International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

H.811

(11/2015)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

E-health multimedia services and applications

Interoperability design guidelines for personal health systems: PAN/LAN/TAN interface

Recommendation ITU-T H.811

International Telecommunication Union

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Recommendation ITU-T H.811

Interoperability design guidelines for personal health systems: PAN/LAN/TAN interface

Summary

The Continua Design Guidelines (CDG) defines a framework of underlying standards and criteria required to ensure the interoperability of devices and data used for personal connected health. It also contains design guidelines (DGs) that further clarify the underlying standards or specifications by reducing options or by adding missing features to improve interoperability. This specification focuses on the following interfaces:

– TAN-IF – Interface between touch area network (TAN) health devices and application hosting devices (AHDs)

– PAN-IF – Interface between personal area network (PAN) health devices and AHDs

– LAN-IF – Interface between local area network (sensor-LAN) health devices and AHDs

Recommendation ITU-T H.811 is part of the "ITU-T H.810 interoperability design guidelines for personal health systems" subseries, as follows:

Mapping of CDG 2013, ITU-T H.810 and restructured ITU-T H.810-series

Part	Elements	Clauses in the 2013 CDG "Endorphin"	Clauses in ITU-T H.810 (2013)	Restructured ITU-T H.810-series (2015)
Part 0	System overview	Up to clause 3, plus Annex A and Appendix G	Up to clause 6, plus Annex A and Appendix V	ITU-T H.810 – System overview
Part 1	TAN/PAN/ LAN	Clauses 4 to 7, Appendices C, D, M	Clauses 7 to 10, Appendices I, II, XI	ITU-T H.811 – TAN-PAN-LAN interface
Part 2	WAN	Clause 8, Appendices H, I, J, K	Clause 11; Appendices VI, VII, VIII, IX	ITU-T H.812 – WAN interface ITU-T H.812.1 – Observation upload ITU-T H.812.2 – Questionnaires ITU-T H.812.3 – Capability exchange ITU-T H.812.4 – Authenticated persistent session
Part 3	HRN	Clause 9, Appendices E, F, L	Clause 12, Appendices III, IV, X	ITU-T H.813 – HRN interface

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.811	2015-11-29	16	11.1002/1000/12652

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Interoperability design guidelines for personal health systems: PAN/LAN/TAN interface

0 Introduction

The Continua Design Guidelines (CDG) defines a framework of underlying standards and criteria required to ensure the interoperability of devices and data used for personal connected health. It also contains design guidelines (DGs) that further clarify the underlying standards or specifications by reducing options or by adding missing features to improve interoperability. This specification focus on the following interfaces:

– TAN-IF – Interface between touch area network (TAN) health devices and application hosting devices (AHDs)

– PAN-IF – Interface between personal area network (PAN) health devices and AHDs

– LAN-IF – Interface between local area network (sensor-LAN) health devices and AHDs

This Recommendation is part of the "ITU-T H.810 interoperability design guidelines for personal health systems" subseries. See [ITU-T H.810] for more details.

0.1 Organization

This specification is organized in the following manner.

– **Clauses 0-5: Introduction and terminology** – These clauses provide useful background information to help understand the structure of the design specifications.

– **Clause 6: Common TAN/PAN/LAN interface design guidelines** – This clause provides an overview of the common elements of the TAN, PAN and LAN-IF architecture with design guidelines that apply to any TAN, PAN and LAN devices.

– **Clause 7: TAN interface design guidelines** – This clause is an overview of the TAN-IF architecture along with the design guidelines for TAN devices and application hosting devices implementing the TAN-IF.

– **Clause 8: PAN interface design guidelines** – This clause is an overview of the PAN-IF architecture along with design guidelines for wired and wireless PAN devices and application hosting devices implementing the PAN-IF.

– **Clause 9: Sensor-LAN interface design guidelines** – This clause is an overview of the LAN-IF architecture with design guidelines for sensor-LAN devices and application hosting devices implementing the LAN-IF.

0.2 Guideline releases and versioning

See clause 0.2 of [ITU-T H.810] for release and versioning information.

0.3 What's new?

To see what is new in this release of the design guidelines, refer to clause 0.3 of [ITU-T H.810].

1 Scope

This Recommendation focuses on the following interfaces:

– **TAN-IF** – Interface between touch area network health devices and application hosting devices (using near-field communications (NFC) communication)

– **PAN-IF** – Interface between personal area network health devices and application hosting devices (using wired (USB), standard wireless (Bluetooth) or LP wireless PAN (Bluetooth LE) communication)

– **Sensor-LAN-IF** – Interface between local area network health devices and application hosting devices (using sensor-LAN (ZigBee) communication)

These interfaces are defined in the Continua architecture as described in clause 6 of [ITU-T H.810], as shown in Figure 1-1 below.

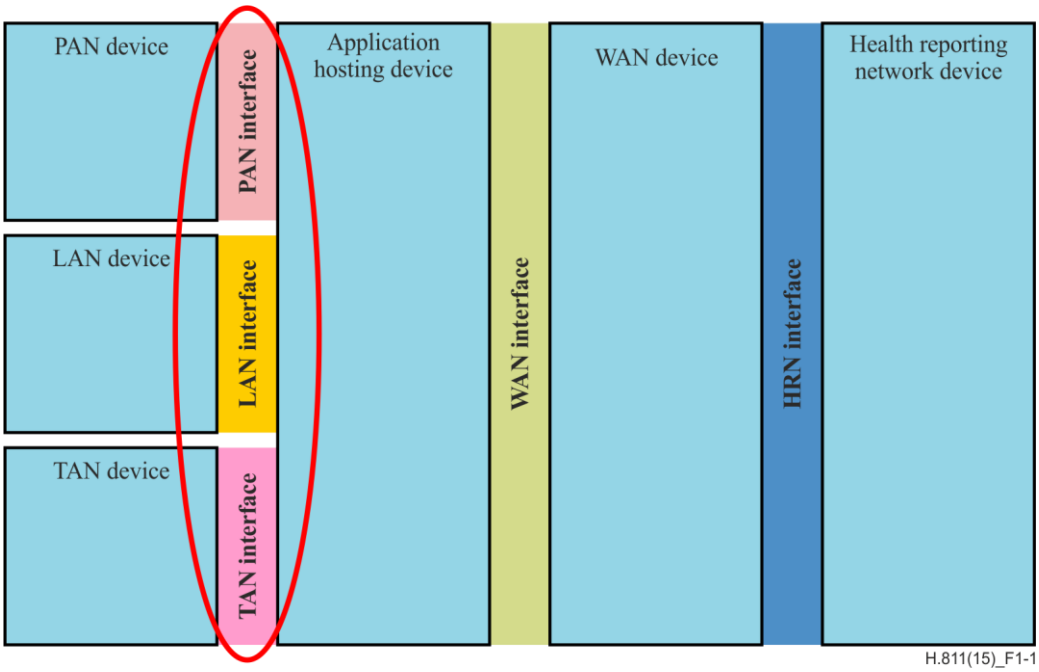

Figure 1-1 – TAN/PAN/LAN interfaces in the Continua architecture

For the following transports:

– Zigbee (sensor-LAN),

– NFC (TAN),

– USB (wired PAN) and

– Bluetooth (standard wireless PAN)

These guidelines are based on [ISO/IEEE 11073-104xx] and cover the following device specializations:

– pulse oximeter

– blood pressure monitor

– thermometer

– weighing-scales

– glucose meter

– cardiovascular fitness

– step counter

– strength fitness

– activity hub

– adherence monitor

– peak flow meter
– fall sensor
– motion sensor
– enuresis sensor
– contact closure sensor
– switch sensor
– dosage sensor
– water sensor
– smoke sensor
– property exit sensor
– temperature sensor
– usage sensor
– PERS sensor
– CO sensor
– gas sensor
– heart-rate sensor
– Basic 1-3 lead ECG sensor
– body composition analyzer
– INR meter
– Sleep apnea breathing therapy equipment (SABTE).

The PAN-IF interface guidelines for LP wireless PAN (Bluetooth LE) are defined for the following device specializations:

– thermometer
– heart-rate sensor
– blood pressure monitor
– glucose meter
– weight scale.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.810] Recommentation ITU-T H.810 (2015), *Interoperability design guidelines for personal health systems*.

All other referenced documents can be found in clause 2 of [ITU-T H.810].

3 Definitions

This Recommendation uses terms defined in [ITU-T H.810].

4 Abbreviations and acronyms

This Recommendation uses abbreviations and acronyms defined in [ITU-T H.810].

5 Conventions

This Recommendation follows the conventions defined in [ITU-T H.810].

6 Common TAN/PAN/LAN interface design guidelines

NOTE – This clause (except for clause 6.2.2.6) does not apply to "LP wireless PAN" devices.

6.1 Architecture

6.1.1 Introduction

This clause lists the design guidelines for the data/messaging layer that are common to the touch, personal and local area network interfaces. This clause does not apply to the low-power wireless subclass of the PAN interface (see Figure 6-1). See clauses 7, 8 and 9 for a detailed description of the TAN, PAN and LAN interfaces and their interface subclasses.

