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Health informatics — Personal health device communication —

Part 10420: Device specialization — Body composition analyzer

Informatique de santé — Communication entre dispositifs de santé personnels —

Partie 10420: Spécialisation de dispositif — Analyseur de la composition du corps

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York • NY 10016-5997, USA
E-mail stds.ipr@ieee.org
Web www.ieee.org

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Foreword

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ISO/IEEE 11073-10420 was prepared by the IEEE 11073 Standards Comittee of the IEEE Engineering in Medicine and Biology Society (as IEEE Std 11073-10420-2010). It was adopted by Technical Committee ISO/TC 215, *Health informatics*, in parallel with its approval by the ISO member bodies, under the “fast-track procedure” defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE. IEEE is responsible for the maintenance of this document with participation and input from ISO member bodies.

ISO/IEEE 11073 consists of the following parts, under the general title *Health informatics — Personal health device communication* (text in parentheses gives a variant of subtitle):

— *Part 10101: (Point-of-care medical device communication) Nomenclature*

— *Part 10201: (Point-of-care medical device communication) Domain information model*

— *Part 10404: Device specialization — Pulse oximeter*

— *Part 10407: Device specialization — Blood pressure monitor*

— *Part 10408: Device specialization — Thermometer*

— *Part 10415: Device specialization — Weighing scale*

— *Part 10417: Device specialization — Glucose meter*

— *Part 10420: Device specialization — Body composition analyzer*

— *Part 10421: Device specialization — Peak expiratory flow monitor (peak flow)*

— *Part 10471: Device specialization — Independant living activity hub*

— *Part 10472: Device specialization — Medication monitor*

— *Part 20101: (Point-of-care medical device communication) Application profiles — Base standard*

— *Part 20601: Application profile — Optimized exchange protocol*

— *Part 30200: (Point-of-care medical device communication) Transport profile — Cable connected*

— *Part 30300: (Point-of-care medical device communication) Transport profile — Infrared wireless*

— *Part 30400: (Point-of-care medical device communication) Interface profile — Cabled Ethernet*

— *Part 90101: (Point-of-care medical device communication) Analytical instruments — Point-of-care test*

— *Part 91064: (Standard communication protocol) Computer-assisted electrocardiography*

— *Part 92001: (Medical waveform format) — Encoding rules*

Introduction

This introduction is not part of IEEE Std 11073-10420-2010, Health Informatics—Personal health device communication— Part 10420: Device specialization—Body composition analyzer.

ISO/IEEE 11073 standards enable communication between medical devices and external computer systems. Within the context of the ISO/IEEE 11073 family of standards for device communication, this standard establishes a normative definition of the communication between medication monitoring devices and managers (e.g., cell phones, personal computers, personal health appliances, set top boxes) in a manner that enables plug-and-play interoperability. It leverages appropriate portions of existing standards including ISO/IEEE 11073 terminology and information models. It specifies the use of specific term codes, formats, and behaviors in telehealth environments restricting ambiguity in base frameworks in favor of interoperability. This standard defines a common core of communication functionality for personal telehealth body composition analyzer devices. In this context, body composition analyzer devices are being used broadly to cover body composition analyzer devices that measure body impedances, and compute the various body components including body fat from the impedance.

Health informatics — Personal health device communication —

Part 10420: Device specialization — Body composition analyzer

1 Overview

1.1 Scope

Within the context of the ISO/IEEE 11073 family of standards for device communication, this standard establishes a normative definition of the communication between personal body composition analyzing devices and managers (e.g. cell phones, personal computers, personal health appliances, set top boxes) in a manner that enables plug-and-play interoperability. It leverages appropriate portions of existing standards including ISO/IEEE 11073 terminology and IEEE Std 11073-20601™-2008[1] information models. It specifies the use of specific term codes, formats, and behaviors in telehealth environments restricting optionality in base frameworks in favor of interoperability. This standard defines a common core of communication functionality for personal telehealth body composition analyzer devices. In this context, body composition analyzer devices are being used broadly to cover body composition analyzer devices that measure body impedances, and compute the various body components including body fat from the impedance.

[1] Information on references can be found in Clause 2.

1.2 Purpose

This standard addresses a need for an openly defined, independent standard for controlling information exchange to and from personal health devices and managers (e.g., cell phones, personal computers, personal health appliances, set top boxes). Interoperability is key to growing the potential market for these devices and enabling people to be better informed participants in the management of their health.

1.3 Context

See IEEE Std 11073-20601-2008 for an overview of the environment within which this standard is written.

This standard defines the device specialization for the body composition analyzer, being a specific agent type, and it provides a description of the device concepts, its capabilities, and its implementation according to this standard.

This standard is based on IEEE Std 11073-20601-2008, which in turn draws information from both ISO/IEEE 11073-10201:2004 [B2][2] and ISO/IEEE 11073-20101:2004 [B3]. The medical device encoding rules (MDER) used within this standard are fully described in IEEE Std 11073-20601-2008.

This standard reproduces relevant portions of the nomenclature found in ISO/IEEE 11073-10101:2004 [B1] and adds new nomenclature codes for the purposes of this standard. Between this standard and IEEE Std 11073-20601-2008 all required nomenclature codes for implementation are documented.

NOTE—In this standard, IEEE Std 11073-104zz is used to refer to the collection of device specialization standards that utilize IEEE Std 11073-20601-2008, where zz can be any number from 01 to 99, inclusive. [3]

2 Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so that each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 11073-20601-2008, Health informatics—Personal health device communication—Part 20601: Application Profile—Optimized Exchange Profile.[4, 5]

IEEE Std 11073-10415™-2008, Health informatics—Personal health device communication—Part 10415: Device specialization—Weighing scale.

See Annex A for all informative material referenced by this standard.

[2] The numbers in brackets correspond to those of the bibliography in Annex A.

[3] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

[4] IEEE publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).

[5] The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.

3 Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. *The IEEE Standards Dictionary: Glossary of Terms & Definitions*[6] should be referenced for terms not defined in this clause.

3.1.1 agent: A node that collects and transmits personal health data to an associated manager.

3.1.2 body composition analyzer: An agent for measuring the fundamental constituents of the human body that consists of water, protein, mineral, and fat.

3.1.3 body fat: The difference between the body weight and the fat free mass.

3.1.4 body water: The total water of the human body.

3.1.5 body weight: The sum of the body water mass, protein mass, mineral mass, and the body fat mass.

3.1.6 class: In object-oriented modeling, it describes the attributes, methods, and events that objects instantiated from the class utilize.

3.1.7 compute engine: *See:* **manager.**

3.1.8 device: A term used to refer to a physical apparatus implementing either an agent or a manager role.

3.1.9 fat free mass: The sum of the soft lean mass and mineral mass.

3.1.10 handle: An unsigned 16-bit number that is locally unique and identifies one of the object instances within an agent.

3.1.11 manager: A node receiving data from one or more agent systems. Some examples of managers include a cellular phone, health appliance, set top box, or a computer system.

3.1.12 mass: An intrinsic property of matter that can be measured using the effect of the gravitational field on an object.

3.1.13 obj-handle: *See:* **handle.**

3.1.14 object: In object-oriented modeling, a particular instantiation of a class. The instantiation realizes attributes, methods, and events from the class.

3.1.15 personal health device: A device used in personal health applications.

3.1.16 personal telehealth device: *See:* **personal health device.**

3.1.17 soft lean mass: The sum of the body water mass and protein mass.

3.1.18 weight: The force that results from the exertion of gravity on an object. The weight is directly proportional to the mass of the object. However, in the health care domain the term body weight is typically used to denote the body mass of a person. This notation applies also to this standard.

[6] *The IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at http://shop.ieee.org/.

3.2 Acronyms and abbreviations

APDU	application protocol data unit
ASN.1	abstract syntax notation one
DIM	domain information model
EUI-64	extended unique identifier (64 bits)
FFM	fat free mass
ICS	implementation conformance statements
MDC	medical device communication
MDER	medical device encoding rules
MDS	medical device system
MOC	managed object class
PDU	protocol data unit
PHD	personal health device
SLM	soft lean mass
VMO	virtual medical object
VMS	virtual medical system

4 Introduction to ISO/IEEE 11073 personal health devices

4.1 General

This standard and the remainder of the series of ISO/IEEE 11073 personal health device (PHD) standards fit in the larger context of the ISO/IEEE 11073 series of standards. The full suite of standards enables agents to interconnect and interoperate with managers and with computerized healthcare information systems. See the IEEE Std 11073-20601-2008 for a description of the guiding principles for this series of ISO/IEEE 11073 Personal Health Device standards.

IEEE Std 11073-20601-2008 supports the modeling and implementation of an extensive set of personal health devices. This standard defines aspects of the body composition analyzer device. It describes all aspects necessary to implement the application layer services and data exchange protocol between an ISO/IEEE 11073 PHD body composition analyzer agent and a manager. This standard defines a sub-set of the objects and functionality contained in IEEE Std 11073-20601-2008, and extends and adds definitions where appropriate. The Abstract Syntax Notation One (ASN.1) [B4] definitions referenced in this standard are in IEEE Std 11073-20601-2008. All additional new definitions are given in Annex B. Nomenclature codes referenced in this standard, which are not defined in IEEE Std 11073-20601-2008, are normatively defined in Annex C.

4.2 Introduction to IEEE 11073-20601 modeling constructs

4.2.1 General

The ISO/IEEE 11073 series of standards, and in particular IEEE Std 11073-20601-2008, is based on an object-oriented systems management paradigm. The overall system model is divided into three principal components: the domain information model (DIM), the service model, and the communication model. See IEEE Std 11073-20601-2008 for a detailed description of the modeling constructs.

4.2.2 Domain information model

The DIM is a hierarchical model that describes an agent as a set of objects. These objects and their attributes represent the elements that control behavior and report on the status of the agent and data that an agent can communicate to a manager. Communication between the agent and the manager is defined by the application protocol in IEEE Std 11073-20601-2008.

4.2.3 Service model

The service model defines the conceptual mechanisms for the data exchange services. Such services are mapped to messages that are exchanged between the agent and the manager. Protocol messages within the ISO/IEEE 11073 series of standards are defined in ASN.1 [B4]. The messages defined in IEEE Std 11073-20601-2008 can coexist with messages defined in other standard application profiles defined in the ISO/IEEE 11073 series of standards.

4.2.4 Communication model

In general, the communication model supports the topology of one or more agents communicating over logical point-to-point connections to a single manager. For each logical point-to-point connection, the dynamic system behavior is defined by a connection state machine as specified in IEEE Std 11073-20601-2008. The security of this communication is largely determined by, but not limited to, the physical security of the device along with the inherent security of the underlying transports. Additional security may be defined by future revisions of IEEE Std 11073-20601-2008.

