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First edition
2007-01

Information technology –
Home electronic system (HES) architecture –

Part 3-3:
User process for network based control of HES Class 1



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INFORMATION TECHNOLOGY - HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-3: User process for network based control of HES Class 1

FOREWORD

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This International Standard is a product family standard. It is not intended to be used as a stand-alone standard.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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INTRODUCTION

The application interface layer is the layer between the application layer and the application. It contains the communication relevant tasks of the application. It eases the communication task of the application by offering a communication interface that abstracts from many application layer details.

This International Standard allows single-processor and dual-processor device designs. A dual processor device uses additional services to communicate via a serial External Message Interface with the external user application running in the second processor.

The following clauses specify the client and server functioning and the communication interface of the internal user application located in the Bus Access Unit (BAU).

The application interface layer contains the following objects and the access routines to them.

– **Group objects**: these can be accessed via Transport layer Service Access Points (TSAPs) on multicast communication services; see the corresponding clause in ISO/IEC 14543-3-2. Group objects may also be references to interface objects.

– **Interface objects**: these can be accessed via application services on point-to-point connectionless and point-to-point connection-oriented communication modes. The interface objects are divided into system interface objects and application interface objects.

  - System interface objects are
    – the device object,
    – the group address table object,
    – the association table object, and
    – the application object.
  - System interface objects are relevant for network management as specified in ISO/IEC 14543-3-4.
  - Application interface objects are objects defined in the user application. They may be defined by the internal or external user application, based on interface object structure rules defined in this document. Application interface objects may also be referenced by a group object reference.

The following clauses specify the data structures of each of the application interface layer objects. Additionally, they define by which application services these objects are accessible. Both the object client and object server functioning may be implemented by the external or the internal application interface layer. It is recommended to locate the group communication objects, the interface objects and the resource objects in the internal application interface layer.

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Currently, ISO/IEC 14543, *Information technology – Home Electronic System (HES) architecture*, consists of the following parts:

Part 2-1: *Introduction and device modularity*
Part 3-1: *Communication layers – Application layer for network based control of HES Class 1*
Part 3-2: *Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1*
Part 3-3: *User process for network based control of HES Class 1*
Part 3-4: *System management – Management procedures for network based control of HES Class 1*
Part 3-5: *Media and media dependent layers – Power line for network based control of HES Class 1*
Part 3-6: *Media and media dependent layers – Twisted pair for network based control of HES Class 1*
Part 3-7: *Media and media dependent layers – Radio frequency for network based control of HES Class 1*
Part 4: *Home and building automation in a mixed-use building (technical report)*
Part 5-1: *Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Core ptotocol* (*under consideration*)
Part 5-2: *Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Device certification* (*under consideration*)

Additional parts may be added later.

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INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-3: User process for network based control of HES Class 1

1 Scope

This part of ISO/IEC 14543 specifies the structure and functioning of servers for the objects which form the interface between the application layer and the application and management.

2 Normative references

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

ISO/IEC 14543-3-1, *Information technology – Home Electronic System (HES) architecture – Part 3-1: Communication layers – Application layer for network based control of HES Class 1*

ISO/IEC 14543-3-4, *Information technology – Home Electronic System (HES) architecture – Part 3-4: System Management – Management procedures for network based control of HES Class 1*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document the terms and definitions given in ISO/IEC 14543-3-1 apply.

3.2 Abbreviations

ASAP	Application layer Service Access Point
BAU	Bus Access Unit
EMI	External Message Interface
HES Class 1	refers to simple control and command
HES Class 2	refers to Class 1 plus simple voice and stable picture transmission
HES Class 3	refers to Class 2 plus complex video transfers
TSAP	Transport layer Service Access Point

4 Conformance

An entity of operational exchange conforming to this International Standard shall support the group objects specified in clause 6.

The implementation of interface objects specified in clause 7 is optional.

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5 Object models

This International Standard specifies two kinds of objects for operational exchanges.

a) Group objects
group objects shall be used to support the shared variable model.

b) Interface objects
interface objects shall be used to support the client/server model and, if they are referenced by group objects, also the shared variable model of the group objects.

An application may use each kind of object at any time; see Figure 1.