6.1.2 Overview

The TAN, PAN and LAN interfaces are composed of different layers. Appropriate standards are selected for the individual layers and establish interoperability in the personal health ecosystem. Figure 6-1 gives an overview of the protocol stack for the different TAN, PAN and LAN interfaces.

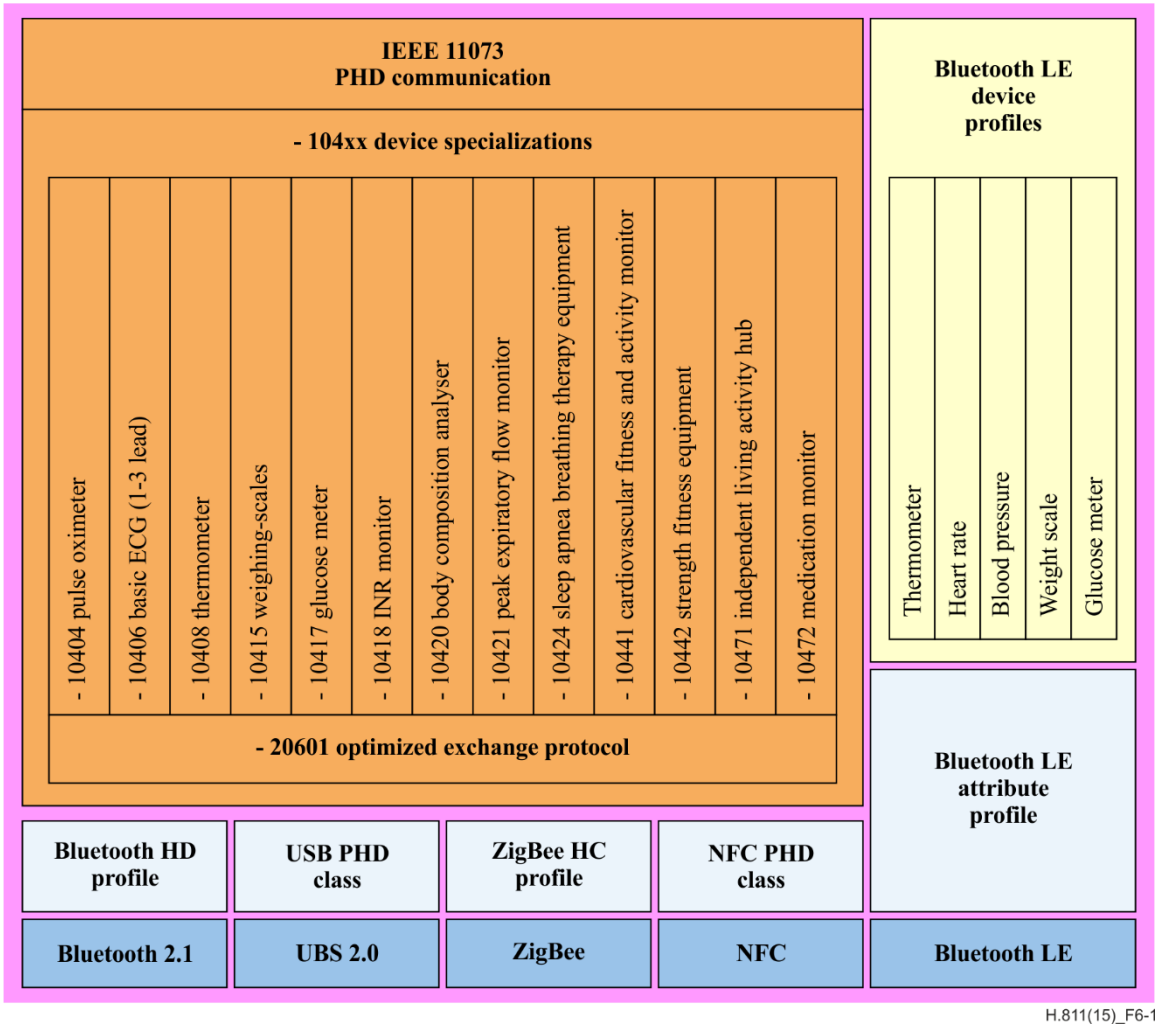

Figure 6-1 – TAN/PAN/LAN interface stack diagram

6.1.3 Common data/messaging layer and selected standards

Different transport technologies and profiles for each of the different TAN, PAN and LAN interfaces have been selected. See clauses 7, 8 and 9 for the TAN, PAN and LAN specific solutions, respectively. However, for the data/messaging there is considerable commonality. A common solution has been selected to serve as the data/messaging layer for the following interfaces: TAN, PAN wired, PAN standard wireless and sensor LAN.

For these interfaces, the communication protocol described in [ISO/IEEE 11073-20601] has been selected for the optimized exchange of information. This internationally harmonized standard provides an interoperable messaging protocol and has definitions and structures in place to convert from an abstract data format into a transmission format. Thus, a consistent data exchange layer is enabled across the above-mentioned interfaces.

The IEEE 11073-20601 protocol (see [ISO/IEEE 11073-20601]) acts as a bridge between device-specific information defined in individual so-called device specializations and the underlying transports to provide a framework for optimized exchange of interoperable data units. The selected device specialization standards specify the data model and nomenclature terms to be used for individual devices. The device specializations are illustrated in Figure 6-1.

6.2 Common data/messaging layer guidelines

6.2.1 Applicable interfaces

This clause contains a general design guideline that lists the CDG network interfaces for which the common data/messaging layer guidelines in clauses 6.2.2 to 6.2.3 are applicable.

Table 6-1 – Applicable interfaces

Name	Description	Comments
11073-20601_Applicable_Interfaces	Continua TAN, standard wireless PAN, wired PAN and sensor-LAN service and client components **shall** implement the guidelines in Table 6-2.	The referenced tables contain guidelines on the data/messaging layer, which are consistent for the listed interfaces. The low-power wireless PAN interface uses a different data/messaging layer (see clause 8.1.3).

6.2.2 Exchange protocol

6.2.2.1 TAN/PAN/LAN component - general

This clause contains a general design guideline that points to the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] specifications. All subsequent requirements in clause 6.2.2 refer to this specification.

Table 6-2 – TAN/PAN/LAN wired/wireless general requirements

Name	Description	Comments
11073-20601_Reqt	Continua TAN/PAN/LAN service and client components **shall** implement the [ISO/IEEE 11073-20601] specification along with all corrections and clarifications included in [IEEE 11073-20601A] subject to the requirements listed below.	[IEEE 11073-20601A] is an amendment of [ISO/IEEE 11073-20601] containing corrections and a technical extension referred to as base offset time. The additional requirements listed below are provided to allow Continua TAN/PAN/LAN service and client components to take advantage of the corrections in [IEEE 11073-20601A] without utilizing the technical extension which would require setting the protocol version field to 2.
11073-20601A_ Restriction	Any Continua TAN/PAN/LAN service components found in Table 6-3 may include the base offset time in objects related to those components. Continua TAN/PAN/LAN service components not listed in Table 6-3 **shall not** include the base offset time in any CDG configurations.	[ISO/IEEE 11073-20601] did not support base offset time so all device specializations prior to CDG V2012 do not use the attribute for backward compatibility and interoperability. [IEEE 11073-20601A] added Base-Offset-Time and device specializations created or updated after that point are allowed to include the attribute in device configurations.
11073-20601A_	Continua TAN/PAN/LAN service	Components introduced in (or after)

Name	Description	Comments
Service_Proto_Version	components not found in Table 6-3 **shall** set only the version 1 bit in the protocol version field of the PHDAssociationInformation structure in the AARQ	CDG 2012 are required to indicate supported protocol versions as per the standards. Since early Continua TAN/PAN/LAN service components require implementing [ISO/IEEE 11073-20601] with only the corrections and clarifications from [IEEE 11073-20601A], any CDG connection **shall** follow protocol version 1 (with corrections). If a vendor wishes to implement a device outside the guidelines of this document or IEEE standards, then it is possible to offer other protocol version bit combinations, but if compliance with these guidelines or IEEE standards is desired, the protocol version needs to have only the version 1 bit set. Again, this restriction might be adjusted in future releases of the CDG
11073-20601A_Client_ Proto_Version	Continua TAN/PAN/LAN client components that support service components listed in Table 6-3 **shall** support associations with Continua TAN/PAN/LAN service components where at least version 2 bit of the protocol-version is set in the PHDAssociationInformation structure in the AARQ. In this case, the Continua TAN/PAN/LAN client components **shall** respond with the version 2 bit of the protocol version set in the PHDAssociationInformation structure in the AARE and **shall** follow the [ISO/IEEE 11073-20601] along with all requirements from [ISO/IEEE 11073-20601A] . Continua TAN/PAN/LAN client components that support service components not listed in Table 6-3 **shall** support associations with Continua TAN/PAN/LAN service components where only the version 1 bit of the protocol-version is set in the PHDAssociationInformation structure in the AARQ In this case, the Continua TAN/PAN/LAN client components **shall** respond with the version 1 bit of the protocol version set in the PHDAssociationInformation structure in the AARE and **shall** follow the [ISO/IEEE 11073-20601] along with all corrections and clarifications included in	Responding to an AARQ with the version 1 bit of the protocol version set indicates that the base offset time is not used. Similar to the Continua TAN/PAN/LAN service components, the Continua TAN/PAN/LAN client component **shall** nevertheless follow the remaining specifications of [IEEE 11073-20601A] even though the specification requires protocol version 2

Name	Description	Comments
	[ISO/IEEE 11073-20601A].	
11073-20601A_Client_ Other_Proto_Version	Continua TAN/PAN/LAN client components **may** accept other bit settings in the protocol version than those described in 11073-20601A_Client_Proto_Version, but would be operating in a non-Continua certified association	This guideline allows Continua TAN/PAN/LAN client components to implement new technical extensions NOTE – This is outside the current Continua Certification Program.

