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Second edition
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Health informatics — Device interoperability —

Part 10404: Personal health device communication — Device specialization — Pulse oximeter

Informatique de santé — Interopérabilité des dispositifs —

Partie 10404: Communication entre dispositifs de santé personnels — Spécialisation des dispositifs — Oxymètre de pouls

Reference number
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Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA

Email: stds.ipr@ieee.org
Website: www.ieee.org

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IEEE Std 11073-10404™-2020
(Revision of IEEE Std 11073-10404-2008)

Health informatics—Personal health device communication

Part 10404: Device specialization—Pulse oximeter

Developed by the
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of the
IEEE Engineering in Medicine and Biology Society

Approved 30 January 2020
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Abstract: Within the context of the ISO/IEEE 11073 family of standards for device communication, this standard establishes a normative definition of communication between personal telehealth pulse oximetry devices and compute engines (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, information models, application profile standards, and transport standards. 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 pulse oximeters.

Keywords: IEEE 11073-10404™, medical device communication, personal health devices, PHD, pulse oximeter

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Karsten Aalders
Charles R. Abbruscato
Nabil Abujbara
Maher Abuzaid
James Agnew
Manfred Aigner
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Kathryn M. Bennett
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Chris Biernacki
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Thomas Blackadar
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Douglas P. Bogia
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Julius Broma
Lyle G. Bullock, Jr.
Bernard Burg
Chris Burns
Jeremy Byford-Rew
Satya Calloji
Xiaoying Cao
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Randy W. Carroll
Simon Carter
Seungchul Chae
Rahul Chauhan
Peggy Chien
David Chiu
Jinyong Choi
Chia-Chin Chong
Saeed A. Choudhary
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John T. Collins
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David Cornejo
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Nigel Cox
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Tomio Crosley
Allen Curtis
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Ciro de la Vega
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Kent Dicks
Hyoungho Do
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Xiaolian Duan
Sourav Dutta
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Leonardo Estevez
Hailing Feng
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Christoph Fischer
Morten Flintrup
Joseph W. Forler
Russell Foster
Eric Freudenthal
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Alan Godfrey
Nicolae Goga
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Channa Gowda
Charles M. Gropper
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Rasmus Haahr
Christian Habermann
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Jerry Hahn
Robert Hall
Shu Han
Nathaniel Hamming
Rickey L. Hampton
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Jordan Hartmann
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Avi Hauser
Wolfgang Heck
Nathaniel Heintzman
Charles Henderson
Jun-Ho Her
Helen B. Hernandez
Timothy L. Hirou
Allen Hobbs
Alex Holland
Arto Holopainen
Kris Holtzclaw
Xinyi Hong
Robert Hoy
Di Hu
Anne Huang
Zhiqiang Huang
Zhiyong Huang
Ron Huby
David Hughes
Robert D. Hughes
Jiyoung Huh
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Philip O. Isaacson
Atsushi Ito
Michael Jaffe
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Danny Jochelson
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Min-Joon Kim
Taekon Kim
Tetsuya Kimura
Michael J. Kirwan
Alfred Kloos
Jeongmee Koh
Jean-Marc Koller
John Koon
Patty Krantz
Raymond Krasinski
Alexander Kraus
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Falko Kuester
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Introduction

This introduction is not part of IEEE Std 11073-10404-2020, Health informatics—Personal health device communication—Part 10404: Device specialization—Pulse oximeter.

ISO/IEEE 11073 standards enable communication between medical devices and external computer systems. This document uses the optimized framework created in IEEE Std 11073-20601-2019™ and describes a specific, interoperable communication approach for the pulse oximeter.[1] These standards align with, and draw on, the existing clinically focused standards to provide support for communication of data from clinical or personal health devices.

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

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Health informatics—Personal health device communication

Part 10404: Device specialization—Pulse oximeter

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 communication between personal telehealth pulse oximeter devices and compute engines (e.g., cell phones, personal computers, personal health appliances, set top boxes) in a manner that enables plug-and-play (PnP) interoperability. It leverages appropriate portions of existing standards including ISO/IEEE 11073 terminology, information models, application profile standards, and transport standards. 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 pulse oximeters.

1.2 Purpose

This standard addresses a need for an openly defined, independent standard for controlling information exchange to and from personal health devices (PHDs) and compute engines (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 11073-20601-2019™[2] for an overview of the environment within which this standard is written.