4.2.5 Implementing the models

An agent implementing this standard shall implement all mandatory elements of the information, service, and communication models as well as all conditional elements where the condition is met. The agent should implement the recommended elements, and it may implement any combination of the optional elements. A manager implementing this standard shall utilize at least one of the mandatory, conditional, recommended, or optional elements. In this context, “utilize” means to use the element as part of the primary function of the manager device. For example, a manager whose primary function is to display data would need to display a piece of data in the element in order to utilize it.

5 Body composition analyzer device concepts and modalities

5.1 General

This clause presents the general concepts of body composition analyzer devices. In the context of personal health devices in this family of standards, a body composition analyzer is a device that analyzes the constituents of the human body. Body composition analyzer devices may use a variety of techniques for measuring body composition. One typical method is body impedance analysis that measures the impedance with pairs of probes applied at the feet and/or hands and calculates the body composition from these impedances.

In the personal health context, the body composition of a person is typically not measured more frequently than once a day.

5.2 Body fat

Body fat is a measure of the obesity of a person. It has measurement units of kilograms (kg), pounds (lb) or percentage (%). The body fat percent is defined as the individual's body fat in kilograms divided by the individual's weight in kilograms as shown in Equation (1).

$$\text{Body fat}\,(\%) = \frac{\text{body fat}\,[\text{kg}]}{\text{body weight}\,[\text{kg}]} \times 100 \qquad (1)$$

The normal range of body fat is 10–20% for men and 18–28 % for women, with the standard value of 15% and 2%, respectively.

5.3 Body height

Refer to 5.3 of IEEE Std 11073-10415-2008. In this standard, body height is required to compute the body composition of a person. It is measured by the device or entered manually.

5.4 Body weight

Refer to 5.2 of IEEE Std 11073-10415-2008. In this standard, body weight is required to compute the body composition of a person. It is measured by the device or entered manually.

5.5 Body mass index

Refer to 5.4 of IEEE Std 11073-10415-2008.

5.6 Fat free mass

The fat free mass (FFM) is the sum of the soft lean mass (SLM) and the mineral mass. It has units of kilograms (kg) or pounds (lb).

5.7 Soft lean mass

The SLM is the sum of the body water and the protein mass. It has units of kilograms (kg) or pounds (lb).

5.8 Body water

Body water accounts for the largest portion of body composition, being about 50–70% of body weight. It has units of kilograms (kg), pounds (lb), or percentage (%). The body water percent is defined as the individual's body water in kilograms divided by the individual's weight as shown in Equation (2).

$$\text{Body water}\,(\%) = \frac{\text{body water}\,[\text{kg}]}{\text{body weight}\,[\text{kg}]} \times 100 \qquad (2)$$

6 Body composition analyzer domain information model

6.1 Overview

This clause describes the domain information model of the body composition analyzer.

6.2 Class extensions

In this standard, no class extensions are defined with respect to IEEE Std 11073-20601-2008.

6.3 Object instance diagram

The object instance diagram of the body composition analyzer domain information model, defined for the purposes of this standard, is shown in Figure 1.

The objects of the DIM, as shown in Figure 1, are described in 6.5 to 6.10. This includes the medical device system (MDS) object (see 6.5), the numeric objects (see 6.6), the RT-SA objects (see 6.7), the enumeration objects (see 6.8), the PM-store objects (see 6.9), and the scanner objects (see 6.10). See 6.11 for rules for extending the body composition analyzer information model beyond elements as described in this standard. Each clause that describes an object of the body composition analyzer contains the following information:

- The nomenclature code used to identify the class of the object. One example where this code is used is the configuration event, where the object class is reported for each object. This allows the manager to determine whether the class of the object being specified is a numeric, real time sample array, enumeration, scanner, or PM-store class.
- The attributes of the object. Each object has attributes that represent and convey information on the physical device and its data sources. Each object has a Handle attribute that identifies the object instance within an agent. Attribute values are accessed and modified using methods such as GET and SET. Attribute types are defined using ASN.1 [B4]. The ASN.1 definitions for new attribute types specific to this standard are in Annex B, and the ASN.1 definitions for existing attribute types referenced in this standard are in IEEE Std 11073-20601-2008.
- The methods available on the object.
- The potential events generated by the object. Data are sent to the manager using events.
- The available services such as getting or setting attributes.

The attributes for each class are defined in tables that specify the name of the attribute, its value, and its qualifier. The qualifiers mean: M—Attribute is Mandatory, C—Attribute is Conditional and depends on the condition stated in the Remark or Value column (if IEEE Std 11073-20601-2008 is referenced, then it contains the conditions), R—Attribute is Recommended, NR—Attribute is Not Recommended, O—Attribute is Optional. Mandatory attributes shall be implemented by an agent. Conditional attributes shall

be implemented if the condition applies and may be implemented otherwise. Recommended attributes should be implemented by the agent. Not recommended attributes should not be implemented by the agent. Optional attributes may be implemented by the agent.

The attributes can be either static, meaning that they shall remain unchanged after the configuration is agreed upon, or dynamic, meaning that the attribute may change at some point after configuration.

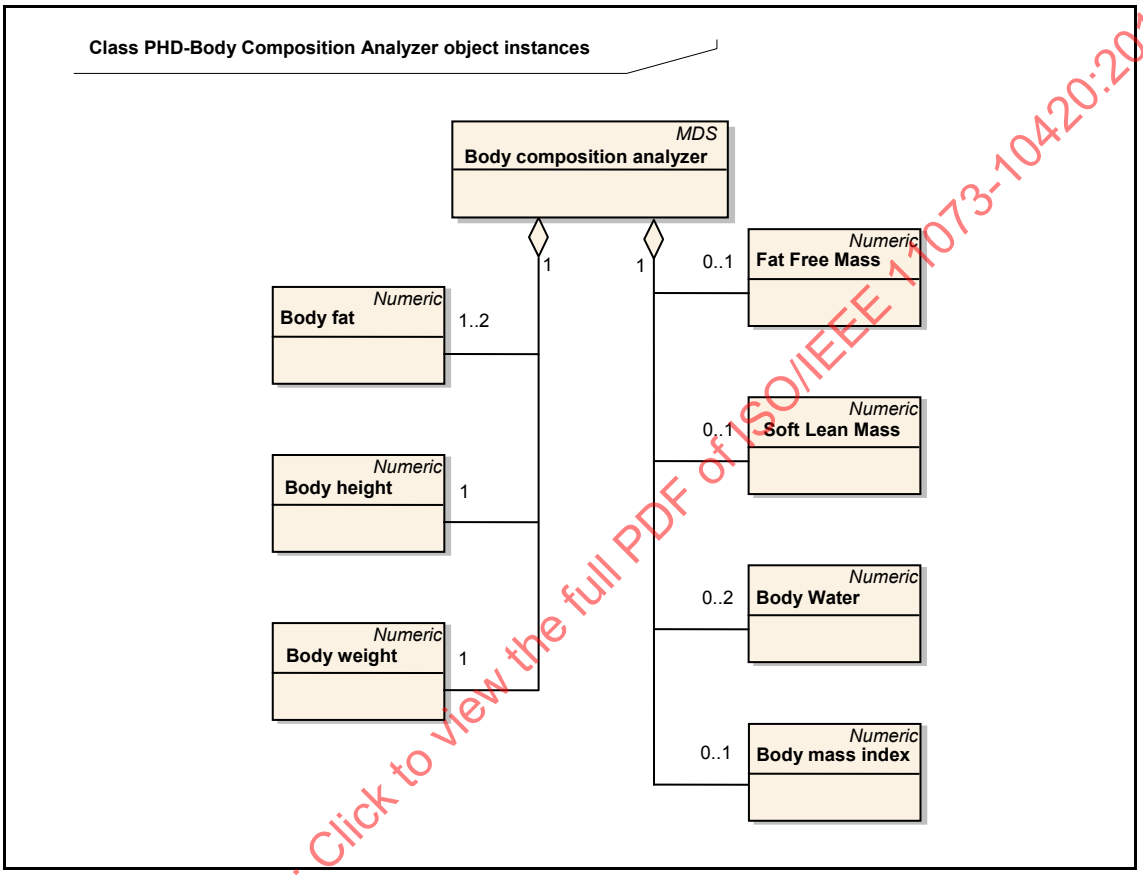

Figure 1—Body composition analyzer—domain information model

6.4 Types of configuration

6.4.1 General

As specified in IEEE Std 11073-20601-2008, there are two styles of configuration available. Subclauses 6.4.2 and 6.4.3 briefly introduce standard and extended configurations.

6.4.2 Standard configuration

Standard configurations are defined in the IEEE Std 11073-104zz specializations (such as this standard) and are assigned a well-known identifier (Dev-Configuration-Id). The usage of a standard configuration is negotiated at association time between the agent and manager. If the manager recognizes and selects to operate using the configuration, then the agent can send measurements immediately. If the manager does not recognize the configuration, the agent provides the configuration prior to transmitting measurement information.

6.4.3 Extended configuration

In extended configurations, the agent's configuration is not predefined in a standard. The agent determines the objects, attributes, and values that will be used in a configuration and assigns a configuration identifier. When the agent associates with a manager, an acceptable configuration is negotiated. Typically, the manager does not recognize the agent's configuration on the first connection, so the manager responds that the agent needs to send its configuration information as a configuration event report. If, however, the manager recognizes the configuration, either because it was preloaded in some way or the agent had previously associated with the manager, then the manager responds that the configuration is known and no further configuration information needs to be sent.

6.5 Medical device system object

6.5.1 MDS object attributes

Table 1 summarizes the attributes of the body composition analyzer MDS object. The nomenclature code to identify the MDS class is MDC_MOC_VMS_MDS_SIMP.

Table 1—MDS object attributes

Attribute name	Value	Qual.
Handle	0	M
System-Type	Attribute not present. See IEEE Std 11073-20601-2008	C
System-Type-Spec-List	{MDC_DEV_SPEC_PROFILE_BCA, 1}	M
System-Model	{"Manufacturer", "Model"}	M
System-Id	Extended unique identifier (64-bits) (EUI-64)	M
Dev-Configuration-Id	Standard config: 0x07D0 (2000) Extended configs: 0x4000-0x7FFF	M
Attribute-Value-Map	See IEEE Std 11073-20601-2008	C
Production-Specification	See IEEE Std 11073-20601-2008	O
Mds-Time-Info	See IEEE Std 11073-20601-2008	C
Date-and-Time	See IEEE Std 11073-20601-2008	C
Relative-Time	See IEEE Std 11073-20601-2008	C
HiRes-Relative-Time	See IEEE Std 11073-20601-2008	C
Date-and-Time-Adjustment	See IEEE Std 11073-20601-2008	C
Power-Status	*onBattery* or *onMains*	R
Battery-Level	See IEEE Std 11073-20601-2008	R
Remaining-Battery-Time	See IEEE Std 11073-20601-2008	R
Reg-Cert-Data-List	See IEEE Std 11073-20601-2008	O
Confirm-Timeout	See IEEE Std 11073-20601-2008	O

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

In the response to a Get MDS Object command, only implemented attributes and their corresponding values are returned.