Table 6-3 – TAN/PAN/LAN components that must or may use Base-Offset-Time

TAN/PAN/LAN component
Basic 1-3 lead ECG
Heart-rate sensor
INR meter
Sleep apnea breathing therapy equipment

6.2.2.2 TAN/PAN/LAN component – Communication capabilities

This clause contains guidelines for general communication capabilities of sensor components.

Table 6-4 – Communication capabilities – General

Name	Description	Comments
11073-20601_Bidirectional	Continua TAN/PAN/LAN service and client components **shall** support bidirectional transmission (i.e., sending and receiving, of [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] defined application layer messages)	
11073_Manager_Initiated_ Communications	Continua TAN/PAN/LAN service components **shall not** support the MDS-Data-Request Action for the transfer of CDG data. This prohibits the service component from using manager initiated event reporting as a mechanism of measurement transfer	This guideline prohibits the use of manager-initiated event transmission. Use of this mechanism causes increased implementation and test effort that can be avoided through the use of a scanner. CDG data is defined as data from any object normatively defined in a device specialization
11073_DataReqMode_Alignment	Continua TAN/PAN/LAN service components **shall** ensure that the fields in the *Metric-Spec-Small* attribute of metric objects are aligned with what was declared in the DataReqModeCapab structure during Association	For example, if the *mss-acc-agent-initiated* bit is set in *Metric-Spec-Small***,** then *data-req-init-agent-count* in *DataReqModeCapab* needs to be set to 1

Name	Description	Comments
11073-20601_FIFO_Store_and_ Forward	Continua TAN/PAN/LAN service components that are designed to store and forward temporary measurements **shall** transmit data in a "First In First Out" sequence	This guideline applies to both temporarily stored measurement events and to measurement data stored in a PM-store

Table 6-5 – Communication capabilities – Event reporting

Name	Description	Comments
11073-20601_Config_Changes_ Service	Continua TAN/PAN/LAN service components **shall** report configuration changes to future measurements only	In the context of these guidelines, configuration changes are changes to attributes that provide context for the measurement. The interpretation of the measurement depends on the values of these contextual attributes, or configuration values. An example of configuration change would be changing the unit code of the reported measurement (e.g., from pounds to kilograms)
11073-20601_Config_Changes_ Client	Continua TAN/PAN/LAN client components that receive a report of a configuration change **shall** apply the change to future measurements only	A configuration update does not apply retroactively to data already received by the client component

Table 6-6 – Communication capabilities – Scanner requirements

Name	Description	Comments
11073-20601_Scanner_Sole_ Reporter	Continua TAN/PAN/LAN service components **shall** send changes to any particular attribute via a single scanner object (if enabled) or the MDS object, but never more than one object (of either the MDS or scanner type)	This guideline and the next one assigns responsibility to objects in the system for notifying the manager of changes and updates The scanner will report changes for attributes in the Scan-Handle-Attr-Val-Map
11073-20601_Unique_Scanner	Continua TAN/PAN/LAN client components **shall not** simultaneously turn on multiple scanners that embed the same measurement object provided by a single service component	

Table 6-7 – Communication capabilities – Time setting

Name	Description	Comments
11073-20601_Set-Time	Continua TAN/PAN/LAN client components that receive a report containing the *Mds-Time-Info* attribute, with the mds-time-mgr-set-time bit set to 1, **shall** invoke the Set-Time action command within a TO_{config} time period in order to set the absolute time on the Continua TAN/PAN/LAN service component that has sent the report.	This guideline ensures the same client behaviour as for the case when the mds-time-mgr-set-time bit is received via a GET MDS response message (see [ISO/IEEE 11073-20601]).
11073-20601_ DateAndTimeUpdate_ PMSegmentTransfer_Server	Continua TAN/PAN/LAN service components that are in the middle of a PM-segment transfer **shall not** update the PM-segment object *Date-and-Time–Adjustment* attribute regardless of any time changes that occur while the segment continues to be transferred"	This guideline ensures that the PM-segment includes measurements from the same, unbroken timeline. NOTE: This is somewhat less likely to occur at the TAN/PAN level since there is not programmatic control from another channel, but it could happen that the UI is still turned on during the transfer so this will cover this case
11073-20601_ DateAndTimeUpdate_ PMSegmentTransfer_Client	Continua TAN/PAN/LAN client components that receive a *Date-and-Time* update from a Continua TAN/PAN/LAN service component in the middle of a PM-segment transfer **shall** use the service component's time reference at the time the first segment entry is transmitted as the reference for the full segment regardless of any time changes that occur while the segment continues to be transferred	This guideline accounts for the fact that the service component's PM-segment contains measurements from the same, unbroken timeline.

Table 6-7 – Communication capabilities – Time setting

Name	Description	Comments
11073-20601_ DateAndTimeUpdate_ PMSegment_LowResource_ Service	Continua TAN/PAN/LAN service components with limited memory which implement PM-store and do not implement Base-Offset-Time **may** maintain measurements across date or time adjustments within a single PM-segment. In this case, the user-facing time of the TAN/PAN/LAN service component at the time of the measurement **shall** be communicated as the measurement timestamp. See NOTE 1 below.	In this case, such service components will not be capable of communicating date or time adjustments and cannot fulfil the requirement within IEEE 11073-20601-2008/2010 Time Coordination section which states: "If an agent collects PM-store measurements and the Date-and-Time attribute is adjusted, the agent **shall** ensure that each PM-segment includes only measurements from the same, unbroken timeline". This requirement is a fix that's only valid for the current release of this document. In the next version it will be removed and all service components must properly handle time and date changes.

NOTE – This requirement resolves the issue with some configurations of current IEEE device specializations that do use a PM Store with multiple segments and that do not include support for Base Offset time. Support of such a configuration would require an implementation to create new segments on each time or date change and to report on this in a single APDU as response to a GetSegmentInfo request from the manager. The memory needed to store the additional segments and the size of the response APDU both grow significantly with each time or date change. This is seen as an unreasonable requirement on such implementations as they would run out of memory too quickly.

This affects configurations of the following device specializations that include a PM Store:

– Glucose meter [IEEE-11073-10417]

– Medication monitor [ISO/IEEE-11073-10472]

– Pulse oximeter [ISO/IEEE-11073-10404]

6.2.2.3 TAN/PAN/LAN component – Device information

This clause contains design guidelines that describe how to map CDG required device information to [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] defined attributes.

Table 6-8 – Device information

Name	Description	Comments
11073-20601_Manufacturer	Continua TAN/PAN/LAN service components **shall** set the *manufacturer* field of the *System-Model* MDS object attribute to the device original manufacturer's name. If this capability is available, the *manufacturer* field **may** be overwritten to the customer-facing company's name by the customer-facing company	
11073-20601_Model	Continua TAN/PAN/LAN service components **shall** set the *model-number* field of the *System-Model* MDS object attribute to the device original manufacturer's model number. The *model-number* field **may** be overwritten to the customer-facing company's model by the customer-facing company	
11073-20601_OUI	The OUI part of the MDS *System-Id* attribute in a Continua TAN/PAN/LAN service component **shall** remain unchanged from the value set by the original manufacturer	This is a unique identifier, which is obtained by the IEEE registration authority and which is associated with a company. This attribute maps to the organizationally unique identifier (OUI) part (first 24 bits) of the EUI-64 attribute
11073-20601_DID	The 40 bit manufacturer defined identifier in the *System-Id* of the MDS object attribute of a Continua TAN/PAN/LAN service component **shall** remain unchanged from the value set by the original manufacturer	In combination with the System-Id attribute OUI part, this is a unique identifier associated with the device. It is required in order to facilitate data quality analysis. This attribute maps to the company-defined part (last 40 bits) of the EUI-64 attribute
11073-20601_DID_Bijective	There **shall not** be multiple different *System-Id* values that identify the same TAN/PAN/LAN service component	This guideline ensures that the System-Id value is an objective identifier of a device, i.e., in addition to every physical device having a globally unique identifier, each assigned identifier corresponds to a different physical device. As a consequence, a device cannot use multiple different System-Id values

Table 6-8 – Device information

Name	Description	Comments
11073-20601_Serial_Number	Continua TAN/PAN/LAN service components **shall** include a component to the *Production-Specification* MDS-object attribute with the *spec-type* field set to *serial-number* and the *prod-spec* field set to the serial number of the device	
11073-20601_FW_Revision	Continua TAN/PAN/LAN service components that provide a firmware identifier **shall** include a component to the *Production-Specification* MDS-object attribute with the *spec-type* field set to *fw-revision* and the *prod-spec* field set to the firmware identifier of the device	The firmware identifier is the version of the firmware deployed on the TAN/PAN/LAN device. The firmware release deployed on a TAN/PAN/LAN device is uniquely identified by the firmware identifier

6.2.2.4 TAN/PAN/LAN component – Unsupported service component

The CDG provides the data and messaging information to enable interoperability between personal healthcare devices. However, there may be regulatory reasons that require some client components to be exclusive about the data they accept. Not all client components will need to be this exclusive. However, the CDG provides the data and the messages for client components that are exclusive to providing the user with a positive experience.