This standard, IEEE Std 11073-10404, defines the device specialization for the pulse oximeter, being a specific agent type, and provides a description of the device concepts, its capabilities, and its implementation according to this standard.

This standard is based on IEEE Std 11073-20601-2019, which in turn draws information from both ISO/IEEE 11073-10201:2004 [B6][3] and ISO/IEEE 11073-20101:2004 [B7]. The medical device encoding rules (MDER) used within this standard are fully described in IEEE Std 11073-20601-2019.

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This standard defines specialized nomenclature codes that will be collected in IEEE Std 11073-10101-2019™. Between this standard, IEEE Std 11073-10101-2019, IEEE Std 11073-20601-2019 and other IEEE Std 11073-104xx, all required nomenclature codes for implementation are documented. New codes may be defined in newer versions / revisions of each of these documents. In the case of a conflict, where one term code has been assigned to two separate semantic concepts with different RefIDs, in general the oldest definition that is in actual use should take precedence. The same policy applies when one RefID has two different code values assigned in different specifications. The resolution of such conflicts will be determined through joint action by the responsible work groups and other stakeholders and any corrective action published as corrigenda.

NOTE—In this standard, ISO/IEEE P11073-104zz is used to refer to the collection of device specialization standards that utilize IEEE Std 11073-20601-2019, where zz can be any number from 01 to 99, inclusive.[4]

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 11073-20601-2019, Health informatics—Personal health device communication—Part 20601: Application profile—Optimized Exchange Protocol.[5, 6]

IEEE Std 11073-10101-2019, Health informatics—Point-of-care medical device communication—Part 10101: Nomenclature.

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

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. The *IEEE Standards Dictionary Online* [B1] should be referenced for terms not defined in this clause.[7]

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

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

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

device: A physical apparatus implementing either an agent or manager role.

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

[4] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.
[5] IEEE publications are available from The Institute of Electrical and Electronics Engineers (https://standards.ieee.org/).
[6] The IEEE standards or products referred to in Clause 2 are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.
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manager: A node receiving data from one or more associated agent systems. Examples of managers include a cellular phone, health appliance, set top box, or a computer system.

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

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

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

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

photoplethysmographic waveform: *See:* **plethysmogram**.

plethysmogram: Sequence of samples related to the sequential time-varying light absorption due to effects of pulsatile blood flow.

plethysmographic: *See:* **plethysmogram**.

SpO_2: Percentage oxygen saturation of haemoglobin as measured by a pulse oximeter, where this measurement is an estimate of the fraction of functional haemoglobin (or hemoglobin) in arterial blood that is saturated with oxygen.

NOTE—For more information about SpO_2, see ISO 80601-2-61:2017 [B9].

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)
ICS	implementation conformance statement
ID	identifier
MDC	medical device communication
MDER	medical device encoding rules
MDS	medical device system
MOC	managed object class
OID	object identifier
PDU	protocol data unit
PHD	personal health device
RT-SA	real-time sample array
SpO_2	percentage oxygen saturation of haemoglobin
VMO	virtual medical object

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 both managers and computerized healthcare information systems. See IEEE Std 11073-20601-2019 for a description of the guiding principles for this series of ISO/IEEE 11073 Personal Health Device standards.

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IEEE Std 11073-20601-2019 supports the modeling and implementation of an extensive set of personal health devices. This standard defines aspects of the pulse oximeter device. It describes all aspects necessary to implement the application layer services and data exchange protocol between an ISO/IEEE 11073 PHD pulse oximetry agent and a manager. This standard defines a subset of the objects and functionality contained in IEEE Std 11073-20601-2019, extending and adding definitions where appropriate.

All nomenclature codes referenced in this standard are collected in Annex C. Annex C may contain definitions of codes that are used by this standard and that are not yet present in the referenced versions of IEEE Std 11073-10101-2019 and IEEE Std 11073-20601-2019.

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 11073-20601-2019, 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 11073-20601-2019 for a detailed description of the modeling constructs.

4.2.2 Domain information model (DIM)

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 manager is defined by the application protocol in IEEE Std 11073-20601-2019.

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 manager. Protocol messages within the ISO/IEEE 11073 series of standards are defined in ASN.1. The messages defined in IEEE Std 11073-20601-2019 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 11073-20601-2019.

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.