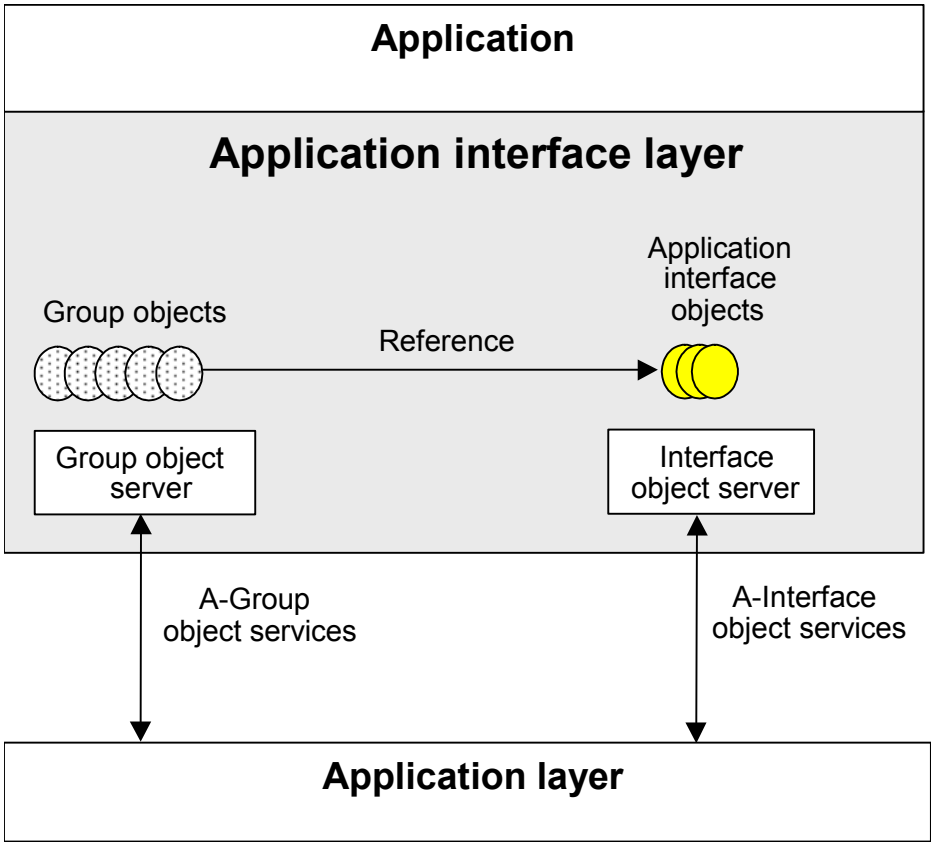


Figure 1 – User process model

6 Group object server

6.1 Overview

Group objects can be distributed to a number of devices. Each device may be transmitter and receiver for group object values. More than one group object can exist in an end device and a group object in a device may be assigned to one or more group addresses. Group objects of an end device may belong to the same or to different groups. Each group shall have a network-wide unique group address. The group address shall be mapped to a local group index (TSAP) by the transport layer; the group index shall be unique for the communication services of the device. The application layer shall map the group index by the association table to the group reference ID (Application layer Service Access Point, ASAP) that shall be used to address the group objects.

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6.2 General data structure group objects

6.2.1 Structure

In the sense of the previous clause a group object shall consist of three parts as shown in Figure 2:

a) the group object description;

b) the object value;

c) the communication flags.

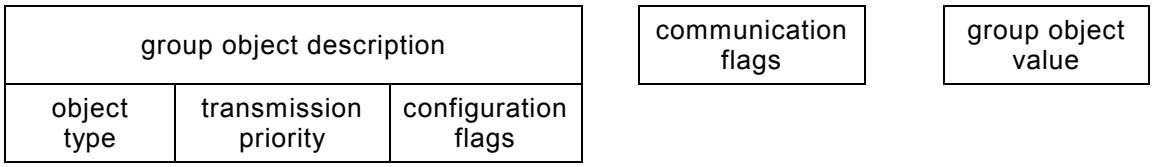


Figure 2 – Data structure of group objects

6.2.2 Group object description

6.2.2.1 Object type

The following value-types shall be possible:

Table 1 – Group object types

Value length / Type	Value-size
Unsigned Integer (1)	1 bit
Unsigned Integer (2)	2 bit
Unsigned Integer (3)	3 bit
Unsigned Integer (4)	4 bit
Unsigned Integer (5)	5 bit
Unsigned Integer (6)	6 bit
Unsigned Integer (7)	7 bit
Unsigned Integer (8)	1 octet
Unsigned Integer (16)	2 octets
Octet (3)	3 octets
Octet (4)	4 octets
Octet (6)	6 octets
Octet (8)	8 octets
Octet (10)	10 octets
Octet (14)	14 octets
Interface object reference	4 to 14 octets

Only group objects of the same type may be linked to one group, and for interface object references the interface object type with the same instance number shall also be the same.