This clause contains design guidelines that define the expected behaviour when a service-side certified device is not available.

Table 6-9 – Unsupported service component

Name	Description	Comments
11073_Unsupported_Device_ Rejection	If a Continua service component does not support at least one Continua certified device class supported by the client component and the client component only accepts Continua certified devices, then the Continua TAN/PAN/LAN client components **shall** request to release the association with a Continua service component using the result field no-more-configurations	If the service component supports any Continua certified device classes, it supports the corresponding Reg-Cert-Data-List MDS object attribute where the certified device class will be listed. The client will need to query the MDS to retrieve this attribute. It is recommended that this query is done before the service component enters the operating state to avoid the unwanted transfer of data

Table 6-9 – Unsupported service component

Name	Description	Comments
11073_Unsupported_Device_ Utilize_11073	Continua TAN/PAN/LAN service and client components that need to selectively accept or reject service or client component data for a specialization they support in order to comply with regulatory requirements **shall** utilize only [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] data structures to make the decision to reject or accept data from a client or service component	It will be necessary to simulate "accepted" devices to fully test service and client components. Device manufacturers will need to document and provide 11073 data structures for "accepted" devices for use during interoperability testing. Note that this design guideline is not a testable design guideline. It is simply used to facilitate testing
11073_Unsupported_Device_ UserNotification_Client	Continua TAN/PAN/LAN client components **shall** notify the user of failure of the connection and corresponding reason, if it has released or rejected the association according to requirement 11073_Unsupported_Device_Rejection	This requirement is related to the user interface of the client component. Notification can be done in various ways (e.g., by displaying a text message or by means of a blinking LED)
11073_Unsupported_Device_ UserNotification_Service	Continua TAN/PAN/LAN service components **should** notify the user of failure of the connection and corresponding reason, if the client has released or rejected the association according to requirement 11073_Unsupported_Device_Rejection	This requirement is related to the user interface of the service/client component. Notification can be done in various ways (e.g., by displaying a text message or by means of a blinking LED)
11073_Unsupported_Device_ UserNotification_String_Client	Continua TAN/PAN/LAN client components with appropriate UI capabilities **should** use the following text string to notify the user of the connection failure in accordance with guideline 11073_Unsupported_Device_UserNotification_Client: "Thank you for choosing Continua certified personal health products. The device you are connecting either has not been Continua certified or the data is not intended for use in this solution. Please see your user manual for more details."	This string **may** be localized by the manufacturer based on the product and target geography

Table 6-9 – Unsupported service component

Name	Description	Comments
11073_Unsupported_Device_ UserNotification_String_Service	Continua TAN/PAN/LAN service components with appropriate UI capabilities **should** use the following text string to notify the user of any failure of the connection according to guideline 11073_Unsupported_Device_UserNotification_Service: "Thank you for choosing Continua certified personal health products. The device you are connecting either has not been Continua certified or the data is not intended for use in this solution. Please see your user manual for more details."	This string **may** be localized by the manufacturer based on the product and target geography
11073_Unsupported_Device_ NotificationDocu	Continua TAN/PAN/LAN service and client components **shall** be shipped with a documentation of the notification mechanism with respect to requirements 11073_Unsupported_Device_UserNotification_Service and 11073_Unspported_Device_UserNotification_Client	

6.2.2.5 TAN/PAN/LAN component – Quality of service

To send ISO/IEEE 11073-20601 and IEEE 11073-20601A data and messages on logical channels based on QoS characteristics, the following requirements are defined.

Table 6-10 – TAN/PAN/LAN QoS implementation

Name	Description	Comments
DataMessaging_BiDir_QoS	Continua TAN/PAN/LAN service and client components shall send all messages on the corresponding Continua QoS bins listed in Table 6-11	

Table 6-11 – Bidirectional transport layer: Message type/QoS bin mapping

Msg Grp	Message type description	APDU Type	QoS bin type
0	Association Request	Aarq	best.medium
	Association Response	Aare	best.medium
	Association Release Request	Rlrq	best.medium
	Association Release Response	Rlre	best.medium
	Association Abort	Abrt	best.medium
1	DATA(Invoke-UnconfirmedEventReport (Unbuf-Scan-Report-*), ScanReportInfo*)	Prst	best.medium or good.medium
	DATA(Invoke-UnconfirmedEventReport(Buf-Scan-Report-*), ScanReportInfo*)	Prst	best.medium or good.medium
	DATA(Invoke-UnconfirmedEventReport (MDS-Dynamic-Data-Update-*), ScanReportInfo*)	Prst	best.medium or good.medium
2	DATA(Invoke-ConfirmedEventReport(MDS-Configuration-Event), ConfigReport)	Prst	best.medium
	DATA(Response-ConfirmedEventReport(MDS-Configuration-Event), ConfigReportRsp)	Prst	best.medium
	DATA(Invoke-ConfirmedEventReport(Segment-Data-Event), SegmentDataEvent)	Prst	best.medium
	DATA(Response-ConfirmedEventReport(Segment-Data-Event), SegmentDataResult)	Prst	best.medium
	DATA(Invoke-ConfirmedEventReport(Unbuf-Scan-Report-*), ScanReportInfo*)	Prst	best.medium
	DATA(Response-ConfirmedEventReport(Unbuf-Scan-Report-*))	Prst	best.medium
	DATA(Invoke-ConfirmedEventReport(Buf-Scan-Report-*), ScanReportInfo*)	Prst	best.medium
	DATA(Response-ConfirmedEventReport(Buf-Scan-Report-*))	Prst	best.medium
	DATA(Invoke-ConfirmedEventReport (MDS-Dynamic-Data-Update-*), ScanReportInfo*)	Prst	best.medium
	DATA(Response-ConfirmedEventReport (MDS-Dynamic-Data-Update-*))	Prst	best.medium
3	DATA(Invoke-UnconfirmedAction()): ***<none defined in [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] >***	N/A	N/A
4	DATA(Invoke-ConfirmedAction(MDS-Data-Request), DataRequest)	Prst	best.medium
	DATA(Response-ConfirmedAction(MDS-Data-Request), DataResponse)	Prst	best.medium
	DATA(Invoke-ConfirmedAction(Set-Time), SetTimeInvoke)	Prst	best.medium
	DATA(Response-ConfirmedAction(Set-Time))	Prst	best.medium

Msg Grp	Message type description	APDU Type	QoS bin type
	DATA(Invoke-ConfirmedAction(Get-Segment-Info), SegmSelection)	Prst	best.medium
	DATA(Response-ConfirmedAction(Get-Segment-Info), SegmentInfoList)	Prst	best.medium
	DATA(Invoke-ConfirmedAction(Trig-Segment-Data-Xfer), TrigSegmDataXferReq)	Prst	best.medium
	DATA(Response-ConfirmedAction(Trig-Segment-Data-Xfer), TrigSegmDataXferRsp)	Prst	best.medium
	DATA(Invoke-ConfirmedAction(Clear-Segments), SegmSelection)	Prst	best.medium
	DATA(Response-ConfirmedAction(Clear-Segments))	Prst	best.medium
	DATA(Invoke-ConfirmedAction(MDS-Data-Request), DataRequest)	Prst	best.medium
	DATA(Response-ConfirmedAction(MDS-Data-Request), DataResponse)	Prst	best.medium
	DATA(Invoke-ConfirmedAction(MDS-Data-Request), DataRequest)	Prst	best.medium
	DATA(Response-ConfirmedAction(MDS-Data-Request))	Prst	best.medium
5	DATA(Invoke-UnconfirmedSet()) {scanner OperationalState}	Prst	best.medium
6	DATA(Invoke-ConfirmedSet()){scanner OperationalState}	Prst	best.medium
	DATA(Response-ConfirmSet()){scanner OperationalState}	Prst	best.medium
7	DATA(Invoke-ConfirmedGet()) {MDS attributes}	Prst	best.medium
	DATA(Response-ConfirmGet()){MDS attributes}	Prst	best.medium
	DATA(Invoke-ConfirmedGet()) {PM-store attributes}	Prst	best.medium
	DATA(Response-ConfirmGet()){PM-store attributes}	Prst	best.medium
8	DATA(Error(), ErrorResult)	Prst	best.medium
	DATA(Reject()), RejectResult)	Prst	best.medium

6.2.2.6 TAN/PAN/LAN component – Regulatory settings

This clause contains design guidelines that deal with the Continua requirements for regulatory issues using the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] capabilities.