4.3 Compliance with other standards

Devices that comply with this standard may also be required to comply with other domain- and device-specific standards that supersede the requirements of this standard with respect to issues including safety,

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reliability, and risk management. A user of this standard is expected to be familiar with all other such standards that apply and to comply with any higher specifications thus imposed.

Typically, medical devices should comply with the IEC 60601-1 [B2] base standards with respect to electrical and mechanical safety and any device-specific standard as might be defined in the IEC 60601-2 [B3] series of standards. Software aspects may apply through standards such as IEC 62304/EN 62304 [B4]. Devices that comply with this standard implement higher layers of network software and utilize lower layers as appropriate to the application. The requirements on performance of such applications and conformance are defined elsewhere and are outside the scope of this standard. Moreover, the use of any medical equipment is subject to risk assessment and risk management appropriate to the application. Some relevant examples are ISO 14971:2007 [B8] and IEC 80001-1 [B5]. The requirements of such risk assessment, risk management, and conformance are outside the scope of this standard. The applicable versions of the referenced safety related standards may differ per country.

5. Pulse oximeter device concepts and modalities

5.1 General

This clause presents the general concepts of pulse oximeter equipment. In the context of PHDs in the ISO/IEEE 11073 family of standards, a pulse oximeter, also called an oximeter, provides a noninvasive estimate of functional oxygen of arterial haemoglobin (SpO_2) from a light signal interacting with tissue, by using the time-dependent changes in tissue optical properties that occur with pulsatile blood flow (see Draft Guidance for Industry and FDA Staff **Error! Reference source not found.**). Applying the Beer-Lambert law of light absorption through such an arterial network, the fraction of oxygenation of arterial haemoglobin can be estimated. This estimate, normally expressed as a percentage by multiplying that fraction by 100, is known as SpO_2. Occasionally, this estimate may be referenced as $\%SpO_2$. ISO 80601-2-61:2017 [B9] contains additional information applicable to pulse oximetry.

5.2 Device types

Pulse oximeter systems with applicability in the personal health space may take on a variety of configurations and sensor compositions, and their configurations have suitability in different personal health application spaces. Pulse oximeter equipment comprises a pulse oximeter monitor, a pulse oximeter probe, and a probe cable extender, if provided. Some oximeters are all-in-one assemblies, where the optical probe, processing, and display components are in a single package. Other oximeters may consist of separate sensor and processing/display components. Still others may place the sensor and signal processing in one component, and send that information into an external component for display and storage. Pulse oximeters may place sensors in numerous locations on the body and use transconductance and reflectance of the light path. This standard assumes all measurements are equal and provides a single measure with no differentiation of location. In addition, other configurations may add storage capability into the system. This implies that different information models may be best suited for each particular device configuration.

5.3 General concepts

5.3.1 Noninvasive measurement

The scope of this specialization covers the intended use of pulse oximeter equipment, which includes, but is not limited to, the estimation of arterial oxygen haemoglobin saturation and pulse rate. This standard is not applicable to pulse oximeter equipment intended for use in laboratory research applications or to oximeters that require a blood sample (see ISO 80601-2-61:2017 [B9]). This standard does not cover measurement of oxygenation via blood extraction. This standard is not applicable to pulse oximeter equipment solely intended for foetal use.

The sensing mechanism may use either transmissive or reflective methods to measure blood oxygenation.

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In addition, blood oxygenation is usually determined as a ratio of the absorbance of two different wavelengths of light, although more wavelengths may be used.

5.3.2 Acquisition modes

5.3.2.1 General

Pulse oximeters are used to measure SpO_2 within a variety of use scenarios.

5.3.2.2 Spot-check

In a spot-check scenario, a user may simply want to take a single, fully processed reading for transmission to a manager. For example, the user would attach the oximeter, whereupon the agent would take an oximetry and pulse rate reading. The agent would then begin communication with a manager and send that single reading. The manager may acknowledge the transmission so the agent can subsequently disassociate and return to its prior state.

5.3.2.3 Continuous monitoring

A continuous monitoring situation involves the pulse oximeter device measuring the user's oxygenation for some period of time greater than that needed to acquire a single measurement. Multiple measurements may be taken to acquire trending information.

5.3.2.4 Stored-and-forwarded measurements

Stored-and-forwarded measurements could be considered as a specialized, continuous monitoring application where the pulse oximetry device is not always in communication with a manager, and the oximeter records data over several minutes or hours. In this case, oximetry data are stored in the device for the duration of the study session and subsequently transferred to the manager at an appropriate time. This measurement communication style is distinct from the situation where temporarily stored measurements are transferred when the communication link is restored.

