                                       Logical breaker status group/
                                       Binary command group/

Analogue set-point group/
Digital set-point group/
Text message group

Gnr	=	Group number
More-D	=	True when more data are to follow for the same request. False for the last primitive in a sequence.
Data	=	Actual group or part thereof.
Result	=	Result ok/
		Gtype out of range/
		Gnr out of range/
		Index out of range/
		T0 out of range/
		Dt out of range/
		No answer from remote part of provider/
		Remote service user unavailable/
		Misbehaviour of remote service user/
		Misbehaviour of remote part of provider
Note 1:		The use of the parameters Gnr, Index1, Index2 is subject to local or global conventions if Gtype=Text message group.

12.4.3   A-Conf-Data

12.4.3.1   Function

This primitive confirms the reception of an A-data primitive with More-D = False or indicates an error situation. (Errors are reported immediately regardless of the value of More-D.)

12.4.3.2   Parameters

Parameter	Comment	Request	Indication
Gtype	See note 1	M	(=)
Gnr		M	(=)
Transmod		M	(=)
Result		M	M

Gtype   =   Measurement group/
                     Status group/
                     Discrete group/
                     Logical breaker status group/
                     Binary command group/
                     Analogue set-point group/
                     Digital set-point group/
                     Text message group

Gnr   =   Group number

Transmod   =   Initiated   - Acknowledgement of initiated transfer
                     Spontaneous   - Acknowledgement of spontaneously transferred data

Result   =   Result ok/
                     Gtype out of range/
                     Gnr out of range/
                     T out of range/
                     Index out of range/
                     No answer from remote system/
                     Remote service user unavailable/

Misbehaviour of remote service user/
Misbehaviour of remote part of provider/
Spontaneous transfer not initiated

Note 1: The use of the parameter Gnr is subject to local or global conventions if Gtype = Text message group.

12.4.4 A-Spont-Mgnt

12.4.4.1 Function

This primitive enables and disables spontaneous data transfer for a specified group. The receiver of the primitive is allowed to transfer data spontaneously within the period delimited by the A-Spont-Mgnt (start) and the A-Spont-Mgnt (stop) primitives. The responding service user may use different criteria for deciding when to transfer data.

More than one group can be requested to send spontaneous data simultaneously. The maximum number of groups is implementation dependent.

The changed values shall be transmitted by use of the A-Data primitive.

The following procedure is an example of how to use spontaneous transfer of changed values:

When values in a specified group are changed, they shall immediately be transferred to the part requesting spontaneous transfer. The number of values transferred shall be the lowest possible containing all the changed elements of the group. (The range of values transferred is indicated by Index1 and Index2 of the A-Data primitive.) It is thus possible that one or more of the values transferred are unchanged.

12.4.4.2 Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Function		M	(=)	(=)	(=)
Gtype		M	(=)	(=)	(=)
Gnr	See note 1	M	(=)	(=)	(=)
Result				M	M

Function = Start/
stop

Gtype = Measurement group/
Status group/
Discrete group/

Logical breaker status group/
Binary command group/
Analogue set-point group/
Digital set-point group/
Text message group

Gnr   =   Group number

Result   =   Result ok/
Gtype out of range/
Gnr out of range/
No answer from remote part of provider/
Remote service user unavailable/
Misbehaviour of remote service user/
Misbehaviour of remote part of provider

Note 1:   The use of the parameter Gnr is subject to local or global conventions if
Gtype = Text message group.

12.4.5   A-Command-Transfer

12.4.5.1   Function

This primitive transfers command and set-point data between service users. One group is transferred for each activation of the primitive. Transferring commands, the primitive only contains one object. Transferring set-points, the primitive contains one or several objects. The Command type parameter makes it possible to implement a "Check Before Execute" function. When this facility is utilised, the service user will have to activate the primitive twice; the first with the check mode and the second with execute mode. The control and actions of the two-step sequence are left to the service users.

12.4.5.2   Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Gtype		M	(=)	(=)	(=)
Gnr		M	(=)	(=)	(=)
Index1		M	(=)	(=)	(=)
Index2		M	(=)	(=)	(=)
T		M	(=)	M	(=)
Time mode		M	(=)	M	(=)
Com.type		M	(=)	M	(=)
Data		M	(=)	(=)	(=)
Result				M	M

Gtype   =   Binary command group/
                        Analogue set-point group/
                        Discrete set-point group

Index1, Index2   =   Index2 is equal to Index1 for commands. For set-points Index2 can be
                        different from Index1.

T   =   The A-service user can utilise this field in different ways dependent of the
                        value in Time mode field.

Time mode	=	Argument not used/
		Latest point of time when command can be issued at the RTU side/
		Point of time when command shall be issued at the RTU side.

This parameter allows for control of the duration of a command transfer operation, and to cancel the command if not within acceptable ranges.

Com.type	=	CBXC Check before execute command/
		EXC Execute command/
		IHC Inhibit command/
		IXC Immediate execute/
		CBR Check back response/
		IHR Inhibit response/
		EXR Execute response

This parameter allows to use the Check Before Execute function to increase the transmission security of the command transfer function.

The A-service user decides whether to support these options or not.

Data	=	Actual group of command or set-point data. The Data parameter may be empty in the CBXC-CBR sequence.

Result	=	Result ok/
		Gtype out of range/
		Gnr out of range/
		Index out of range/
		T out of range/
		Time mode out of range/
		Command type out of range/
		Time mode not supported by A-service user/
		Command type not supported by A-service user/
		EXC data different from CBXC data/
		CBXC not received before EXC/
		Remote service user unavailable/
		No answer from remote part of provider.

12.4.6 A-Mixed-Data

12.4.6.1 Function

This primitive transfers data between the service users. Objects from more than one group can be transferred with one activation of the primitive. The objects can come from different groups. These groups may be of different types, e.g. measure groups, status groups, discrete groups or logical breaker groups. The primitive gives the service user the ability to buffer spontaneous data for transmission in one block.

12.4.6.2 Parameters

Parameter	Comment	Request	Indication
T Data		M M	(=) (=)

T = Time stamp of this incarnation. (Year, Month, Day, Hour, Minute, Second, Millisecond)

Data = Actual information objects to be transferred. The format is described in [14].

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12.4.7 A-Mixed-Data-Error

12.4.7.1 Function

This primitive gives the service user an ability to signal to the responder that an error is detected in the received Data field of a previous A-Mixed-Data indication.

12.4.7.2 Parameters

Parameter	Comment	Request	Indication
Gnr Result		M M	(=) (=)

Gnr   =   Group number

Result   =   Spontaneous transfer not initiated/
                          Gnr out of range/
                          Index out of range

12.5   Test Association

12.5.1   A-Test-Connection

12.5.1.1 Function

This primitive ensures reachability and "liveness" of the remote application entity and user.

12.5.1.2 Parameters

Parameter	Comment	Request	Indication	Response	Confirm
Result				M	M

Result   =   Result ok/
No answer from remote part of provider/
Remote service user unavailable/
Misbehaviour of remote service user/
Misbehaviour of remote part of provider