For this purpose, the following abstract syntax notation one (ASN.1) definitions are introduced and referenced in Table 6-12.

NOTE - This clause DOES apply to "LP wireless PAN" devices after applying the transcoding defined in [Bluetooth PHDT]

```
ContinuaStructType ::= INT-U8 {
     continua-version-struct(1),   -- auth-body-data is a ContinuaBodyStruct
     continua-reg-struct(2)          -- auth-body-data is a ContinuaRegStruct

}

ContinuaBodyStruct ::= SEQUENCE {
        major-IG-version      INT-U8,
        minor-IG-version      INT-U8,
        certified-devices     CertifiedDeviceClassList
}

CertifiedDeviceClassList ::= SEQUENCE OF CertifiedDeviceClassEntry

-- See guideline  11073-20601_DeviceClassEntry for the algorithm to compute the
value
CertifiedDeviceClassEntry ::= INT-U16

ContinuaRegStruct ::= SEQUENCE {
        regulation-bit-field     RegulationBitFieldType
}


RegulationBitFieldType  ::= BITS-16 {
     unregulated-device (0)  -- This bit shall be set if the device is not
regulated }
```

Figure 6-2 – ASN.1 definition of Continua certification structures

6.2.2.6.1 Regulatory / certification information

Table 6-12 – Regulatory / certification information

Name	Description	Comments
11073-20601_ Certification	Continua TAN/PAN/LAN service components **shall** support the *Reg-Cert-Data-List* MDS object attribute containing a *RegCertData* element with the *auth-body* field set to *auth-body-continua* and the *auth-body-struc-type* field set to *continua-version-struct* from a ContinuaStructType as defined above. The field *auth-body-data* **shall** be filled in as a *ContinuaBodyStruct* as defined above	Continua certification information - This is used to indicate whether a device is Continua certified and (if so) which version of the guidelines it is certified to
11073-20601_ DeviceClassList	Continua TAN/PAN/LAN service components **shall** list all implemented and only the implemented Certified Device Classes in the certified-devices attribute of the ContinuaBodyStruct structure	

Table 6-12 – Regulatory / certification information

Name	Description	Comments
11073-20601_ DeviceClassEntry	Continua TAN/PAN/LAN service components **shall** assign the following CertifiedDeviceClassEntry to an implemented Certified Device Class: MDC_DEV_*_SPEC_PROFILE_* - 4096 + TCode x 8192, where MDC_DEV_*_SPEC_PROFILE_* denotes the IEEE 11073 PHD nomenclature code for the corresponding device (sub-) specialization and TCode denotes the corresponding transport standard, with TCode = {1 for Wired PAN, 2 for wireless PAN, 3 for sensor-LAN, 4 for LP wireless PAN and 5 for TAN}. For backward compatibility with CDG version 1 which did not define TCodes, wired PAN and wireless PAN service components **should** additionally include the supported MDC_DEV_*_SPEC_PROFILE_* codes along with a TCode of 0 to interoperate with version 1 client components	Example 1: For a wireless PAN step counter, the assigned CertifiedDeviceClassEntry computes as 0x4068 (16488 decimal), where it has been substituted MDC_DEV_*_SPEC_PROFILE_* = MDC_DEV_SUB_SPEC_PROFILE_STEP_COUNTER = 4200 and TCode = 2. This gives, 4200 - 4096 + 2 x 8192 = 16488 (0x4068) Example 2: For a sensor-LAN smoke sensor, the assigned CertifiedDeviceClassEntry computes as 0x6077 (24,695 decimal), where it has been substituted MDC_DEV_*_SPEC_PROFILE_* = MDC_DEV_SUB_SPEC_PROFILE_SMOKE_SENSOR = 4215 and TCode = 3. This gives, 4215 – 4096 + 3 x 8192 = 24,695 (0x6077)
11073-20601_ DeviceSpecList	Continua TAN/PAN/LAN service components **shall** list MDC_DEV_SPEC_PROFILE_* value(s) corresponding to each supported Continua certified device class in the System-Type-Spec-List attribute of the MDS object. The attribute **may** contain additional MDC_DEV_SPEC_PROFILE_* value(s) corresponding to supported IEEE specializations that are not Continua certified	
11073-20601_ Regulation	Continua TAN/PAN/LAN service components **shall** support the *Reg-Cert-Data-List* MDS object attribute containing a *RegCertData* element with the *auth-body* field set to *auth-body-continua* and the *auth-body-struc-type* field set to *continua-reg-struct* from a ContinuaStructType as defined below. The field *auth-body-data* **shall** be filled in as a *ContinuaRegStruct* as defined below	Regulation Information - This is used to provide a coarse regulatory indication (e.g., "Regulated or Not Regulated")

6.2.2.6.2 Conformance

This clause contains guidelines for the conformance of service and client components to [ISO/IEEE 11073-20601], [IEEE 11073-20601A] and [ISO/IEEE 11073-104xx] specifications and capabilities.

Table 6-13 – Manager conformance

Name	Description	Comments
11073-20601_Manager_ Conformance	Continua TAN/PAN/LAN client components **shall** appropriately utilize the mandatory measurement objects from compliant device specializations	In the context of these requirements, the term "appropriately utilize" implies that the objects get utilized in accordance with the function of the device. That is, a mandatory measurement object can be displayed and/or forwarded and/or used as input for an assessment algorithm, etc.
11073-20601_Utilization_ Documentation	Continua TAN/PAN/LAN client components **shall** provide to the test and certification organization documentation on the appropriate utilization of the individual mandatory measurement objects	

6.2.2.6.3 Nomenclature codes

Table 6-14 – Nomenclature codes

Name	Description	Comments
11073-20601_Continua_ Nomenclature_Codes	Continua TAN/PAN/LAN service and client components that use private nomenclature codes **shall** allocate them from the range 0xF000 through 0xFBFF	The range from 0xFC00 through 0xFFFF is reserved for future use by the CDG

6.2.2.7 TAN/PAN/LAN component – User identification

Table 6-15 – User identification

Name	Description	Comments
11073-20601_PID_ScanReport	Continua TAN/PAN/LAN service components designed to store and utilize data from multiple users simultaneously and that use agent-initiated measurement data transmission **shall** identify users and set the person-id field in the corresponding ScanReportPer* structure	Identification means distinguishing between users of the measurement device
11073-20601_PID_PM-Store	Continua TAN/PAN/LAN service components designed to store and utilize data from multiple users simultaneously in one or more PM-stores **shall** identify users and support the PM-Seg-Person-Id PM-segment object attribute and set the pmsc-multi-person bit in the PM-Store-Capab PM-Store object attribute	Identification means distinguishing between users of the measurement device

6.2.3 Devices

6.2.3.1 Pulse oximeter

6.2.3.1.1 Pulse oximeter – general requirements

Table 6-16 – Pulse oximeter – General requirements

Name	Description	Comments
11073-10404_Reqt	Continua TAN/PAN/LAN pulse oximeter service and client components **shall** implement [ISO/IEEE 11073-10404]	
11073-Pulse_Oximeter_PM_Store	Continua TAN/PAN/LAN pulse oximeter service and client components that implement and use the PM-Store model **shall** implement the guidelines in Table 6-20 and Table 6-21 and should use the models recommended by Table 6-2 or Table 6-3 and subsequent explanatory text.	

6.2.3.1.2 PM-store objects for the pulse oximeter

The PM-store and PM-segment classes provide a flexible and powerful means for storing large amounts of measurement data for later transmission to an AHD. However, this flexibility could potentially lead to ambiguities that could jeopardize interoperability. This clause describes recommended implementations for the most common use case, the sleep study.

Figure 6-3 illustrates one arrangement of a PM-store organized into two PM-segments. Each PM-segment stores periodically sampled data from a single contiguous session and each PM-segment entry contains a SpO_2 measurement and a pulse rate measurement sampled at a single point in time.