6.2.2.2 Transmission priority

The priority can only be “urgent”, “normal” or “low”. The transmission priority “system” shall not be allowed for communication using group objects.

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6.2.2.3 Configuration flags

The configuration flags shall include the static configuration of the group object, as follows:

a) read enable;

b) write enable;

c) transmit enable;

d) update enable;

e) communication enable.

If the “read enable” flag is set, the user process shall allow reading the group object value. The user process shall thus react to an A_GroupValue_Read.ind service from the application layer as specified in ISO/IEC 14543-3-1. If the “read enable” flag is clear, the user process shall ignore this service for this group object.

If the “write enable” flag is set, the user process shall allow setting the group object value; the user process shall thus react to an A_GroupValue_Write.ind service from the application layer as specified in ISO/IEC 14543-3-1. If the “write enable” flag is clear, the user process shall ignore this service for this group object.

If the “transmit enable” flag is set, the user process shall allow transmitting the group object value. On request by the user application the user process shall thus pass an A_GroupValue_Write.req service to the application layer as specified in ISO/IEC 14543-3-1. If the “transmit enable” flag is clear, the user process shall ignore this request from the user application.

If the “update enable” flag is set, the user process shall update the communication object value on reception of an A_GroupValue_Read.con to that group object by setting the group object value to the contained value. If the “update enable” flag is clear, the user process shall not react on A_GroupValue_Read.res-services to that group object.

The “communication enable” flag shall take priority over the “read enable”, “write enable”, “transmit enable” and “update enable” flags. If the “communication enable” flag is set, these flags shall be evaluated as specified. If the “communication enable” flag is clear, these configuration flags shall not be evaluated; instead, all services and requests shall be ignored.

6.2.3 Communication flags

The communication flags show the state of a group communication object. The following states are possible:

a) update;

b) read-request;

c) write-request;

d) transmitting;

e) ok-error.

The “update” flag shall be set by the user process to indicate to the user application that it has updated the group object value. The “update” flag shall be cleared by the user application.

The “read-request” flag shall be set by the user application to indicate that it wants to obtain an update of its group object value. As a reaction, the user process shall generate an A_GroupValue_Read.req as specified in ISO/IEC 14543-3-1 and clear the “read-request” flag if successful.

The “write-request” shall be set by the user application to indicate that it wants to transmit the group object value. As a reaction, the user process shall generate an A_GroupValue_Write.req as specified in ISO/IEC 14543-3-1 and clear the “write-request” flag if successful.

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The “transmitting” flag shall be set by the user process to indicate to the user application that it is processing a read request or a write request. It shall be cleared by the user process when the request is handled.

The “ok-error” flag shall be set by the user process to indicate to the user application that the handling of the previous read request or write request was not successful. It shall be cleared by the user process otherwise.

6.2.4 Group object value

The group object value shall contain the value of the group object. It shall be set by the user application for the transmission of the group object value. It shall be set by the user process when the data addressed to the group object is received from the application layer.

The coding of the group object value shall comply with the interworking requirements in this standard.

6.3 Group object value transfers

6.3.1 Overview of group object value transfers

The application process shall trigger group object value transfers by setting or clearing the relevant communication flags of a group object. The group objects, or their images, shall be held in the group object server. The communication flags shall be used to trigger the user process’s group object server to initiate the transfers. The local access to a group object of the group object server shall cause the group object server to initiate a network-wide update of that group object. When an update has been received, the local user application shall be triggered by the group object server to use the new value. There are four cases to be considered:

a) the user application process wants to read the group object's value;

b) the user application process wants to write the group object's value;

c) the group object server has received from the application layer a request to read the group object’s value;

d) the group object server has received from the application layer an update of the group object's value.

The interaction between the user application process and the group object server shall be equivalent to the service primitives for request and indication, except that in this case the exchange shall be subject to the status of the communication flags. This shall enable distinguishing local access from network-wide updates.

It shall be the responsibility of the internal or external user application program to trigger group object value transmissions.