5.4 Collected data

5.4.1 General

This subclause describes the nature of the data that have been collected based on the acquisition modes described in 5.3.2.

5.4.2 Percentage of arterial haemoglobin oxygen saturation

5.4.2.1 SpO_2

Every oximeter sends at least one expression of SpO_2. This is the primary measurement of a pulse oximeter. It is important to note that this measurement is determined through various signal processing techniques and can be expressed in different ways. Each method and expression has its applicability in particular application spaces (e.g., vital signs monitoring and diagnostic sleep studies). Often the reported SpO_2 has been processed with a variety of techniques in order to present the data for use in a number of ways.

In response to the various physiological phenomena and situations, SpO_2 measurements may be expressed in a variety of ways. Additional modalities for expressing SpO_2 are often used that are better suited to expose or suppress various physiological or environmental phenomena, as seen in 5.4.2.2. The following subclause outlines three expressions of SpO_2 that may be used by a device manufacturer to convey blood oxygenation level.

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It is also conceivable that pulse oximeter equipment may deliver a single SpO_2 that is determined by one of these modalities. Furthermore, several of these distinct expressions may be transmitted concurrently during a measurement session. The manager, upon receiving this collection of information, may choose to display another subset of these expressions. It is required for a pulse oximeter agent to support at least one instance of this measurement.

5.4.2.2 Alternative expressions of SpO_2

One case of SpO_2 measurement involves a user wearing a sensor during unintentional or moderate activity. The result of this activity may be intermittent loss of signal acquisition. The most common expression of SpO_2 may be too sensitive to these effects and could result in a fluctuating (and, therefore, misleading) reading. An SpO_2 measurement modality known as "slow-response" modality has a characteristic that "smooths out" a series of measurements in some fashion, perhaps by changing an averaging parameter or by employing a different algorithm. This modality is defined in this standard.

During a sleep study, an apnea event results in a rapid desaturation of blood oxygenation. This SpO_2 measurement can be expressed by a "fast-response" modality that uses a technique that more effectively captures such events. The technique may vary among device manufacturers, but a distinct expression able to capture these rapid changes is defined in this standard.

The terms *slow-response* and *fast-response* are relative to a particular implementation and are not intended to show a comparison across devices or vendors. Note that these are descriptive terms intentionally left unspecific to allow more flexible interpretations within a particular implementation.

A pulse oximeter will often send SpO_2 measurements periodically; e.g., once every second. In addition, pulse oximeters may begin outputting measurements as soon as it has a reasonable estimate of functional haemoglobin oxygenation. Subsequent measurements may, in some fashion, converge on the oximeter's best estimate. An additional modality, the "spot-check" modality, fulfills the desire to be able to perform and display a single SpO_2 measurement that is also its best estimate of functional haemoglobin oxygenation. In other words, a spot-check is not simply the first measurement, but the first *best* measurement. The specific manner in which this measurement is produced is specific to the pulse oximeter implementation. Once that measurement is transmitted, the measurement session is complete.

5.4.3 Pulse rate

The heart rate measured by a pulse oximeter is produced by a heartbeat, but also requires ejection of blood by the heart and generation of an arterial and tissue pressure wave that is detectable by photoplethysmographic means. Therefore, the pulse rate may be a less reliable measure of heart rate than that of directly measuring by electrocardiograph (ECG). As described in 5.4.2.1 and 5.4.2.2, the reported value or values may be determined in a variety of ways, and corresponding modalities of "slow-response," "fast-response," and "spot-check" are defined for pulse rate measurements. It is required for a pulse oximeter agent to support at least one instance of this feature.

5.4.4 Pulsatile occurrence

If a precisely timestamped occurrence of a pulse is transmitted to a manager, that information can be used in conjunction with other reported physiological events to derive another physiological measurement. Other application spaces may wish to indicate pulsatile occurrence with less precision for purposes of displaying, for instance, a flashing heart icon. It is not required for a pulse oximeter agent to support this feature.

5.4.5 Plethysmogram

There are applications where it is desired to visualize the sequence of samples related to the time-varying light absorption due to the effects of pulsatile blood flow. Often these samples are taken from a single wavelength light source, usually the wavelength less affected by changes in oxygen saturation. It is not required for a pulse oximeter agent to support this feature.