See IEEE Std 11073-20601-2008 for descriptive explanations of the individual attributes as well as for information on attribute id and attribute type.

The Dev-Configuration-Id attribute holds a locally unique 16-bit identifier that identifies the device configuration. For a body composition analyzer agent with extended configuration, this identifier is chosen in the range of extended-config-start to extended-config-end (see IEEE Std 11073-20601-2008) as shown in Table 1.

The agent sends the Dev-Configuration-Id during the Associating state (see 8.3) to identify its configuration for the duration of the association. If the manager already holds the configuration information relating to the Dev-Configuration-Id, it recognizes the Dev-Configuration-Id and the Configuring state (see 8.4) is skipped; the agent and manager then enter the Operating state. If the manager does not recognize the Dev-Configuration-Id, the agent and manager enter the Configuring state.

If an agent implements multiple IEEE Std 11073-104zz specializations, System-Type-Spec-List is a list of type/version pairs, each referencing the respective device specialization and version of that specialization.

6.5.2 MDS object methods

Table 2 defines the methods (actions) of the MDS object. These methods are invoked using the Action service. In Table 2, the Subservice type name column defines the name of the method; the Mode column defines whether the method is invoked as an unconfirmed action (i.e., roiv-cmip-action from IEEE Std 11073-20601-2008) or a confirmed action (i.e., roiv-cmip-confirmed-action); the Subservice type (action-type) column defines the nomenclature code to use in the action-type field of an action request and response (see IEEE Std 11073-20601-2008); the Parameters (action-info-args) column defines the associated ASN.1 data structure (see IEEE Std 11073-20601-2008 for ASN.1 definitions) to use in the action message for the action-info-args field of the request; and the Results (action-info-args) column defines the structure to use in the action-info-args of the response.

Table 2—MDS object methods

Service	Subservice type name	Mode	Subservice type (action-type)	Parameters (action-info-args)	Results (action-info-args)
ACTION	Set-Time	Confirmed	MDC_ACT_SET_TIME	SetTimeInvoke	—

Set-Time

This method allows the manager to set a real-time clock in the agent with the absolute time. The agent indicates whether the Set-Time command is valid using the mds-time-capab-set-clock bit in the Mds-Time-Info attribute (see IEEE Std 11073-20601-2008).

If the agent supports the Absolute-Time-Stamp attribute, this method shall be implemented.

Agents following only this device specialization and no others shall send event reports using agent-initiated measurement data transmission. Agents following this device specialization as well as others shall send event reports in the appropriate fashion. During the association procedure (see 8.3), data-req-mode-capab shall be set to the appropriate value for the event report style. Implementation of the MDS-Data-Request method/action is not required in this standard and is not shown in Table 2.

6.5.3 MDS object events

Table 3 defines the events that can be sent by the body composition analyzer MDS object.

Table 3—Body composition analyzer MDS object events

Service	Subservice type name	Mode	Subservice type (event-type)	Parameters (event-info)	Results (event-reply-info)
EVENT REPORT	MDS-Configuration-Event	Confirmed	MDC_NOTI_CONFIG	ConfigReport	ConfigReportRsp
	MDS-Dynamic-Data-Update-Var	Confirmed	MDC_NOTI_SCAN_REPORT_VAR	ScanReportInfoVar	—
	MDS-Dynamic-Data-Update-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_FIXED	ScanReportInfoFixed	—
	MDS-Dynamic-Data-Update-MP-Var	Confirmed	MDC_NOTI_SCAN_REPORT_MP_VAR	ScanReportInfoMPVar	—
	MDS-Dynamic-Data-Update-MP-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_MP_FIXED	ScanReportInfoMPFixed	—

— **MDS-Configuration-Event:**
This event is sent by the body composition analyzer agent during the configuring procedure if the manager does not already know the body composition analyzer agent's configuration from past associations or because the manager has not been implemented to recognize the configuration according to the body composition analyzer device specialization. The event provides static information about the supported measurement capabilities of the body composition analyzer agent.

— **MDS-Dynamic-Data-Update-Var:**
This event provides dynamic measurement data from the body composition analyzer agent for the body fat, body height, body weight and optionally body mass index, fat free mass, soft lean mass, and body water numeric objects. These data are reported using a generic attribute list variable format. The event is sent as an unsolicited message by the agent (i.e., an agent-initiated measurement data transmission). See 8.5.3 for more information on unsolicited event reporting.

— **MDS-Dynamic-Data-Update-Fixed:**
This event provides dynamic measurement data from the body composition analyzer agent for the body fat, body height, body weight and optionally body mass index, fat free mass, soft lean mass, and body water numeric object. These data are reported in the fixed format defined by the Attribute-Value-Map attribute of the object. The event is sent as an unsolicited message by the agent (i.e., an agent-initiated measurement data transmission). See 8.5.3 for more information on unsolicited event reporting.

— **MDS-Dynamic-Data-Update-MP-Var:**
This is the same as MDS-Dynamic-Data-Update-Var, but allows inclusion of data from multiple people.

MDS-Dynamic-Data-Update-MP-Fixed:
This is the same as MDS-Dynamic-Data-Update-Fixed, but allows inclusion of data from multiple people.

NOTE—IEEE Std 11073-20601-2008 requires that managers support all of the MDS Object Events listed above.

6.5.4 Other MDS services

6.5.4.1 GET service

A body composition analyzer agent shall support the GET service, which is provided by the MDS object to retrieve the values of all implemented MDS object attributes. The GET service can be invoked as soon as the body composition analyzer agent receives the Association Response and moves to the Associated state, including the Operating and Configuring sub-states.

The GET request for all attributes shall be supported. An attribute-id-list parameter may be supported.

The manager may request the MDS object attributes of the body composition analyzer agent in which case the manager shall send the "Remote Operation Invoke | Get" message (see roiv-cmip-get in IEEE Std 11073-20601-2008) with the reserved MDS handle value of 0. The body composition analyzer agent shall report its MDS object attributes to the manager using the "Remote Operation Response | Get" message (see rors-cmip-get in IEEE Std 11073-20601-2008). See Table 4 for a summary of the GET service including some message fields.

Table 4—body composition analyzer MDS object GET service

Service	Sub-service type name	Mode	Subservice type	Parameters	Results
GET	<na>	<implied confirmed>	<na>	GetArgumentSimple = (obj-handle = 0), attribute-id-list *<optional>*	GetResultSimple = (obj-handle = 0), attribute-list

See 8.5.2 for details on the procedure for getting the MDS object attributes.

6.5.4.2 SET service

The body composition analyzer specialization does not require an implementation to support the MDS object SET service.

6.6 Numeric objects

6.6.1 General

The body composition analyzer DIM (see Figure 1) contains three mandatory objects for body fat, body height, body weight, and four optional numeric objects for body mass index, fat free mass, soft lean mass, and body water. These are described in 6.6.2 through 6.6.8.

Sometimes, the interpretation of one attribute value in an object depends on other attribute values in the same object. For example, Unit-Code and Unit-LabelString provide context for the observed values. Whenever a contextual attribute changes, the agent shall report these changes to the manager using an MDS object event (see 6.5.3) prior to reporting any of the dependent values.

6.6.2 Body fat

Table 5 summarizes the attributes of the body fat numeric object. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The body fat numeric object shall be supported by a body composition analyzer agent. The agent is also allowed to report two body fat objects, one in percent (%) and the other in kilograms (kg).

Table 5—Body fat numeric object attributes

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x07D0)	
	Value	Qual.	Value	Qual.
Handle	See IEEE Std 11073-20601-2008	M	3	M
Type	MDC_PART_SCADA | MDC_BODY_FAT	M	MDC_PART_SCADA | MDC_BODY_FAT	M
Supplemental-Types	See IEEE Std 11073-20601-2008	NR	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Metric-Spec-Small	See IEEE Std 11073-20601-2008	M	mss-avail-intermittent, mss-avail-stored-data, mss-upd-aperiodic, mss-msmt-aperiodic, mss-acc-agent-initiated, mss-cat-calculation	M
Metric-Structure-Small	See IEEE Std 11073-20601-2008	NR	{ms-struct-simple, 0}	NR
Measurement-Status	See IEEE Std 11073-20601-2008	R	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	O
Metric-Id	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Metric-Id-List	See IEEE Std 11073-20601-2008	NR	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Metric-Id-Partition	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Unit-Code	MDC_DIM_PERCENT or MDC_DIM_KILO_G or MDC_DIM_LB	M	MDC_DIM_PERCENT	M
Attribute-Value-Map	See IEEE Std 11073-20601-2008	C	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_ABS	M
Source-Handle-Reference	See IEEE Std 11073-20601-2008	NR	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Label-String	See IEEE Std 11073-20601-2008	O	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	O
Unit-LabelString	See IEEE Std 11073-20601-2008	O	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601-2008	C	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from IEEE Std 11073-20601-2008 apply.	C
Relative-Time-Stamp	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
Measure-Active-Period	See IEEE Std 11073-20601-2008	NR	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	NR
Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	See IEEE Std 11073-20601-2008. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from IEEE Std 11073-20601-2008 apply.	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C

	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x07D0)	
Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	C
Accuracy	See IEEE Std 11073-20601-2008	R	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008.	R

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

For a body composition analyzer agent with standard configuration the AttrValMap structure (see IEEE Std 11073-20601-2008) of the Attribute-Value-Map attribute shall contain the attribute id and attribute length information of the Simple-Nu-Observed-Value and Absolute-Time-Stamp attribute in the same order as indicated in Table 5.

The body fat numeric object does not support any methods, events, or other services.

See IEEE Std 11073-20601-2008 for descriptive explanations on the individual attributes as well as for information on attribute id and attribute type.

6.6.3 Body height

Table 6 summarizes the attributes of the body height numeric object in the standard configuration. For the attributes in the extended configuration, refer to 6.6.3 of IEEE Std 11073-10415-2008. The body height numeric object shall be supported by a body composition analyzer agent.

Table 6—Body height numeric object attributes

Attribute name	Standard configuration (Dev-Configuration-Id = 0x07D0)	
	Value	Qual.
Handle	2	M
Type	MDC_PART_SCADA | MDC_LEN_BODY_ACTUAL	M
Supplemental-Types	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-upd-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated | mss-cat-manual	M
Metric-Structure-Small	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Measurement-Status	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	O
Metric-Id	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Metric-Id-List	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Metric-Id-Partition	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Unit-Code	MDC_DIM_CENTI_M	M
Attribute-Value-Map	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_ABS	M
Source-Handle-Reference	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Label-String	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	O
Unit-LabelString	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	O
Absolute-Time-Stamp	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from IEEE Std 11073-20601-2008 apply	C
Relative-Time-Stamp	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	C
HiRes-Time-Stamp	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	C
Measure-Active-Period	Attribute not initially present. If present, follow IEEE Std 11073-20601-2008	NR
Simple-Nu-Observed-Value	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from IEEE Std 11073-20601-2008 apply	C
Compound-Simple-Nu-Observed-Value	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	C
Basic-Nu-Observed-Value	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	C
Compound-Basic-Nu-Observed-Value	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	C

	Standard configuration (Dev-Configuration-Id = 0x07D0)	
Nu-Observed-Value	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	C
Compound-Nu-Observed-Value	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	C
Accuracy	Attribute not initially present. If present follow IEEE Std 11073-20601-2008	R

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

The body height numeric object does not support any methods, events, or other services.