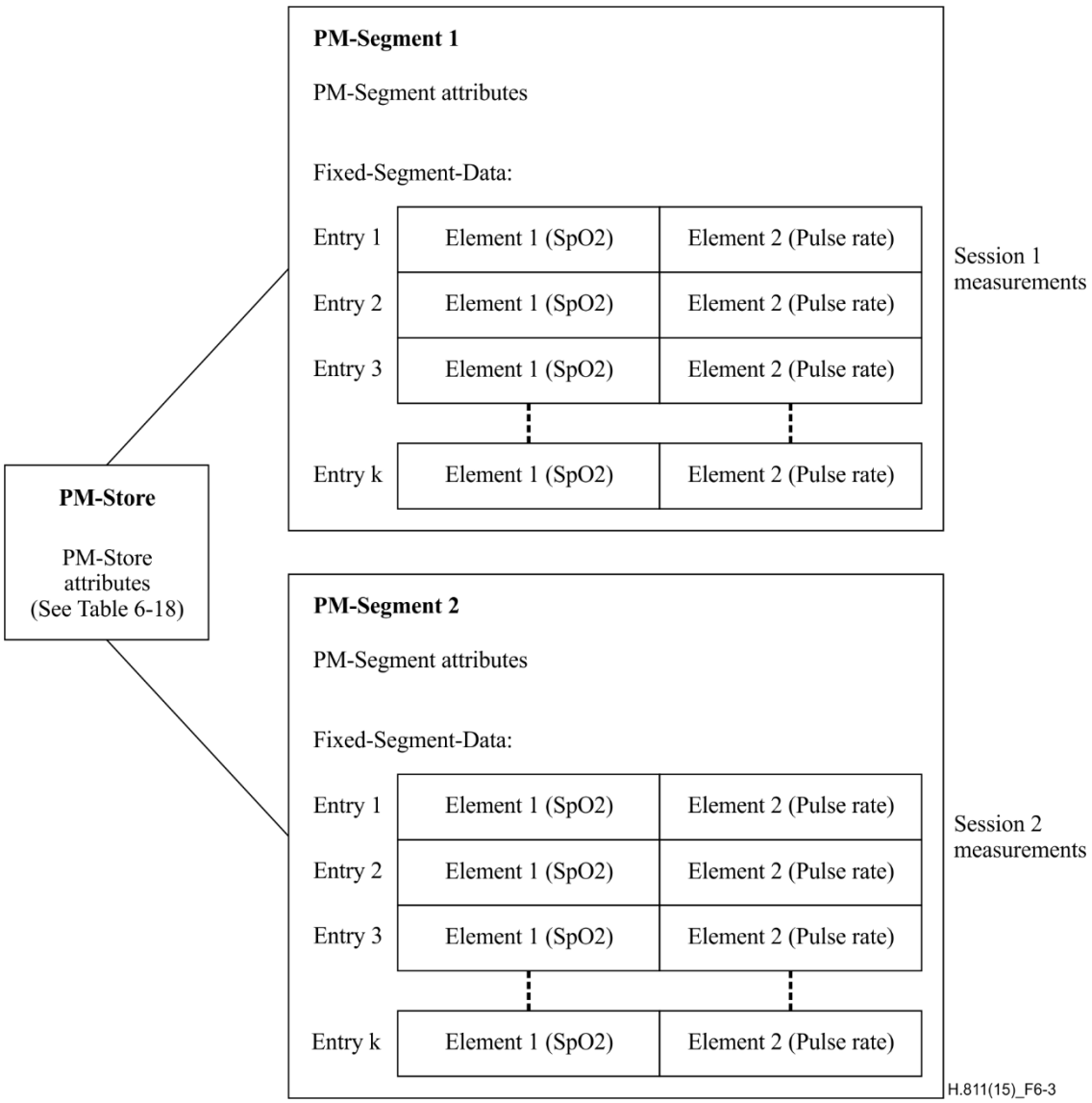

Figure 6-3 – PM-Store usage for pulse oximeter

Some situations may not be suitable for the previous approach. For instance, a pulse oximeter may record SpO_2 measurements at a different sampling period than pulse rate measurements, or one of the measurements during a session could conceivably be episodic. A PM-segment organization that could be better suited to this situation is illustrated in Figure 6-4.

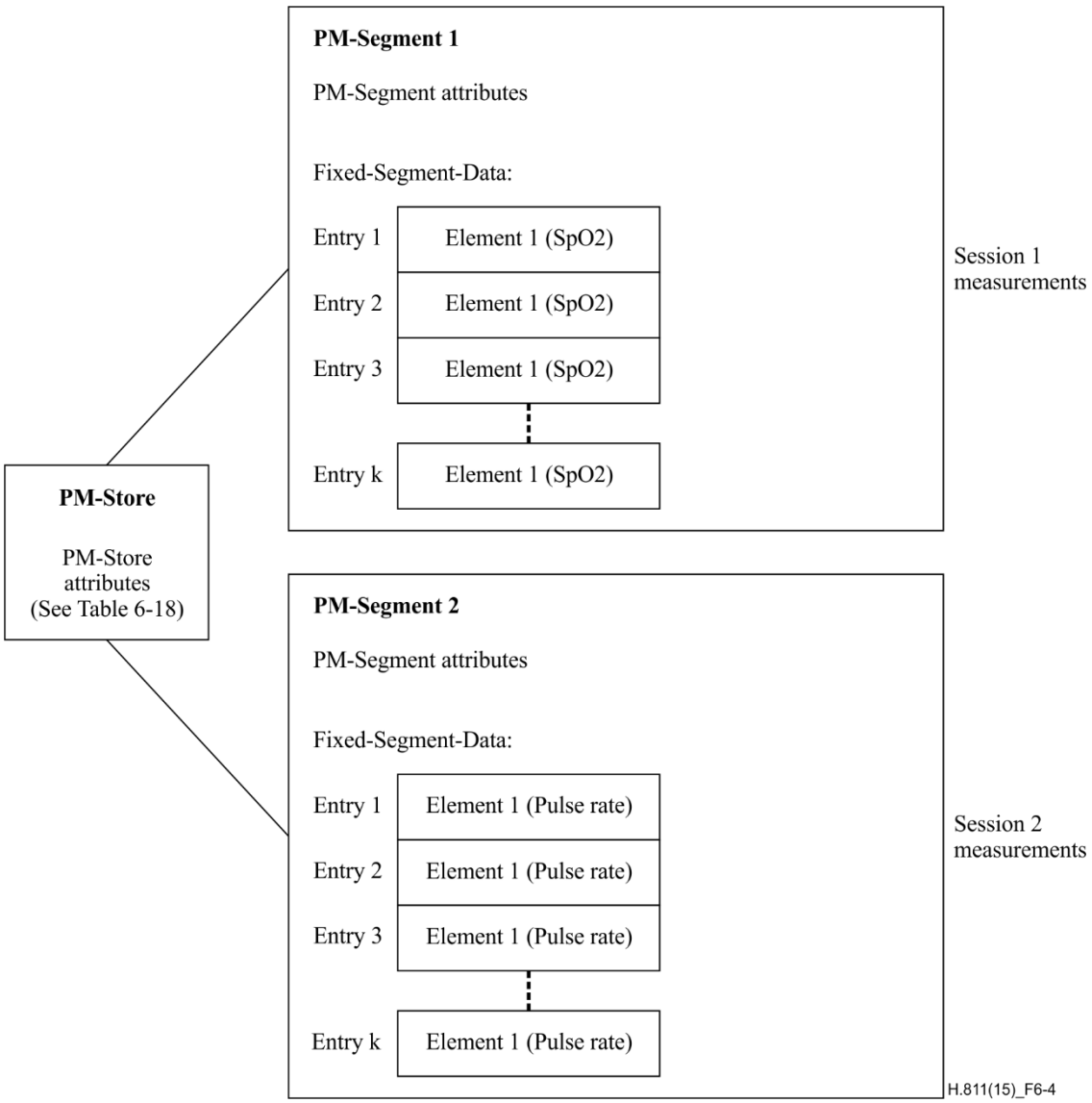

Figure 6-4 – Alternate PM-segment organization

This alternate arrangement challenges the notion of measurement association. Given a collection of PM-segments, how can the AHD determine which, if any, segments are associated?

Time stamps are used to determine whether one or more PM-segments are associated with another. Any measurements within one or more PM-segments in a PM-store are considered to be associated if their start and end segment attributes are overlapping, or if one segment's time range is contained within another segment. Table 6-17 prohibits the storage of associated PM-segments in separate PM-stores, which would add unnecessary complexity for client components to identify associated PM-segments.