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5.4.6 Pulsatile quality and signal characterization

Pulse oximeter manufacturers have many ways to characterize the quality of the pulsatile wave. Unfortunately, no industry-wide standard currently exists to quantify the characteristics of the signal. However, signal amplitude metrics among the different vendors provide quantities that can be found to have a linear relationship. One notable characteristic is the amplitude of the signal modulation. Other methods to characterize the quality of the pulsatile wave may be employed. It is not required for a pulse oximeter to support this feature.

5.5 Derived data

5.5.1 Limit indications

Pulse oximeters may implement indicators based on monitoring physiological values as falling outside predefined limits. The commonly implemented indicators include reaching the thresholds of a high or low SpO_2, or reaching the thresholds of a high or low pulse rate.

5.5.2 Pulsatile status

Pulse oximeters may provide status indications of certain characteristics of a pulsatile wave or irregularities in the waveform.

5.5.3 Device and sensor status

Pulse oximeters may provide status indications pertaining to sensor malfunction or dislodgement as well as various signal anomalies.

5.6 Stored data

As stated in 5.3.2.4, a pulse oximeter may be used over one or more sessions of several hours without being in contact with a manager to send its data. After the session or sessions are completed, the pulse oximeter agent connects to a manager. The manager is able to select which of the agent's stored sessions to retrieve. The agent then transmits the manager's selection in one or several blocks of messages for processing by a manager or other processing apparatus. The manager is also able to choose a set of sessions for deletion.

5.7 Device configurations

Although agents typically have a static configuration, it is permissible and desirable for an agent to support multiple configurations, one of which would be active at any given time. Pulse oximeters may have a rich set of features that can be combined into a collection of different configurations, one of which can be selected by the manager during configuration.

Two general categories of configurations exist. The first category is known as the set of standard configurations. These are intended to describe a relatively limited feature set of a single device specialization, which have predefined configuration identity (ID) codes. Managers may be pre-loaded with these configurations, in which case the configuration process is eliminated and immediate operation is allowed. The second category involves the set of extended configurations. These configurations are more flexible in that they may include concepts particular to one or more device specializations or include other features as defined in this standard.

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6. Pulse oximeter DIM

6.1 Overview

This clause describes the DIM of the pulse oximeter.

6.2 Class extensions

In this standard, no class extensions are defined with respect to IEEE Std 11073-20601-2019.

6.3 Object instance diagram

The object instance diagram of the pulse oximeter DIM's numeric objects, defined for the purposes of this standard, is shown in Figure 1.