See IEEE Std 11073-20601-2008 for descriptive explanations on the individual attributes as well as information on attribute id and attribute type.

6.6.4 Body weight

For all the attributes of the body weight numeric object in the standard configuration (Dev-Configuration-Id=0x07D0) except Handle and Metric-Spec-Small, the definitions of the standard configuration (Dev-Configuration-Id=0x05DC) in 6.6.2 of IEEE Std 11073-10415-2008 apply. Table 7 summarizes the Handle and Metric-Spec-Small attributes of this object in the standard configuration. For the attributes in the extended configuration, refer to 6.6.2 of IEEE Std 11073-10415-2008. The body weight numeric object shall be supported by a body composition analyzer agent.

Table 7—Body weight numeric object Metric-Spec-Small attribute

Attribute name	Standard configuration (Dev-Configuration-Id = 0x07D0)	
	Value	Qual.
Handle	1	M
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-upd-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated | mss-cat-manual	M

6.6.5 Body mass index

For the attributes of the body mass index numeric object, refer to 6.6.4 of IEEE Std 11073-10415-2008. The body mass index numeric object may be supported by a body composition analyzer agent with extended configuration and shall not be present in the standard configuration.

6.6.6 Fat free mass

Table 8 summarizes the attributes of the fat free mass numeric object. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The fat free mass numeric object may be supported by a body composition analyzer agent with extended configuration and shall not be present in the standard configuration.

Table 8—Fat free mass numeric object attributes

Attribute name	Extended configuration	
	Value	Qual.
Handle	See IEEE Std 11073-20601-2008	M
Type	MDC_PART_SCADA | MDC_MASS_BODY_FAT_FREE	M
Supplemental-Types	See IEEE Std 11073-20601-2008	NR
Metric-Spec-Small	See IEEE Std 11073-20601-2008	M
Metric-Structure-Small	See IEEE Std 11073-20601-2008	NR
Measurement-Status	See IEEE Std 11073-20601-2008	R
Metric-Id	See IEEE Std 11073-20601-2008	NR
Metric-Id-List	See IEEE Std 11073-20601-2008	NR
Metric-Id-Partition	See IEEE Std 11073-20601-2008	NR
Unit-Code	MDC_DIM_KILO_G or MDC_DIM_LB	M
Attribute-Value-Map	See IEEE Std 11073-20601-2008	C
Source-Handle-Reference	See IEEE Std 11073-20601-2008	NR
Label-String	See IEEE Std 11073-20601-2008	O
Unit-LabelString	See IEEE Std 11073-20601-2008	O
Absolute-Time-Stamp	See IEEE Std 11073-20601-2008	C
Relative-Time-Stamp	See IEEE Std 11073-20601-2008	C
HiRes-Time-Stamp	See IEEE Std 11073-20601-2008	C
Measure-Active-Period	See IEEE Std 11073-20601-2008	NR
Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Accuracy	See IEEE Std 11073-20601-2008	R

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

The fat free mass numeric object does not support any methods, events, or other services.

See IEEE Std 11073-20601-2008 for descriptive explanations on the individual attributes as well as information on attribute id and attribute type.

6.6.7 Soft lean mass

Table 9 summarizes the attributes of the soft lean mass numeric object. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The soft lean mass numeric object may be supported by a body composition analyzer agent with extended configuration and shall not be present in the standard configuration.

Table 9—Soft lean mass numeric object attributes

Attribute name	Extended configuration	
	Value	Qual.
Handle	See IEEE Std 11073-20601-2008	M
Type	MDC_PART_SCADA | MDC_MASS_BODY_SOFT_LEAN	M
Supplemental-Types	See IEEE Std 11073-20601-2008	NR
Metric-Spec-Small	See IEEE Std 11073-20601-2008	M
Metric-Structure-Small	See IEEE Std 11073-20601-2008	NR
Measurement-Status	See IEEE Std 11073-20601-2008	R
Metric-Id	See IEEE Std 11073-20601-2008	NR
Metric-Id-List	See IEEE Std 11073-20601-2008	NR
Metric-Id-Partition	See IEEE Std 11073-20601-2008	NR
Unit-Code	MDC_DIM_KILO_G or MDC_DIM_LB	M
Attribute-Value-Map	See IEEE Std 11073-20601-2008	C
Source-Handle-Reference	See IEEE Std 11073-20601-2008	NR
Label-String	See IEEE Std 11073-20601-2008	O
Unit-LabelString	See IEEE Std 11073-20601-2008	O
Absolute-Time-Stamp	See IEEE Std 11073-20601-2008	C
Relative-Time-Stamp	See IEEE Std 11073-20601-2008	C
HiRes-Time-Stamp	See IEEE Std 11073-20601-2008	C
Measure-Active-Period	See IEEE Std 11073-20601-2008	NR
Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Accuracy	See IEEE Std 11073-20601-2008	R

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

The soft lean mass numeric object does not support any methods, events, or other services.

See IEEE Std 11073-20601-2008 for descriptive explanations on the individual attributes as well as information on attribute id and attribute type.

6.6.8 Body water

Table 10 summarizes the attributes of the body water numeric object. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The body water numeric object may be supported by a body composition analyzer agent with extended configuration and shall not be present in the standard configuration. The agent is allowed to report two body water objects, one in kilograms (kg) and the other in percent (%).

Table 10—Body water numeric object attributes

Attribute name	Extended configuration	
	Value	Qual.
Handle	See IEEE Std 11073-20601-2008	M
Type	MDC_PART_SCADA | MDC_BODY_WATER	M
Supplemental-Types	See IEEE Std 11073-20601-2008	NR
Metric-Spec-Small	See IEEE Std 11073-20601-2008	M
Metric-Structure-Small	See IEEE Std 11073-20601-2008	NR
Measurement-Status	See IEEE Std 11073-20601-2008	R
Metric-Id	See IEEE Std 11073-20601-2008	NR
Metric-Id-List	See IEEE Std 11073-20601-2008	NR
Metric-Id-Partition	See IEEE Std 11073-20601-2008	NR
Unit-Code	MDC_DIM_KILO_G or MDC_DIM_LB or MDC_DIM_PERCENT	M
Attribute-Value-Map	See IEEE Std 11073-20601-2008	C
Source-Handle-Reference	See IEEE Std 11073-20601-2008	NR
Label-String	See IEEE Std 11073-20601-2008	O
Unit-LabelString	See IEEE Std 11073-20601-2008	O
Absolute-Time-Stamp	See IEEE Std 11073-20601-2008	C
Relative-Time-Stamp	See IEEE Std 11073-20601-2008	C
HiRes-Time-Stamp	See IEEE Std 11073-20601-2008	C
Measure-Active-Period	See IEEE Std 11073-20601-2008	NR
Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601-2008	C
Accuracy	See IEEE Std 11073-20601-2008	R

NOTE—See IEEE Std 11073-20601-2008 for information on whether an attribute is static or dynamic.

The body water numeric object does not support any methods, events, or other services.

See IEEE Std 11073-20601-2008 for descriptive explanations on the individual attributes as well as information on attribute id and attribute type.

6.7 Real-time sample array objects

Real-time sample array objects are not required by this standard.

6.8 Enumeration objects

Enumeration objects are not required by this standard.

6.9 PM-store objects

PM-store objects are not required by this standard.

6.10 Scanner objects

Scanner objects are not required by this standard.

6.11 Class extension objects

In this standard, no class extension objects are defined with respect to IEEE Std 11073-20601-2008.

6.12 Body composition analyzer information model extensibility rules

The body composition analyzer domain information model of this standard may be extended by including vendor-specific metrics and attributes as required. For example, a vendor might require including a body fat mass, intracellular water, extracelluar water, etc. Any object or attribute extensions implemented should follow the guidelines of this standard as closely as possible.

A body composition analyzer agent having a configuration with extensions beyond the standard configuration, as specified in this standard, shall use a configuration ID in the range of IDs reserved for extended configurations (see IEEE Std 11073-20601-2008).

7 Body composition analyzer service model

7.1 General

The service model defines the conceptual mechanisms for data exchange services. These services are mapped to messages that are exchanged between the agent and manager. Protocol messages within the ISO/IEEE 11073 series of standards are defined in ASN.1 [B4]. See IEEE Std 11073-20601-2008 for a detailed description of the personal health device service model. Subclauses 7.2 and 7.3 define the specifics of object access and event reporting services for a body composition analyzer agent according to this standard.

7.2 Object access services

The object access services of IEEE Std 11073-20601-2008 are used to access the objects defined in the domain information model of the body composition analyzer.

The following generic object access services are supported by a body composition analyzer agent according to this standard:

— **GET service:** Used by the manager to retrieve the values of the agent MDS object attributes. The list of body composition analyzer MDS object attributes is given in 6.5.4.1.

— **SET service:** Used by the manager to set the values of the agent object attributes. There are no settable attributes defined for a body composition analyzer agent according to this standard.

— **Event report service:** Used by the agent to send configuration reports and measurement data to the manager. The list of event reports for the body composition analyzer device specialization is given in 6.5.3.

— **Action service:** Used by the manager to invoke actions (or methods) supported by the agent. An example is Set-Time action, which is used to set a real-time clock with the absolute time at the agent.

Table 11 summarizes the object access services described in this standard.

Table 11—Body composition analyzer object access services

Service	Subservice type name	Mode	Subservice type	Parameters	Result	Remarks
GET	<na>	<implied Confirmed>	<na>	GetArgumentSimple = (obj-handle = 0), attribute-id-list <*optional*>	GetResultSimple = (obj-handle = 0), attribute-list	Allows the manager to retrieve the value of an attribute of an object in the agent.
EVENT REPORT	MDS-Configuration-Event	Confirmed	MDC_NOTI_CONFIG	ConfigReport	ConfigReport Rsp	Configuration Report to inform manager of the configuration of the agent.
	MDS-Scan-Report-Var	Confirmed	MDC_NOTI_SCAN_REPORT_VAR	ScanReportInfoVar	—	Data Report to provide dynamic data to manager for some or all of the agent's objects in variable format.
	MDS-Scan-Report-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_FIXED	ScanReportInfoFixed	—	Data Report to provide dynamic data to manager for some or all of the agent's objects in fixed format.
	MDS-Scan-Report MP-Var	Confirmed	MDC_NOTI_SCAN_REPORT_MP_VAR	ScanReportInfoMPVar	—	This is the same as MDS-Dynamic-Data-Update-Var, but allows inclusion of data from multiple people.
	MDS-Scan-Report-MP-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_MP_FIXED	ScanReportInfoMPFixed	—	This is the same as MDS-Dynamic-Data-Update-Fixed, but allows inclusion of data from multiple people.
ACTION	Set-Time	Confirmed	MDC_ACT_SET_TIME	SetTimeInvoke	—	Manager method to invoke the agent to set time to requested value.