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6.3.2 Reading the group object value

If a user application reads a group object value, the process shown in Figure 3 shall be followed:

User application	User process (group object server)	Application layer
→ set communication status to "read-request" → ↓ ↓ application polls ... ↓ ↓ ↓ ↓	Group object server polls ... ↓ ↓ →set communication status to "transmitting" ←← →→	→ A_GroupValue_Read.req →→→ (local)← ← A_GroupValue_Read.Lcon
application polls ... ↓ ↓ ↓ ↓ ↓ ↓	set communication status to "ok" ←← [a]	←←← ← A_GroupValue_Read.Acon
read value reset "updated" flag ←←	set new group object value set communication status to "updated" [b] ←←	

[a] If a negative A_GroupValue_Read.Lcon is received, then the communication status shall be set to "error"; the actions following should not occur (no new value, no "updated" flag).

[b] Update shall be subject to the "Update Enable" and "Communication" flag if used, otherwise to the "Write Enable" flag.

Figure 3 – Reading a group object value

6.3.3 Receiving a request to read the group object value

If the group object server receives a read request for a group object it contains, the process shown in Figure 4 shall be followed:

User application	User process (group object server)	Application layer
application polls ... ↓ ↓ ↓ ↓	group object server polls ... ↓ ↓ read group object value group object server polls ... ↓	←←← ←A_GroupValue_Read.ind → A_GroupValue_Read.res →→→ (local)←← ← A_GroupValue_Read.Rcon

Figure 4 – Receiving a request to read the group object value

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6.3.4 Writing the group object value

If a user application sets the group object value and requests its transmission, the process shown in Figure 5 shall be followed:

User application	User process (group object server)	Application layer
set communication status to "transmit_request"→ application polls ... ↓ ↓ ↓ ↓ ↓ ↓ ↓ application polls ...	Group object server polls ... ↓ ↓ ↓ → set communication status to "transmitting" ←← →→ set communication status to "ok" ←← [a]	→A_GroupValue_Write.req →→→ (local)← ←A_GroupValue_Write.Lcon
[a] If a negative A_GroupValue_Write.Lcon is received, then the communication status shall be set to "error".		

Figure 5 – Writing a group object value

6.3.5 Receiving an update of the group object value

If the user process receives an update of a group object it contains, the process shown in Figure 6 shall be followed:

User application	User process (group object server)	Application layer
application polls ... "updated" flag ↓ ↓ ↓ ↓ ← read value resets "updated" flag	Group object server polls ... ↓ ↓ ← set new group object value set communication status to "updated" [a] ←←	←←← ← A_GroupValue_Write.ind
[a] Update is subject to the write enable/disable flags.		

Figure 6 – Receiving an update of the group object value

7 Interface object server

7.1 Overview

Interface objects shall be instances of a common general structure. Interface objects can be located either in the internal or in the external user application. Each object instance in a device shall have a unique identifier in the device, the object_index.

Interface objects should typically be accessed via property services ina point-to-point connectionless or connection-oriented communication mode. In the case of a linked group object the whole object can be accessed via group services in multicast communication mode. Each object in a device shall be addressed either by an object_index or via a linked group object. The object_index shall be unique within the device. Each property of an object shall be addressed with a property_id. The property_id shall be unique for the interface object. For the A_PropertyDescription_Read-service, a property can also be addressed by the property index.

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Each object shall consist of at least the property “object_type”. Interface objects with active access protection shall only be accessible over connection-oriented communication relationships.

An interface object shall have the common structure shown in Figure 7:

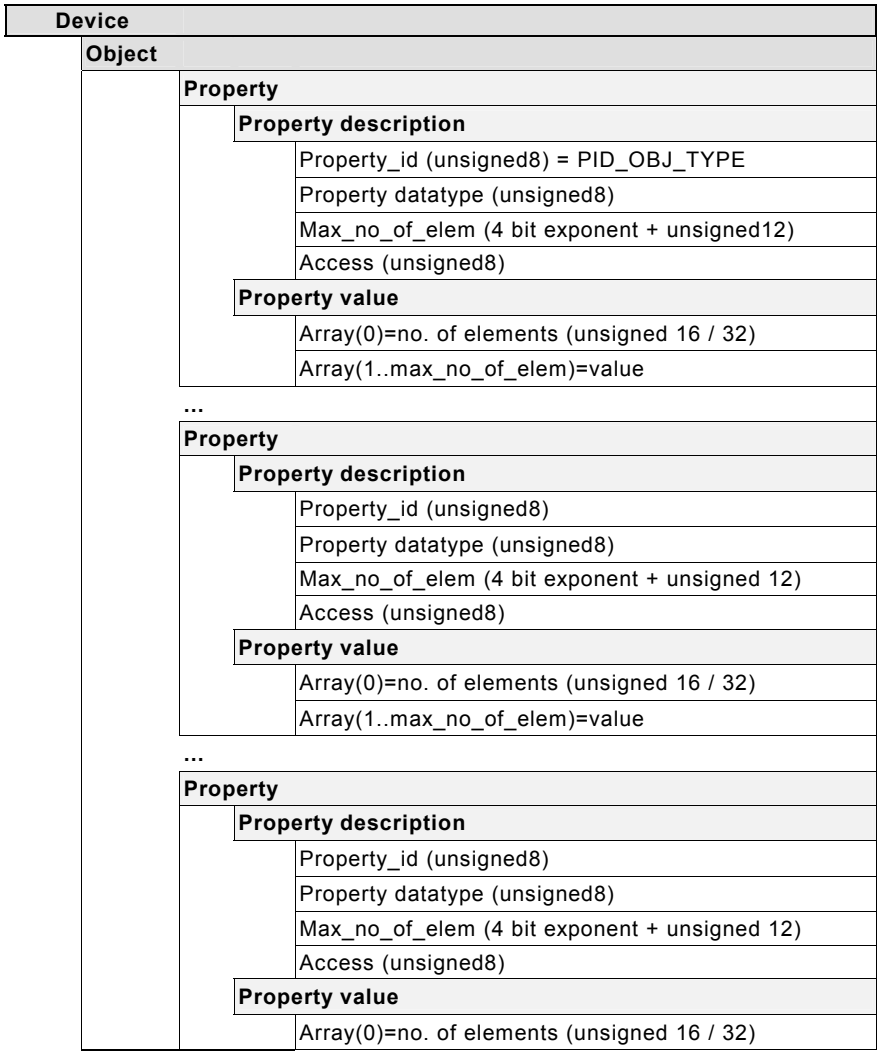


Figure 7 – Structure of interface objects

Every object shall consist of a number of properties. Every property shall consist of a property description and a property value. The property description shall consist of a property_id, a property_index (implicit, starting at 0 for the topmost property), a property datatype, max_no_of_elem and access rights.

The **property datatype** shall describe the datatype of the property.

The **property value** shall be an array with array index 1…max_no_of_elem. The maximum number of elements of the array shall be defined in max_no_of_elem of the property description. The value for max_no_of_elem shall be an unsigned 12 bit integer value with a 4 bit binary exponent without sign (the 4 most significant bits shall be the exponent). The array element ‘0’ shall contain the current number (unsigned 16 if max_no_of_elem exponent is 0 else unsigned 32) of valid array elements. The array can be reset to no elements by writing zero in element ‘0’. The array shall automatically be extended if an element is written beyond the currently last element, but within the maximum allowed number of entries. The attribute

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access in the property description shall indicate the necessary access level to read or write to the property value.

The property with property_id = PID_OBJ_TYPE and property_index = 0 shall be the description of the object itself. This property, the property “object type”, is required for every interface object.

If the maximum number of elements of the property object_type is greater than 1, then the whole object shall be an array of this interface object. Each property of the array object shall at least have the number of elements or a multiple of the number of elements of the object_type property.

7.2 Address levels for interface objects

There shall be two different ways to address properties of an interface object in a device:

a) → IndividualAddress → interface object Index →Property ID;
b) → GroupAddress → object Instance →Property ID.

To access the description of a property there shall also be two different ways:

a) → IndividualAddress → interface object Index → Property ID;
b) → IndividualAddress → interface object Index → Property Index.

7.3 Interworking requirements for interface objects

Specific requirements for property datatypes, property identifiers and the object types will be specified in an amendment to this standard.

7.4 System interface objects (management objects)

System interface objects are objects that shall be used for network and application management. No system interface objects are mandatory for a device. The following system interface objects are defined:

a) the device object;

b) the address table object;

c) the association table object;

d) the application program object.

The purpose of system interface objects is to enable uniform network management. The network management shall support the end user during the configuration of end devices through predefined system interface objects that offer the necessary properties. This is specified in ISO/IEC 14543-3-4.

7.5 Application interface objects

7.5.1 General

Standard application interface objects should be used.

Proprietary application interface objects, not specified in this standard, may also be created. These shall comply with the structures and datatypes given in this clause.

Application interface objects can also be accessed by the group object server via a reference in the group object table.

7.5.2 Property server for own application interface objects

Application interface objects shall have the same structure as system interface objects and therefore they can use the same property server.