Table 6-17 – PM-Store measurement requirements

Name	Description	Comments
11073-Pulse_Oximeter_PM_ Store_Organization	Continua TAN/PAN/LAN pulse oximeter service components **should** organize their stored measurements as shown in Figure 6-3 or Figure 6-4	The order of SpO2 and pulse rate is defined in the SegEntryMap
11073-Pulse_Oximeter_PM_ Store_StartTime_StopTime	Continua TAN/PAN/LAN pulse oximeter service components **shall** store the start time and end time in the PM-Segment attributes *Segment-Start-Abs-Time* and *Segment-end-Abs-Time*	Enables the AHD to determine whether one or more PM-segments are associated
11073_Pulse_Oximeter_PM_ Store_Associated_Measurements_ Locations	Continua TAN/PAN/LAN pulse oximeter service components **shall** create PM-segments within the same PM-store, if the PM-segments are overlapping in time	PM-segments are considered to be overlapping in time if the time ranges defined by their *Segment-Start-Abs-Time* and *Segment-End-Abs-Time* attribute values are overlapping

6.2.3.1.3 PM-Store object attributes

Table 6-18 – PM-Store object attributes guideline

Name	Description	Comments
11073_Pulse_Oximeter_PM_ Store_Object_Attributes_PM-Store-Capab_set	Continua TAN/PAN/LAN pulse oximeter service components **shall** set the following bit value for the PM-store-Capab attribute of the PM-store Object: *pmsc-clear-segm-by-all-sup*	
11073_Pulse_Oximeter_PM_ Store_Object_Attributes_PM-Store-Capab_clear	Continua TAN/PAN/LAN pulse oximeter service components **shall** clear the following bit value for the PM-store-Capab attribute of the PM-Store object: *pmsc-clear-segm-by-time-sup*	
11073_Pulse_Oximeter_PM_ Store_Object_Attributes_PM-Store-Label	Continua TAN/PAN/LAN pulse oximeter service components, that implement the PM-store-Label attribute of the PM-store object, **shall** not set a value of size larger than 255 octets	
11073_Pulse_Oximeter_PM_ Store_Object_Attributes_Sample-Period_Attribute	Continua TAN/PAN/LAN pulse oximeter service components **shall** implement the *Sample-Period* attribute of a PM-store object, if the stored measurements are periodic and the *Sample-Period* attribute is not implemented in each of the PM-segment objects created within that PM-store object. If the Sample-Period is defined in both the PM-store and in the PM-segment(s), the PM-segment attribute value **shall** take precedence	
11073_Pulse_Oximeter_PM_ Store_Object_alignment	Continua TAN/PAN/LAN pulse oximeter service components **shall** align periodic	Need to align events in case two associated

Table 6-18 – PM-Store object attributes guideline

Name	Description	Comments
	measurements so that the time of the first measurement is equivalent to *Segment-Start-Abs-Time*	PM-segments have widely varying sample periods

6.2.3.2 Basic 1-3 lead ECG

Table 6-19 – Basic 1-3 lead ECG – General requirements

Name	Description	Comments
11073-10406_Basic_ ECG_Reqt	Continua TAN/PAN/LAN Basic 1-3 lead ECG service and client components **shall** implement [IEEE 11073-10406]	
11073-10406_Simple_ ECG_Profile	Continua TAN/PAN/LAN Basic 1-3 lead ECG service and client components **shall** implement the simple ECG profile defined in [IEEE 11073-10406]	The simple ECG profile defined in [IEEE 11073-10406] mandates implementation of ECG waveform functionality
11073_Basic_ECG_ PM_Store	Continua TAN/PAN/LAN Basic 1-3 lead ECG service and client components that implement and use the PM-Store model **shall** implement the guidelines in Table 6-20 and Table 6-21 and **should** follow the storage layout as shown in Figure 7 of [IEEE 11073-10406]	Figure 7 of [IEEE 11073-10406] illustrates the example of a 3-lead Basic 1-3 lead ECG, with measurement data from all leads being contained in each entry preceded by a segment entry header. For a lower number of leads the number of elements in each entry reduces accordingly. The order of elements within an entry is defined in the SegEntryMap attribute

6.2.3.2.1 PM-store objects for the Basic 1-3 lead ECG

The PM-store and PM-segment classes provide a flexible and powerful means for storing large amounts of measurement data for later transmission to an AHD. However, this flexibility could potentially lead to ambiguities that could jeopardize interoperability. This clause describes recommended implementations for the most common use case involving persistently stored metric data, the storage of ECG waveform data.

Figure 7 of [IEEE 11073-10406] illustrates one arrangement of a periodic PM-store organized into two PM-segments. Each PM-segment stores periodically sampled data from a single contiguous session and each PM-segment entry contains sample arrays of ECG waveform data for all implemented leads sampled during the same period of time.

Some situations may not be suitable for the previous approach. For instance, a Basic 1-3 lead ECG may record heart-rate measurements at a different sampling period than ECG waveform measurements, or one of the measurements during a session could conceivably be aperiodic. A PM-segment organization that could be better suited to this situation is to use a separate PM-segment for different measurement types. See also Figure 6-4 for a conceptual illustration of this type of PM-segment organization. This alternate arrangement challenges the notion of measurement association, i.e., for the AHD to determine which segments are associated for a given collection of PM-segments. Storage of periodic and aperiodic measurements involves organization in separate aperiodic and periodic PM-stores, respectively.

Time stamps are used to determine whether one or more PM-segments are associated with another. Any measurements within one or more PM-segments in a PM-store are considered to be associated if their start and end segment attributes are overlapping, or if one segment's time range is contained within another segment. Table 6-20 prohibits the storage of associated PM-segments in separate PM-stores, which would add unnecessary complexity for client components to identify associated PM-segments.

Table 6-20 – PM-Store measurement requirements

Name	Description	Comments
11073_Basic_ECG_Periodic_ PM_Store_Associated_ Measurements_Locations	For periodic measurements, Continua TAN/PAN/LAN Basic 1-3 lead ECG service components **shall** create PM-segments within the same periodic PM-store, if the PM-segments are overlapping in time	PM-segments are considered to be overlapping in time if the time ranges defined by their *Segment-Start-Abs-Time* and *Segment-End-Abs-Time* attribute values are overlapping
11073_Basic_ECG_ Aperiodic_PM_Store_ Associated_Measurements_ Locations	For aperiodic measurements, Continua TAN/PAN/LAN Basic 1-3 lead ECG service components **shall** create PM-segments within the same aperiodic PM-store, if the PM-segments are overlapping in time	PM-segments are considered to be overlapping in time if the time ranges defined by their *Segment-Start-Abs-Time* and *Segment-End-Abs-Time* attribute values are overlapping

6.2.3.2.2 PM-store object attributes

Table 6-21 – PM-Store object attributes guidelines

Name	Description	Comments
11073_Basic_ECG_PM_ Store_Object_Attributes_ PM-Store-Label	Continua TAN/PAN/LAN Basic 1-3 lead ECG service components, that implement the PM-Store-Label attribute of the PM-Store object, **shall** not set a value of size larger than 255 octets	
11073_Basic_ECG_PM_ Store_Object_alignment	Continua TAN/PAN/LAN Basic 1-3 lead ECG service components **shall** align periodic measurements such that the time of the first measurement is equivalent to *Segment-Start-Abs-Time*	Need to align events in case two associated PM-segments have widely varying sample periods

6.2.3.3 Heart-rate sensor

Table 6-22 – Heart-rate sensor – General requirements

Name	Description	Comments
11073-10406_Heart_ Rate_Reqt	Continua TAN/PAN/LAN heart-rate sensor service and client components **shall** implement [IEEE 11073-10406]	
11073-10406_Heart_ Rate_Profile	Continua TAN/PAN/LAN heart-rate sensor service and client components **shall** implement the heart rate profile defined in [IEEE 11073-10406]	The heart rate profile defined in [IEEE 11073-10406] mandates the implementation of heart-rate functionality

Table 6-22 – Heart-rate sensor – General requirements

Name	Description	Comments
11073_Heart_Rate_PM_ Store	Continua TAN/PAN/LAN heart-rate sensor service and client components that implement and use the PM-Store model **shall** implement the guidelines in Table 6-23 and Table 6-24	For simple heart-rate sensors PM-Store functionality is typically not implemented. This guideline provides guidance for the case that PM-Store functionality is implemented

6.2.3.3.1 PM-store objects for the heart-rate sensor

The PM-store and PM-segment classes provide a flexible and powerful means for storing large amounts of measurement data for later transmission to an AHD. For simple heart-rate sensors this functionality is typically not implemented. However, if implemented this clause provides guidance to ensure interoperability.

A common use case involves persistently stored R-R interval data. Figure 6-5 illustrates a simple arrangement of an aperiodic PM-store containing PM-segments for storing R-R interval data from different measurement sessions. The entries of a PM-segment each contain an element of R-R interval data.