7.3 Object access event report services

The event report service (see Table 11) is used by the agent to report its information (e.g., measurements). Event reports in this standard are a property of the MDS object only. The event reports used in this standard are defined in IEEE Std 11073-20601-2008.

The following conditions apply for a body composition analyzer agent according to this standard:

— Event reports shall be used in confirmed mode

— Agent-initiated mode shall be supported for measurement data transmission

A body composition analyzer agent, which is designed to operate in an environment where data may be collected from multiple people, may use one of the multi-person event report styles to transmit all the data from each person in a single event. If this functionality is not required, the agent may use the single-person event report styles, which have reduced overhead.

A manager shall support both single-person and multi-person event reports. A body composition analyzer agent may support either one or both single-person and multi-person event reports. The formats for single- and multiple-person reports are described in IEEE Std 11073-20601-2008.

8 Body composition analyzer communication model

8.1 Overview

The following clauses describe the general communication model and procedures of the body composition analyzer agent as defined in IEEE Std 11073-20601-2008. Therefore, the respective parts of IEEE Std 11073-20601-2008 are not reproduced; rather the specific choices and restrictions with respect to optional elements (e.g., objects, attributes, and actions) and specific extensions (e.g., nomenclature terms) are specified.

For an illustrative overview of the various message transactions during a typical measurement session, see the sequence diagram for the example use case in Annex D and the corresponding protocol data unit (PDU) examples in Annex E.

8.2 Communications characteristics

In this subclause, limits on the size of an application protocol data unit (APDU) transmitted or to be received by a body composition analyzer agent are defined. Small limits allow for simple implementations in terms of low cost and complexity.

A body composition analyzer agent implementing only this device specialization shall not transmit any APDU larger than N_{tx} and shall be capable of receiving any APDU up to a size of N_{rx}. For this standard, N_{tx} shall be 7730 octets and N_{rx} shall be 1230 octets.

For a body composition analyzer agent implementing functions from other device specializations, an upper bound estimation of the APDU sizes brings the following: an agent shall not transmit any APDU larger than the sum of N_{tx} of all the device specializations implemented and shall be capable of receiving any APDU up to the sum of N_{rx} of all the device specializations implemented. If these numbers are higher than the maximum size determined in IEEE Std 11073-20601-2008, the latter shall be applied.

In case the APDU size limit does not allow for the inclusion of a certain amount of multiple pending measurements at the agent, they shall be sent using multiple event reports. See 8.5.3 for the maximum number of measurements allowed for inclusion in a single event report.

8.3 Association procedure

8.3.1 General

Unless otherwise stated, the association procedure for a body composition analyzer agent and manager according to this standard shall be pursued as specified in IEEE Std 11073-20601-2008.

8.3.2 Agent procedure—association request

In the association request sent by the agent to the manager:

— The version of the association procedure used by the agent shall be set to assoc-version1 (i.e., *assoc-version* = 0x80000000).

— The DataProtoList structure element of the data protocol identifier shall be set to data-proto-id-20601 (i.e., *data-proto-id* = 0x5079).

— The *data-proto-info* field shall contain a PhdAssociationInformation structure which shall contain the following parameter values:

1) The version of the data exchange protocol shall be set to protocol-version1 (i.e., *protocol-version* = 0x80000000).

2) At least the MDER encoding rules shall be supported (i.e., *encoding-rules* = 0x8000).

3) The version of the nomenclature used shall be set to nom-version1 (i.e., *nomenclature-version* = 0x80000000).

4) The field *functional-units* may have the test association bits set but shall not have any other bits set.

5) The field *system-type* shall be set to sys-type-agent (i.e., *system-type* = 0x00800000).

6) The *system-id* field shall be set to the value of the System-Id attribute of the MDS object of the agent. The manager may use this field to determine the identity of the body composition analyzer with which it is associating and, optionally, to implement a simple access restriction policy.

7) The *dev-config-id* field shall be set to the value of the Dev-Configuration-Id attribute of the MDS object of the agent.

8) If the agent supports only the body composition analyzer specialization, then the field indicating the data request modes (*data-req-mode-capab*) supported by the body composition analyzer agent shall be set to *data-req-supp-init-agent.*

9) If the agent supports only the body composition analyzer specialization, then *data-req-init-manager-count* shall be set to zero, and *data-req-init-agent-count* shall be set to 1.

8.3.3 Manager procedure—association response

In the association response message sent by the manager:

— The result field shall be set to an appropriate response from those defined in IEEE Std 11073-20601. For example, if all other conditions of the association protocol are satisfied, accepted is returned when the manager recognizes the dev-config-id of the agent and accepted-unknown-config otherwise.

— In the DataProtoList structure element, the data protocol identifier shall be set to data-proto-id-20601 (i.e., data-proto-id = 0x5079).

— The data-proto-info field shall be filled in with a PhdAssociationInformation structure which shall contain the following parameter values:

1) The version of the data exchange protocol shall be set to protocol-version1 (i.e., protocol-version = 0x80000000).

2) The manager shall respond with a single selected encoding rule that is supported by both agent and manager. The manager shall support at least the MDER encoding rules.

3) The version of the nomenclature used shall be set to nom-version1 (i.e., nomenclature-version = 0x80000000).

4) The field functional-units shall have all bits reset except for those relating to a test association.

5) The field system-type shall be set to sys-type-manager (i.e., system-type = 0x80000000).

6) The system-id field shall contain the unique system id of the manager device, which shall be a valid EUI-64 type identifier.

7) The field dev-config-id shall be manager-config-response (0).

8) The field data-req-mode-capab shall be 0.

9) If the agent supports only the body composition analyzer specialization, data-req-init-agent-count shall be 1 and *data-req-init-manager-count* shall be 0.

8.4 Configuring procedure

8.4.1 General

The agent enters the Configuring state if it receives an association response of *accepted-unknown-config*. In this case, the configuration procedure as specified in IEEE Std 11073-20601-2008 shall be followed. Subclause 8.4.2 specifies the configuration notification and response messages for a body composition analyzer agent with standard configuration ID 2000 (0x07D0). Normally, a manager would already know the standard configuration. However, for the purposes of this example, it does not.

8.4.2 Body composition analyzer—standard configuration

8.4.2.1 Agent procedure

The agent performs the configuration procedure using a "Remote Operation Invoke | Confirmed Event Report" message with an MDC_NOTI_CONFIG event to send its configuration to the manager (see IEEE Std 11073-20601-2008). The ConfigReport structure is used for the *event-info* field (see Table 3). For a body composition analyzer agent with standard configuration ID 2000 (0x07D0), the format and contents of the configuration notification message are as follows:

```
0xE7 0x00                 APDU CHOICE Type (PrstApdu)
0x00 0x9C                 CHOICE.length = 156
0x00 0x9A                 OCTET STRING.length = 154
0xXX 0xXX                 invoke-id (differentiates this message from any other outstanding)
0x01 0x01                 CHOICE(Remote Operation Invoke | Confirmed Event Report)
0x00 0x94                 CHOICE.length = 148
0x00 0x00                 obj-handle = 0 (MDS object)
0xXX 0xXX 0xXX 0xXX       event-time (set to 0xFFFFFFFF if RelativeTime is not supported)
0x0D 0x1C                 event-type = MDC_NOTI_CONFIG
0x00 0x8A                 event-info.length = 138 (start of ConfigReport)
0x07 0xD0                 config-report-id (Dev-Configuration-Id value)
0x00 0x03                 config-obj-list.count = 3 Measurement objects will be "announced"
0x00 0x84                 config-obj-list.length = 132
0x00 0x06                 obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x03                 obj-handle = 3     (→ 1st Measurement is body fat)
```

```
0x00 0x04                 attributes.count = 4
0x00 0x24                 attributes.length = 36
0x09 0x2F                 attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                 attribute-value.length = 4
0x00 0x02 0xE1 0x4C       MDC_PART_SCADA | MDC_BODY_FAT
0x0A 0x46                 attribute-id = MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                 attribute-value.length = 2
0xF0 0x42                 intermittent, stored data, upd & msmt aperiodic, agent init, calculated
0x09 0x96                 attribute-id = MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0x02 0x20                 MDC_DIM_PERCENT
0x0A 0x55                 attribute-id = MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
0x00 0x08                 AttrValMap.length = 8
0x0A 0x56 0x00 0x02       MDC_ATTR_NU_VAL_OBS_ SIMP | value length = 2
0x09 0x90 0x00 0x08       MDC_ATTR_TIME_STAMP_ABS | value length = 8
0x00 0x06                 obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x02                 obj-handle = 2     (→2nd Measurement is body height)
0x00 0x04                 attributes.count = 4
0x00 0x24                 attributes.length = 36
0x09 0x2F                 attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                 attribute-value.length = 4
0x00 0x02 0xE1 0x44       MDC_PART_SCADA | MDC_LEN_BODY_ACTUAL
0x0A 0x46                 attribute-id = MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                 attribute-value.length = 2
0xF0 0x48                 intermittent, stored data, upd & msmt aperiodic, agent init, manual
0x09 0x96                 attribute-id = MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0x05 0x11                 MDC_DIM_CENTI_M
0x0A 0x55                 attribute-id = MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
0x00 0x08                 AttrValMap.length = 8
0x0A 0x56 0x00 0x04       MDC_ATTR_NU_VAL_OBS_SIMP, 4
0x09 0x90 0x00 0x08       MDC_ATTR_TIME_STAMP_ABS, 8
0x00 0x06                 obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x01                 obj-handle = 1     (→3rd Measurement is body weight)
0x00 0x04                 attributes.count = 4
0x00 0x24                 attributes.length = 36
0x09 0x2F                 attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                 attribute-value.length = 4
0x00 0x02 0xE1 0x40       MDC_PART_SCADA | MDC_MASS_BODY_ACTUAL
0x0A 0x46                 attribute-id = MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                 attribute-value.length = 2
0xF0 0x48                 intermittent, stored data, upd & msmt aperiodic, agent init, manual
0x09 0x96                 attribute-id = MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0x06 0xC3                 MDC_DIM_KILO_G
0x0A 0x55                 attribute-id = MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
```

0x00 0x08	AttrValMap.length = 8
0x0A 0x56 0x00 0x04	MDC_ATTR_NU_VAL_OBS_SIMP, 4
0x09 0x90 0x00 0x08	MDC_ATTR_TIME_STAMP_ABS, 8

At the locations of the message, where the content is not fixed, the value "0xXX" denotes a placeholder and depends on the implementation or on the preceding messaging of the agent.