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7.5.3 Property client for accessing remote application interface objects

A property client can be external or internal.

An internal property client may be based on the internal message format of A_Property-Description_Read, A_PropertyValue_Read, A_PropertyDescription_Read and A_Property-Value_Write request and confirmation messages.

7.5.4 Message flow for interface object services

7.5.4.1 Property value read

Property client	Property server
A_PropertyValue_Read.req →	
A_PropertyValue_Read.Lcon ←	→A_PropertyValue_Read.ind
	←A_PropertyValue_Read.res
A_PropertyValue_Read.Acon ←	→A_PropertyValue_Read.Rcon

Figure 8 – Message flow for the A_PropertyValue_Read-service

The application layer user in the client shall use the A_PropertyValue_Read.req service primitive to read the value of a property of an object in the property server; see Figure 8. The property server shall be addressed with a local ASAP that shall be mapped to an individual address by the transport layer in the client. The object in the server shall be addressed with an object_index and the property of the object shall be addressed with a property_id. The no_of_elements and start_index shall indicate the number of array elements starting with the given start_index in the property value that the user wants to read. The service shall be confirmed by the application layer in the client with an A_PropertyValue_Read.Lcon.

The user of the application layer in the property server receives an A_PropertyValue_Read.ind and shall respond with an A_PropertyValue_Read.res. The transport layer in the server shall transmit the A_PropertyValue_Read.res with a TSDU = A_PropertyValue_Response-PDU. The A_PropertyValue_Read.res service primitive shall be locally confirmed in the server with an A_PropertyValue_Read.Rcon.

The application layer user in the client receives an A_PropertyValue_Read.Acon with the requested data.

If the property server has a problem to respond to the A_PropertyValue_Read.ind, for example the object or property doesn't exist or the requester does not have the required access rights, the no_of_elements in the A_PropertyValue_Response-PDU shall be set to zero and shall contain no data.

7.5.4.2 Property value write

Property client	Property server
A_PropertyValue_Write.req →	
	→ A_PropertyValue_Write.ind
	← A_PropertyValue_Write.res
A_PropertyValue_Write.Acon ←	→ A_PropertyValue_Write.Rcon

Figure 9 – Message flow for the A_PropertyValue_Write-service

The application layer user in the client shall use the A_PropertyValue_Write.req service primitive to write the value of a property of an object in the property server. The property server

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shall be addressed with a local ASAP that shall be mapped to an individual address by the transport layer in the client. The object in the server shall be addressed with an object_index and the property of the object shall be addressed with a property_id. The no_of_elem and start_index shall indicate the number of array elements starting with the given start_index in the property value that the property client wants to write. The service shall be confirmed by the application layer in the client with an A_PropertyValue_Write.Lcon; see Figure 9.

The application layer user in the property server receives an A_PropertyValue_Write.ind and shall respond with an A_PropertyValue_Read.res. The transport layer in the server shall transmit the A_PropertyValue_Read.res with a TSDU = A_PropertyValue_Response-PDU. The A_PropertyValue_Read.res service primitive shall be locally confirmed in the server with an A_PropertyValue_Write.Rcon.

The application layer user in the client receives an A_PropertyValue_Write.Acon with the written data.

7.5.4.3 PropertyDescription_Read

Property client	Property server
A_PropertyDescription_Read.req→	
	→A_PropertyDescription_Read.ind
	←A_PropertyDescription_Read.res
A_PropertyDescription_Read.Acon←	→A_PropertyDescription_Read.Rcon

Figure 10 – Message flow for the A_PropertyDescription_Read-service

The application layer user in the client shall use the A_PropertyDescription_Read.req service to read the value of a property of an object in the property server; see Figure 10. The property server shall be addressed with a local ASAP that shall be mapped to an individual address by the transport layer in the client. The object in the server shall be addressed with an object_index and the property of the object shall be addressed with a property_id. The service shall be confirmed by the application layer in the client with an A_Property-Description_Read.Lcon.

The application layer user in the property server receives an A_PropertyDescription_Read.ind and shall respond with an A_PropertyDescription_Read.res. The transport layer in the server shall transmit the A_PropertyDescription_Read.res with a TSDU = A_Property-Description_Response-PDU. The A_PropertyDescription_Read.res service primitive shall be confirmed locally in the server with an A_PropertyDescription_Read.Rcon.

The application layer user in the client receives an A_PropertyDescription_Read.Acon with the requested data.

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