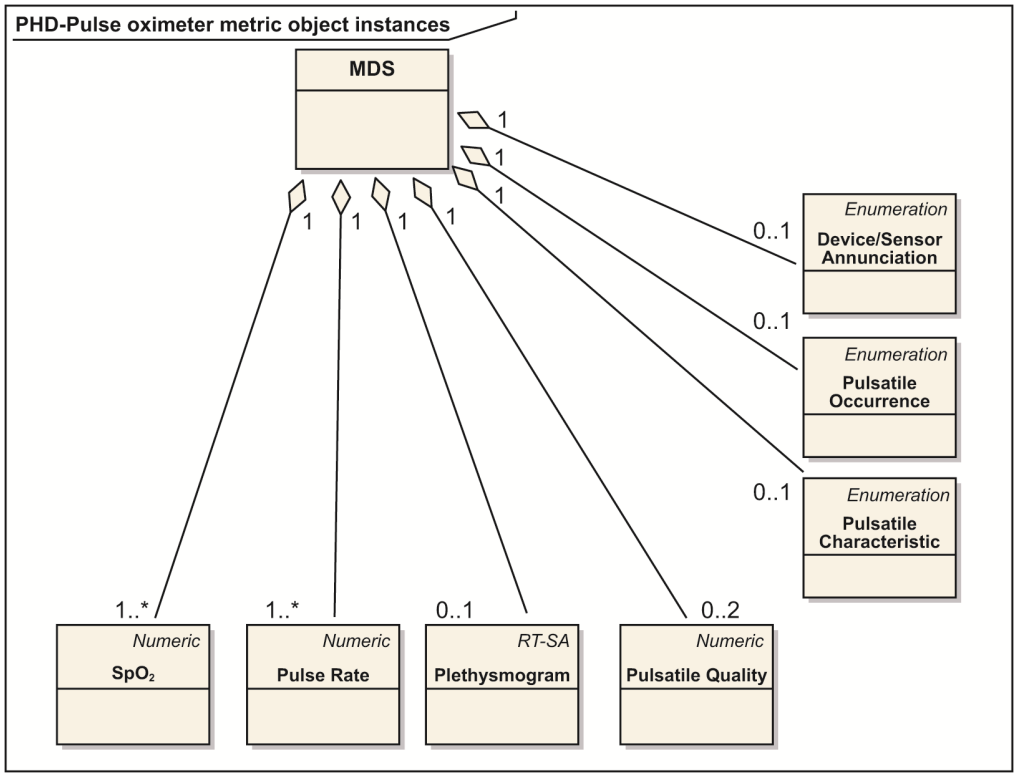

Figure 1—Pulse oximeter DIM for metric objects

The objects of the DIM, as shown in Figure 1, are described in the following subclauses: medical device system (MDS) object (see 6.5), the numeric objects (see 6.6), the real-time sample array (RT-SA) objects (see 6.7), and the enumeration objects (see 6.8). Figure 2 illustrates the PM-store objects (see 6.9), and the scanner objects (see 6.10) are shown in Figure 4. See 6.11 for rules for extending the pulse oximeter information model beyond elements as described in this standard. Each subclause that describes an object of the pulse oximeter 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, RT-SA, enumeration, scanner, or PM-store class.

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— 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. 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 11073-20601-2019.

— 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 are as follows:

— M – Attribute is Mandatory, C – Attribute is Conditional and depends on the condition stated in the Remark or Value column (if IEEE Std 11073-20601-2019 is referenced, then it contains the conditions), R – Attribute is Recommended, O – Attribute is Optional, NR – Attribute is Not Recommended and NA — Attribute is Not Allowed. 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. Optional attributes may be implemented on an agent. Not recommended attributes should not be implemented by the agent. If any attribute defined in the DIM of IEEE Std 11073-20601-2019 is not included in the definition of that object in this standard, it shall not be included in that object by an implementation. Vendor-specific attributes are allowed as described in 6.12.

An attribute is further qualified as static, dynamic, or observational. Static attributes shall not change value during the life of an association. Dynamic attributes have a value that may change during the life of an association. The dynamic attribute value should be sent at configuration time and shall be sent at or before the time when the value would be needed for interpreting a reported observation. Observational attributes have a value that may change during the life of an association. When a set of observational attribute values are received, these values are combined with the available context information (i.e., all related dynamic and static attribute values) to represent the observation at the observation time.

6.4 Types of configuration

6.4.1 General

As specified in IEEE Std 11073-20601-2019, two styles of configuration are available. The following subclauses briefly introduce standard and extended configurations.

6.4.2 Standard configuration

Standard configurations are defined in the ISO/IEEE 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 configuration time between the agent and manager. If the manager acknowledges that it recognizes and wants to operate using the configuration, then the agent can begin sending measurements immediately. If the manager does not understand 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 which objects, attributes, and values that it wants to use in a configuration and assigns a configuration identifier. When the agent associates with a manager, it negotiates an acceptable configuration. Typically,

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the manager does not know the agent's configuration on the first connection. Therefore, the manager responds that it needs the configuration and the agent transmits its configuration information by sending a configuration event report. If the manager already recognizes the configuration, either because it was preloaded via an installation program or the agent previously associated with the manager, then the manager responds that the configuration is known and no further configuration information needs to be sent.

If the device uses concepts and terms outside of this device specialization or terms defined in the private partition of IEEE 11073-10101, it is considered a proprietary device.

6.5 MDS object

6.5.1 MDS object attributes

Table 1 summarizes the attributes of the pulse oximeter MDS object. The nomenclature code to identify the MDS class is MDC_MOC_VMS_MDS_SIMP.

If a standard configuration is chosen, the timestamp type of MDS shall be consistent with the timestamp type of the metric objects in the chosen standard configuration.

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

See IEEE Std 11073-20601-2019 for descriptive explanations of the individual attributes as well as 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 pulse oximetry agent with extended configuration, this identifier is chosen in the range of extended-config-start to extended-config-end (see IEEE Std 11073-20601-2019) 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. Then the Configuring state (see 8.4) is skipped, and the agent and manager 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 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.

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