8.4.2.2 Manager procedure

The manager shall respond to a configuration notification message using a "Remote Operation Response | Confirmed Event Report" data message with an MDC_NOTI_CONFIG event using the ConfigReportRsp structure for the *event-info* field (see Table 3). As a response to the standard configuration notification message in 8.4.2.1, the format and contents of the manager's configuration notification response message are as follows:

0xE7 0x00	APDU CHOICE Type (PrstApdu)
0x00 0x16	CHOICE.length = 22
0x00 0x14	OCTET STRING.length = 20
0xXX 0xXX	invoke-id (differentiates this message from any other outstanding)
0x02 0x01	CHOICE (Remote Operation Response | Confirmed Event Report)
0x00 0x0E	CHOICE.length = 14
0x00 0x00	obj-handle = 0 (MDS object)
0xXX 0xXX 0xXX 0xXX	currentTime
0x0D 0x1C	event-type = MDC_NOTI_CONFIG
0x00 0x04	event-reply-info.length = 4
0x07 0xD0	ConfigReportRsp.config-report-id = 0x07D0
0x00 0x00	ConfigReportRsp.config-result = accepted-config

Again, the value "0xXX" denotes a placeholder and refers to a fixed location, varying content parts of the message.

8.5 Operating procedure

8.5.1 General

Measurement data and status information are communicated from the body composition analyzer agent during the Operating state. If not stated otherwise, the operating procedure for a body composition analyzer agent of this standard shall be as specified in IEEE Std 11073-20601-2008.

8.5.2 GET body composition analyzer MDS attributes

See Table 4 for a summary of the GET service.

If the attribute-id-list field in the roiv-cmip-get service message is empty, the body composition analyzer agent shall respond with a rors-cmip-get service message in which the attribute-list contains a list of all implemented attributes of the MDS object.

If the manager requests specific MDS object attributes, indicated by the elements in attribute-id-list, and the agent supports this capability, the body composition analyzer agent shall respond with a rors-cmip-get service message in which the attribute-list contains a list of the requested attributes of the MDS object that

are implemented. It is not required for a body composition analyzer agent to support this capability. If this capability is not implemented, the body composition analyzer agent shall respond as specified in IEEE Std 11073-20601-2008 clause "MDS object attributes."

8.5.3 Measurement data transmission

See Table 3 for a summary of the event report services available for measurement data transfer.

Measurement data transfer for a body composition analyzer agent of this standard shall always be initiated by the body composition analyzer (see agent-initiated measurement data transmission in IEEE Std 11073-20601-2008). To limit the amount of data being transported within an APDU, the body composition analyzer agent shall not include more than 25 temporarily stored measurements in a single event report. If more than 25 pending measurements are available for transmission, they shall be sent using multiple event reports. If multiple body fat measurements are available, up to 25 measurements should be transmitted within a single event report. Alternatively, they may be transmitted using a single event report for each body fat measurement. However, the former strategy is recommended to reduce overall message size and power consumption.

A body composition analyzer agent with standard configuration shall use the fixed format data update messages method for transmitting measurement data. A body composition analyzer agent with extended configuration may use either fixed or variable format data update messages for transmitting measurement data.

8.6 Time synchronization

Time synchronization between a body composition analyzer agent and a manager may be used to coordinate the clocks used when reporting physiological events. Note that the mechanism for synchronizing an agent to a manager is outside the scope of this standard. If time synchronization is used, then this shall be reported in the Mds-Time-Info attribute of the MDS object.

9 Test associations

The test association provides a manufacturer the mechanism to test or demonstrate features of a product in a comprehensive manner. This clause defines the behavior of the standard body composition analyzer agent during a test association. Support for test association is optional.

9.1 Behavior with standard configuration

An agent or manager entering a test association using the configuration ID for the standard body composition analyzer device of this standard shall enter the Operating state in test mode. When in test mode, where possible, this should be indicated visually to any user. Normal functionality shall be suspended and any test data generated shall not be processed by the device as physiological data.

The body composition analyzer agent shall send a simulated body fat value of 20%, a body height of 170 cm, and a body weight of 55 kg within 30 s of entering the Operating state. If the measurement-status attribute of the numeric object is implemented, then the test-data bit shall be set.

The test association is terminated in a manner consistent with the agent's normal behavior for terminating an association.

9.2 Behavior with extended configurations

This specification does not define a test association that uses an extended configuration.

10 Conformance

10.1 Applicability

This standard shall be used in conjunction with IEEE Std 11073-20601-2008.

An implementation or a system can conform to the following elements of this standard:

— Domain information model class hierarchy and object definitions (object attributes, notifications, methods, and data type definitions)

— Nomenclature code values

— Protocol and service models

— Communication service model (association and configuration)

10.2 Conformance specification

This standard offers levels of conformance with respect to strict adherence to the standard device and the use of extensions for the following:

— Information model of a specific device

— Use of attributes, value ranges and access methods

A vendor shall specify the level of conformance for an implementation based on this standard and provide details of the way in which the definitions of this standard and any extensions are applied.

Specifications shall be provided in the form of a set of implementation conformance statements (ICS) as detailed in 10.4.

This standard is used in conjunction with IEEE Std 11073-20601-2008. It is recommended that the ICS for this standard be created first so that the ICS created for IEEE Std 11073-20601-2008 may refer to the ICS for this standard where applicable.

10.3 Levels of conformance

10.3.1 General

This standard defines the levels of conformance detailed in 10.3.2 and 10.3.3.

10.3.2 Conformance level 1: Base conformance

The application uses elements of the information, service, and communication models (object hierarchy, actions, event reports, and data type definitions) and the nomenclature scheme defined in IEEE Std 11073-20601-2008 and IEEE Std 11073-104zz. All mandatory features defined in the object definition tables and in the ICS tables are implemented. Furthermore, any conditional, recommended, or optional features that are implemented shall follow the requirements in IEEE Std 11073-20601-2008 and IEEE Std 11073-104zz.

10.3.3 Conformance level 2: Extended nomenclature (ASN.1 and/or ISO/IEEE 11073-10101)

Conformance level 2 meets conformance level 1, but also uses or adds extensions in at least one of the information, service, or nomenclature models. Extensions to nomenclature codes shall conform to the framework of ISO/IEEE 11073-10101:2004 [B1] and lie within the private nomenclature extension range (0xF000–0xFFFF).

Extensions to the information or service models shall be fully defined using ASN.1 [B4] where appropriate and have their behavior fully described following the framework of the IEEE Std 11073-20601-2008 and/or ISO/IEEE 11073-20101:2004 [B1]. All extensions shall be specified and include reference to the definition for the extension, or where no publicly available reference is available, the definition of the extension should be appended to the conformance statement.

10.4 Implementation conformance statements

10.4.1 General format

The ICSs are provided as an overall conformance statement document that comprises a set of tables in the form given by the templates in 10.4.2 through 10.4.6.

Each ICS table has the following columns:

Index	Feature	Reference	Req/Status	Support	Comment

The table column headings have the following meaning:

— **Index:** An identifier (e.g., a tag) of a specific feature.

— **Feature:** Briefly describes the characteristic for which a conformance statement is being made.

— **Reference:** To the clause/paragraph within this document or an external source for the definition of the feature (may be empty).

— **Req/Status:** Specifies the conformance requirement (mandatory, recommended, etc.)—in some cases this standard does not specify conformance requirements but requests the status of a particular feature be provided.

— **Support:** Specifies the presence or absence of a feature and any description of the characteristics of the feature in the implementation. This column is to be filled out by the implementer.

— **Comment:** Contains any additional information on the feature. This column is to be filled out by the implementer.

Subclauses 10.4.2 to 10.4.6 specify the format of the specific ICS tables.

10.4.2 General implementation conformance statement

The general ICS specifies the versions/revisions that are supported by the implementation and high-level system behavior. Table 12 shows the General ICS.

Table 12— IEEE 11073-10420 General ICS table

Index[7]	Feature	Reference	Req./Status	Support	Comment
GEN 11073-10420-1	Implementation Description	—	Identification of the device/ application. Description of functionality.		
GEN 11073-10420-2	Standards followed and their revisions	(standard documents)	(set of existing revisions)	(set of supported revision)	
GEN 11073-10420-3	Nomenclature document used and revision	(standard documents)	(set of existing revisions)	(set of supported revisions)	
GEN 11073-10420-4	Conformance Adherence - Level 1 -	See 10.3.2	Base conformance declaration that device meets the following IEEE Std 11073-10420 conformance requirements: a) All mandatory requirements shall be implemented. b) If implemented, conditional, recommended, and optional requirements shall conform to standard.	Yes/No (No is not expected as No implies that the implementation is non-conformant)	
GEN 11073-10420-5	Conformance Adherence - Level 2 -	See 10.3.3	In addition to GEN 11073-10420-4, if the device implements extensions and/or additions, they shall conform to nomenclature codes from ASN.1 [B4] and/or ISO/IEEE 11073-10101 [B1] framework. These extensions should also be defined in ICS tables pointing toward their reference.	Yes/No	
GEN 11073-10420-6	Object Containment Tree	See 6.3	Provide Object Containment Diagram showing relations between object instances used by the application. A conforming implementation uses only object relations as defined in the DIM.		
GEN 11073-10420-7	Nomenclature document used and revision	(standard documents)	(set of existing revisions)	(set of supported revision)	
GEN 11073-10420-8	Data Structure Encoding	—	—	description of encoding method(s) for ASN.1 data structures	

[7] The prefix GEN11073-10420 is used for the index in the General ICS table.

Index[7]	Feature	Reference	Req./Status	Support	Comment
GEN 11073-10420-9	Use of Private Objects	—	Does the implementation use objects that are not defined in the DIM?	Yes/No (If yes: explain in Table 13]	
GEN 11073-10420-10	Use of Private Nomenclature Extensions	—	Does the implementation use private extensions to the nomenclature (i.e., 0xF000-0xFFFF codes from ISO/IEEE 11073-10101 [B1])? Private Nomenclature extensions are only allowed if the standard nomenclature does not include the specific terms required by the application.	Yes/No [If yes: explain in the Table 16]	
GEN 11073-10420-11	IEEE Std 11073-20601 Conformance		Provide the conformance report required by IEEE Std 11073-20601-2008.		

10.4.3 DIM MOC implementation conformance statement

The DIM MOC ICS defines which objects are implemented. Information on each object shall be provided as a separate row in the template of Table 13.

Table 13—Template for DIM MOC ICS table

Index	Feature	Reference	Req./Status	Support	Comment
MOC-n	Object description	Reference to the clause in the standard or other location where the object is defined.	Implemented	Specify restrictions, e.g., max. number of supported instances	

The n in the Index column should be the object handle for implementations that have predefined objects. Otherwise, the Index column shall simply be a unique number (1..m).

All private objects should be specified and include either a reference to the definition for the object or, where no publicly available reference is available, the definition of the object should be appended to the conformance statement.

The Support column should indicate any restrictions for the object implementation.

An object containment diagram (class instance diagram) should be provided as part of the DIM MOC ICS.

10.4.4 MOC attribute ICS

The MOC attribute ICS defines which attributes, including any inherited attributes, are used/supported in each object of an implementation. Information on each attribute of an object shall be provided as a separate row in the template of Table 14. A separate MOC attribute ICS shall be provided for each object.

Table 14—Template for MOC attribute ICS table

Index	Feature	Reference	Req./Status	Support	Comment
ATTR-n-x	Attribute Name. Extended attributes shall include the attribute ID also.	Fill in the reference to the ASN.1 structure if the attribute is not defined in this standard.	M = Mandatory / C = Conditional / R = Recommended / O = Optional (as per definition in Attribute Definition Tables)	Implemented? Yes/No Static/Dynamic Specify restrictions, (e.g., value ranges). Describe how attribute is accessed (e.g., Get, Set, sent in config event report, sent in a data event report). Describe any specific restrictions.	

The Support column shall specify: whether the attribute is implemented; for extension attributes, whether the attribute value is static or dynamic; any value ranges; restrictions on attribute access or availability; and any other information.

The *n* in the Index column refers to the ID of the managed object for which the table is supplied (i.e., the index of the managed object as specified in the MOC ICS). There is one separate table for each supported managed object.

The *x* in the Index column is a unique serial number (1..m).

10.4.5 MOC notification implementation conformance statement

The MOC notification ICS specifies all implemented notifications (typically in the form of the event report service) that are emitted by the agent. Table 15 provides a template for use. One table has to be provided for each object that supports special object notifications. One row of the table shall be used for each notification.

Table 15— Template for MOC notification ICS table

Index	Feature	Reference	Req./Status	Support	Comment
NOTI-n-x	Notification Name and Notification ID	Reference to the clause in the standard or other location where the event is defined.		The Support column shall specify how the notification is sent and any restrictions.	

The n in the Index column refers to the ID of the managed object for which the table is supplied (i.e., the index of the managed object as specified in the MOC ICS). There is one separate table for each managed object that supports specific object notifications (i.e., events).

The x in the Index column is a unique serial number (1..m).

All private notifications should be specified and include reference to the definition for the notification. Where no publicly available reference is available, the definition of the notification should be appended to the conformance statement.

10.4.6 MOC nomenclature conformance statement

The MOC nomenclature ICS specifies all nonstandard nomenclature codes that are utilized by the agent. Table 16 provides a template for use. One row of the table is to be used for each nomenclature element.

Table 16—Template for MOC nomenclature ICS table

Index	Feature	Reference	Req./Status	Support	Comment
NOME-n	Nomenclature Name and Nomenclature value	Reference to the clause in the standard or other location where the nomenclature is defined or used		Describe how the nomenclature is used. Describe any specific restrictions	

The *n* in the Index column is a unique serial number (1..m).

Annex A
(informative)

Bibliography

[B1] ISO/IEEE 11073-10101:2004, Health informatics—Point-of-care medical device communication — Part 10101: Nomenclature.

[B2] ISO/IEEE 11073-10201:2004, Health informatics—Point-of-care medical device communication — Part 10201: Domain information model.

[B3] ISO/IEEE 11073-20101:2004, Health informatics—Point-of-care medical device communication — Part 20101: Application Profiles—Base Standard.

[B4] ITU-T Rec. X.680-2002, Information technology—Abstract Syntax Notation One (ASN.1): Specification of basic notation. [8]

[8] This specification is available from the ITU-T Web Site http://www.itu.int (see the information at the following Internet location: http://www.itu.int/ITU-T/studygroups/com17/languages/X.680-0207.pdf).

Annex B
(normative)

Any additional ASN.1 definitions

No additional ASN.1 definitions are defined.

Annex C

(normative)

Allocation of identifiers

This annex contains the nomenclature codes used in this document and not found in IEEE Std 11073-20601-2008. For those not contained in this annex, the normative definition is found in IEEE Std 11073-20601-2008.

The format used here follows that of ISO/IEEE 11073-10101:2004 [B1].

```
/*****************************************************************************
* From Medical supervisory control and data acquisition (MDC_PART_SCADA)
*****************************************************************************/

#define MDC_BODY_FAT                    57676 /*                          */
#define MDC_MASS_BODY_FAT_FREE          57684 /*                          */
#define MDC_MASS_BODY_SOFT_LEAN         57688 /*                          */
#define MDC_BODY_WATER                  57692 /*                          */

/*****************************************************************************
* From Dimensions (MDC_PART_DIM)
*****************************************************************************/
#define MDC_DIM_CENTI_M                 1297  /* cm                       */
#define MDC_DIM_INCH                    1376  /* in                       */
#define MDC_DIM_LB                      1760  /* lb                       */
#define MDC_DIM_KG_PER_M_SQ             1955  /* kg m-2                   */
```

Annex D
(informative)

Message sequence examples

Figure D.1 shows a sequence diagram of the messaging procedure corresponding to the following use case. The user of a medication monitor agent device intends to connect it to a manager device for the first time. The medication monitor is capable of performing medication dosage event measurements.

a) When the user connects the medication monitor, the manager does not recognize the agent's configuration and sends a response to the agent's association request with the result *accepted-unknown-config*. See E.2.2.2 and E.2.2.3 for the corresponding PDU examples.

b) As a consequence of this, the agent negotiates its configuration information to the manager. After getting confirmation from the manager accepting the agent's configuration, the agent device is ready to send measurements. Both devices enter the Operating state. See E.3.2.2 and E.3.2.3 for the corresponding PDU examples.

c) Subsequently, the manager may request the MDS object attributes of the agent by sending a Data message with the "Remote Operation Invoke | Get" command. Note that the manager may request the MDS object attributes as soon as the agent enters the Associated state, including the Configuring and Operating sub-states. As a response, the agent reports its MDS object attributes to the manager using a Data message with the "Remote Operation Response | Get" command. See E.4.2 and E.4.3 for the corresponding PDU examples.

d) As a next step, the user of the agent device takes a single measurement. The measurement data is transmitted to the manager using a confirmed event report. After having successfully received the measurement data, the manager sends a confirmation to the agent. See E.5.1 and E.5.2 for the corresponding PDU examples.

e) The user ends the measurement session (e.g., by pushing a proper button on the device, or just by not using the device for a duration longer than a certain time period). As a consequence, the agent disassociates from the manager by sending an association release request. The manager responds with an association release response. See E.6.1 and E.6.2 for the corresponding PDU examples.

f) When the agent requests to associate to the manager for the next measurement session (e.g., the next day), the result in the manager's response is *accepted*, as it already knows the agent's configuration from the previous measurement session. Both devices transition directly to the Operating state.

g) Finally, the last two steps shown are similar as in item e) and item f). The user takes a single confirmed measurement followed by releasing the association.

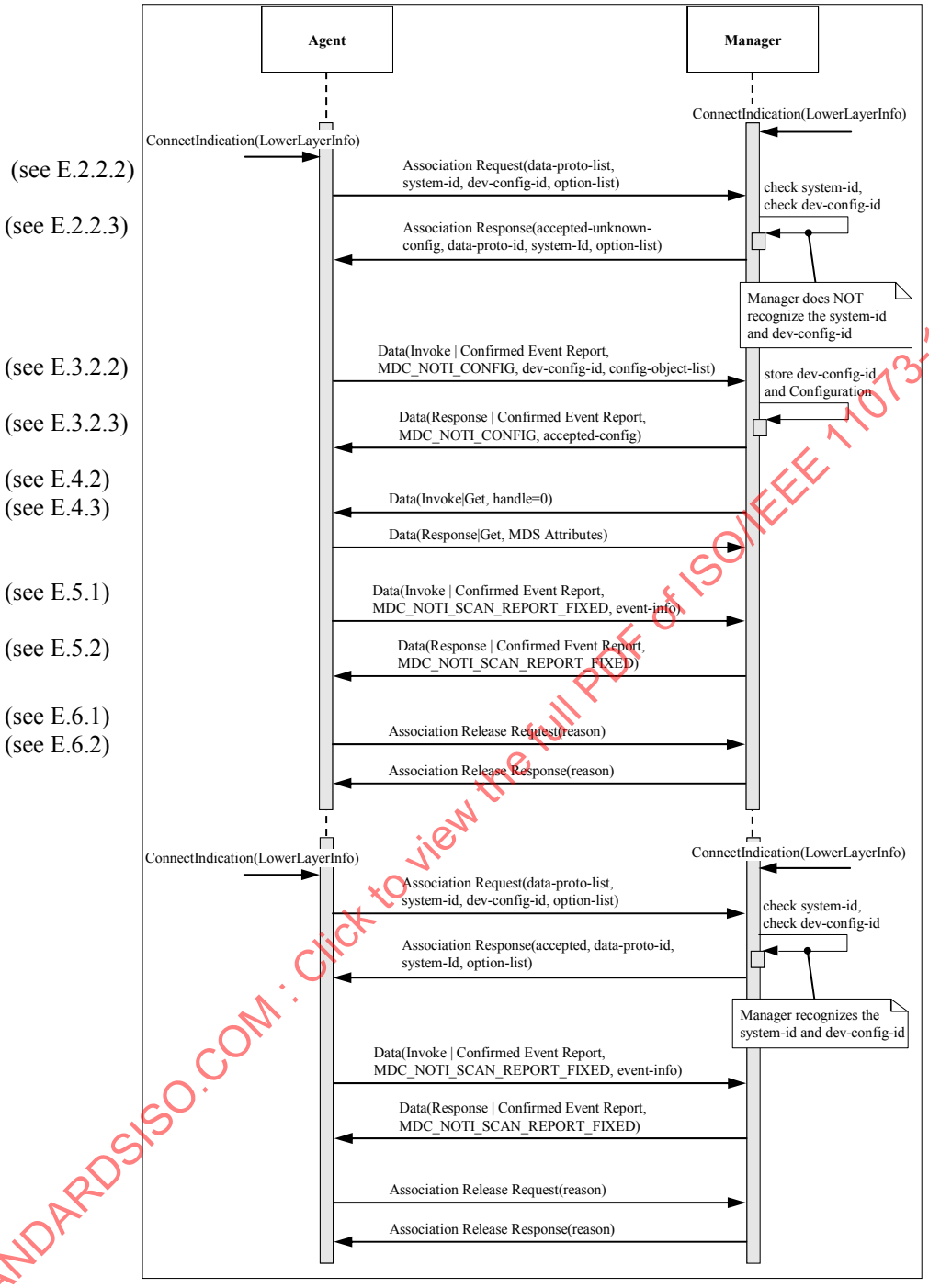

Figure D.1—Sequence diagram for medication monitor example use case

Annex E
(informative)

Protocol data unit examples

E.1 General

This annex shows binary examples of messages exchanged between a body composition analyzer agent and manager. Three different scenarios containing the association and configuration information exchanges are presented in E.2 and E.3. The first scenario illustrates the case when the agent intends to operate using an Extended configuration. The manager does not have the configuration declared by the agent from a prior association. The second illustrates the agent presenting the same Extended configuration to the manager, and the manager does have the configuration from the previously transferred configuration exchange. Finally, the agent presents a Standard configuration to the manager, and the manager has the configuration because the manager has been preprogrammed with this configuration.

E.2 Association information exchange

E.2.1 General

When the transport connection is established between the manager and the agent, they both enter the Unassociated state. When the agent sends an Association Request, both manager and agent enter the Associating state.

E.2.2 Extended configuration

E.2.2.1 General

In this exchange, the agent sends an Association Request intending to use an Extended configuration during measurement transfer. However, the manager does not have this configuration.

E.2.2.2 Association request

The body composition analyzer agent sends the following message to the manager. The agent intends to associate using an Extended configuration.

0xE2 0x00	APDU CHOICE Type (AarqApdu)
0x00 0x32	CHOICE.length = 50
0x80 0x00 0x00 0x00	assoc-version
0x00 0x01 0x00 0x2A	data-proto-list.count = 1 | length = 42
0x50 0x79	data-proto-id = 20601
0x00 0x26	data-proto-info length = 38
0x80 0x00 0x00 0x00	protocolVersion
0xA0 0x00	encoding rules = MDER or PER
0x80 0x00 0x00 0x00	nomenclatureVersion

```
0x00 0x00 0x00 0x00      functionalUnits – no Test Association capabilities
0x00 0x80 0x00 0x00      systemType = sys-type-agent
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x88
0x40 0x00                dev-config-id – extended configuration
0x00 0x01                data-req-mode-flags
0x01 0x00                data-req-init-agent-count, data-req-init-manager-count
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.2.2.3 Association response

A manager responds to the agent that it can associate but does not have the body composition analyzer extended configuration (i.e., there is the need for the agent to send its configuration).

```
0xE3 0x00                APDU CHOICE Type (AareApdu)
0x00 0x2C                CHOICE.length = 44
0x00 0x03                result = accepted-unknown-config
0x50 0x79                data-proto-id = 20601
0x00 0x26                data-proto-info length = 38
0x80 0x00 0x00 0x00      protocolVersion
0x80 0x00                encoding rules = MDER
0x80 0x00 0x00 0x00      nomenclatureVersion
0x00 0x00 0x00 0x00      functionalUnits – normal Association
0x80 0x00 0x00 0x00      systemType = sys-type-manager
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x88 0x77 0x66 0x55 0x44 0x33 0x22 0x11
0x00 0x00                Manager's response to config-id is always 0
0x00 0x00                Manager's response to data-req-mode-flags is always 0
0x00 0x00                data-req-init-agent-count and data-req-init-manager-count are always 0
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.2.3 Previously known extended configuration

E.2.3.1 General

This exchange illustrates a transaction that takes place after a session beginning with an exchange like E.2.2 has occurred.

E.2.3.2 Association request

The body composition analyzer agent sends the following message to the manager. The agent intends to associate using an Extended configuration.

```
0xE2 0x00                APDU CHOICE Type (AarqApdu)
0x00 0x32                CHOICE.length = 50
0x80 0x00 0x00 0x00      assoc-version
0x00 0x01 0x00 0x2A      data-proto-list.count = 1 | length = 42
0x50 0x79                data-proto-id = 20601
0x00 0x26                data-proto-info length = 38
0x80 0x00 0x00 0x00      protocolVersion
0xA0 0x00                encoding rules = MDER or PER
```

```
0x80 0x00 0x00 0x00      nomenclatureVersion
0x00 0x00 0x00 0x00      functionalUnits, no Test Association capabilities
0x00 0x80 0x00 0x00      systemType = sys-type-agent
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x04
0x40 0x00                dev-config-id – extended configuration
0x00 0x01                data-req-mode-flags
0x01 0x00                data-req-init-agent-count, data-req-init-manager-count
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.2.3.3 Association response

A manager responds to the agent that it can associate with, recognizes, and accepts and has the body composition analyzer's extended configuration (i.e., there is no need for the agent to send its configuration).

```
0xE3 0x00                APDU CHOICE Type (AareApdu)
0x00 0x2C                CHOICE.length = 44
0x00 0x00                result = accepted
0x50 0x79                data-proto-id = 20601
0x00 0x26                data-proto-info length = 38
0x80 0x00 0x00 0x00      protocolVersion
0x80 0x00                encoding rules = MDER
0x80 0x00 0x00 0x00      nomenclatureVersion
0x00 0x00 0x00 0x00      functionalUnits = normal Association
0x80 0x00 0x00 0x00      systemType = sys-type-manager
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x88 0x77 0x66 0x55 0x44 0x33 0x22 0x11
0x00 0x00                Manager's response to config-id is always 0
0x00 0x00                Manager's response to data-req-mode-flags is always 0
0x00 0x00                data-req-init-agent-count and data-req-init-manager-count are always 0
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.2.4 Standard configuration

E.2.4.1 General

This transaction would occur if an agent presents an Association Request incorporating the dev-config-id corresponding to a Standard configuration. The manager has the configuration because it has been programmed with this configuration according to the information presented in this standard.

E.2.4.2 Association request

The body composition analyzer agent sends the following message to the manager. The agent intends to associate using a Standard configuration. The agent is willing to enter into a test association as defined in Clause 9.

```
0xE2 0x00                APDU CHOICE Type (AarqApdu)
0x00 0x32                CHOICE.length = 50
0x80 0x00 0x00 0x00      assoc-version
```

```
0x00 0x01 0x00 0x2A      data-proto-list.count = 1 | length = 42
0x50 0x79                data-proto-id = 20601
0x00 0x26                data-proto-info length = 38
0x80 0x00 0x00 0x00      protocolVersion
0xA0 0x00                encoding rules = MDER or PER
0x80 0x00 0x00 0x00      nomenclatureVersion
0x40 0x00 0x00 0x00      functionalUnits, has Test Association capabilities
0x00 0x80 0x00 0x00      systemType = sys-type-agent
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x88
0x07 0xD0                dev-config-id – standard configuration
0x00 0x01                data-req-mode-flags
0x01 0x00                data-req-init-agent-count, data-req-manager-count
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.2.4.3 Association response

A manager responds to the agent that it can associate with, recognizes, and accepts and has the body composition analyzer standard configuration (i.e., there is no need for the agent to send its configuration). The manager does not start a Test Association.

```
0xE3 0x00                APDU CHOICE Type (AareApdu)
0x00 0x2C                CHOICE.length = 44
0x00 0x00                result = accepted
0x50 0x79                data-proto-id = 20601
0x00 0x26                data-proto-info length = 38
0x80 0x00 0x00 0x00      protocolVersion
0x80 0x00                encoding rules = MDER
0x80 0x00 0x00 0x00      nomenclatureVersion
0x00 0x00 0x00 0x00      functionalUnits, normal Association
0x80 0x00 0x00 0x00      systemType = sys-type-manager
0x00 0x08                system-id length = 8 and value (manufacturer- and device- specific)
0x88 0x77 0x66 0x55 0x44 0x33 0x22 0x11
0x00 0x00                Manager's response to config-id is always 0
0x00 0x00                Manager's response to data-req-mode-flags is always 0
0x00 0x00                data-req-init-agent-count and data-req-init-manager-count are always 0
0x00 0x00 0x00 0x00      optionList.count = 0 | optionList.length = 0
```

E.3 Configuration information exchange

E.3.1 General

If the association is not rejected or aborted, the agent and manager transition from the Associating state into one of two states. If the manager's AssociateResult code is accepted, the agent and manager enter the operating state. If the manager's AssociateResult code is accepted-unknown-config, the agent and manager enter the Configuring state.

E.3.2 Extended configuration

E.3.2.1 General

This exchange takes place when the manager returns the AssociateResult code of accepted-unknown-config. The agent presents a description of its configuration corresponding to the dev-config-id it presented in the Association Request.

E.3.2.2 Remote operation invoke event report configuration

The body composition analyzer agent sends the description of its Extended configuration. It does this by sending a Confirmed Event Report of type MDC_NOTI_CONFIG.

```
0xE7 0x00                APDU CHOICE Type (PrstApdu)
0x01 0x50                CHOICE.length = 336
0x01 0x4C                OCTET STRING.length = 332
0x12 0x35                invoke-id = 0x1235 (start of DataApdu. MDER encoded.)
0x01 0x01                CHOICE(Remote Operation Invoke | Confirmed Event Report)
0x01 0x48                CHOICE.length = 328
0x00 0x00                obj-handle = 0 (MDS object)
0xFF 0xFF 0xFF 0xFF      event-time = 0xFFFFFFFF
0x0D 0x1C                event-type = MDC_NOTI_CONFIG
0x01 0x3E                event-info.length = 318 (start of ConfigReport)
0x40 0x00                config-report-id
0x00 0x07                config-obj-list.count = 7 Measurement objects will be “announced”
0x01 0x38                config-obj-list.length = 312
0x00 0x06                obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x03                obj-handle = 3     (→ 1st Measurement is body fat)
0x00 0x04                attributes.count = 4
0x00 0x24                attributes.length = 36
0x09 0x2F                attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                attribute-value.length = 4
0x00 0x02 0xE1 0x4C      MDC_PART_SCADA | MDC_BODY_FAT
0x0A 0x46                attribute-id = MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                attribute-value.length = 2
0xF0 0x42                intermittent, stored data, upd & msmt aperiodic, agent init, calculated
0x09 0x96                attribute-id = MDC_ATTR_UNIT_CODE
0x00 0x02                attribute-value.length = 2
0x02 0x20                MDC_DIM_PERCENT
0x0A 0x55                attribute-id = MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                attribute-value.length = 12
0x00 0x02                AttrValMap.count = 2
0x00 0x08                AttrValMap.length = 8
0x0A 0x56 0x00 0x02      MDC_ATTR_NU_VAL_OBS_ SIMP | value length = 2
0x09 0x90 0x00 0x08      MDC_ATTR_TIME_STAMP_ABS | value length = 8
0x00 0x06                obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x02                obj-handle = 2     (→2nd Measurement is body height)
0x00 0x04                attributes.count = 4
0x00 0x24                attributes.length = 36
0x09 0x2F                attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                attribute-value.length = 4
```