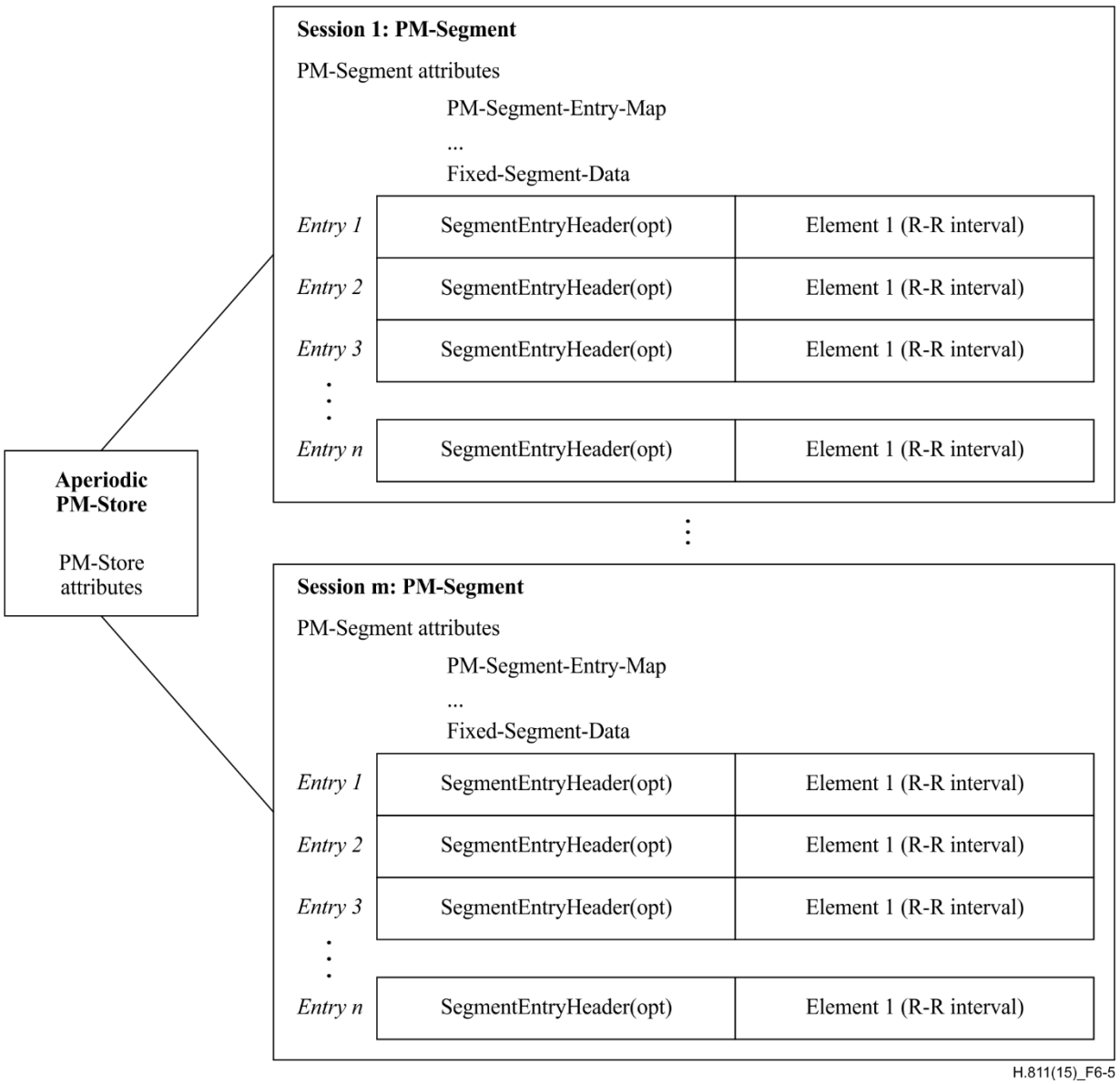

Figure 6-5 – PM-store usage example for heart-rate sensor

Time stamps are used to determine whether one or more PM-segments are associated with another. Any measurements within one or more PM-segments in a PM-store are considered to be associated if their start and end segment attributes are overlapping, or if one segment's time range is contained within another segment. Table 6-23 prohibits the storage of associated PM-segments in separate PM-stores, which would add unnecessary complexity for client components to identify associated PM-segments.

Table 6-23 – PM-Store measurement requirements

Name	Description	Comments
11073_Heart_rate_Periodic_PM_ Store_Associated_Measurements_ Locations	For periodic measurements, Continua TAN/PAN/LAN heart-rate sensor service components **shall** create PM-segments within the same periodic PM-store, if the PM-segments are overlapping in time	PM-segments are considered to be overlapping in time if the time ranges defined by their *Segment-Start-Abs-Time* and *Segment-End-Abs-Time* attribute values are overlapping
11073_Heart_Rate_Aperiodic_ PM_Store_Associated_ Measurements_Locations	For aperiodic measurements, Continua TAN/PAN/LAN heart-rate sensor service components **shall** create PM-segments within the same aperiodic PM-store, if the PM-segments are overlapping in time	PM-segments are considered to be overlapping in time if the time ranges defined by their *Segment-Start-Abs-Time* and *Segment-End-Abs-Time* attribute values are overlapping

6.2.3.3.2 PM-store object attributes

Table 6-24 – PM-Store object attributes guidelines

Name	Description	Comments
11073_Heart_Rate_PM_ Store_Object_Attributes_ PM-Store-Label	Continua TAN/PAN/LAN heart-rate sensor service components, that implement the PM-Store-Label attribute of the PM-Store object, **shall** not set a value of size larger than 255 octets	
11073_Heart_Rate_PM_ Store_Object_alignment	Continua TAN/PAN/LAN heart-rate sensor service components **shall** align periodic measurements such that the time of the first measurement is equivalent to *Segment-Start-Abs-Time*	Need to align events in case two associated PM-segments have widely varying sample periods

6.2.3.4 Blood pressure monitor

Table 6-25 – Blood pressure monitor – General requirements

Name	Description	Comments
11073-10407_Reqt	Continua TAN/PAN/LAN blood pressure monitor service and client components **shall** implement [ISO/IEEE 11073-10407]	

6.2.3.5 Thermometer

Table 6-26 – Thermometer – General requirements

Name	Description	Comments
11073-10408_Reqt	Continua TAN/PAN/LAN thermometer service and client components **shall** implement [ISO/IEEE 11073-10408]	

6.2.3.6 Weighing-scales

Table 6-27 – Weighing-scales – General requirements

Name	Description	Comments
11073-10415_Reqt	Continua TAN/PAN/LAN weighing-scales service and client components **shall** implement [ISO/IEEE 11073-10415]	

6.2.3.7 Glucose meter

Table 6-28 – Glucose meter – General requirements

Name	Description	Comments
11073-10417_Reqt	Continua TAN/PAN/LAN glucose meter service and client components **shall** implement [IEEE 11073-10417]	

6.2.3.8 INR meter

Table 6-29 – INR meter – General requirements

Name	Description	Comments
11073-10418_Reqt	Continua TAN/PAN/LAN INR meter service and client components **shall** implement [IEEE 11073-10418]	

6.2.3.9 Body composition analyzer

Table 6-30 – Body composition analyzer – General requirements

Name	Description	Comments
11073-10420_Reqt	Continua TAN/PAN/LAN Body composition analyzer service and client components **shall** implement [IEEE 11073-10420]	

6.2.3.10 Peak flow monitor

Table 6-31 – Peak flow monitor – General requirements

Name	Description	Comments
11073-10421_Reqt	Continua TAN/PAN/LAN peak flow monitor service and client components **shall** implement [ISO/IEEE 11073-10421]	

6.2.3.11 Cardiovascular fitness

Table 6-32 – Cardiovascular fitness – General requirements

Name	Description	Comments
11073-10441_Reqt	Continua TAN/PAN/LAN cardiovascular fitness service and client components **shall** implement [IEEE 11073-10441]	

6.2.3.12 Cardiovascular step counter

There is no IEEE 11073 device specialization dedicated to a cardiovascular step counter. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10441] to create a TAN/PAN/LAN cardiovascular step counter.

Table 6-33 – Cardiovascular step counter – General requirements

Name	Description	Comments
11073_10441_Reqt	Continua TAN/PAN/LAN cardiovascular step counter service and client components **shall** implement [IEEE 11073-10441]	
11073_Step_Counter_ Service_Max_APDU	Continua TAN/PAN/LAN cardiovascular step counter service components **shall** be able to support a maximum APDU size of 224 octets from Continua TAN/PAN/LAN client components	These are consistent with weighing scale, thermometer, glucose meter, blood pressure monitor and independent living activity hub
11073_Step_Counter_ Client_Max_APDU	Continua TAN/PAN/LAN cardiovascular step counter client components **shall** be able to support a maximum APDU size of 6624 octets from Continua TAN/PAN/LAN service components	
11073_Step_Counter_ Service_Mandatory_Objects	Continua TAN/PAN/LAN cardiovascular step counter service components **shall** support the session and distance object in units of steps	
11073_Step_Counter_ Client_Mandatory_Objects	Continua TAN/PAN/LAN cardiovascular step counter client components **shall** support the session and distance object (all unit codes)	
11073_Step_Counter_ Service_Optional_Objects	Continua TAN/PAN/LAN cardiovascular step counter service components **may** support the subsession, cadence, speed, distance (in meters and/or feet), stride length, or energy expended objects as defined in [IEEE 11073-10441]	
11073_Step_Counter_ Client_Optional_Objects	Continua TAN/PAN/LAN cardiovascular step counter client components **may** support the subsession, cadence, speed, stride length, or energy expended objects as defined in [ISO/IEEE 11073-10441]	
11073_Step_Counter_	Continua TAN/PAN/LAN step counter	

Table 6-33 – Cardiovascular step counter – General requirements

Name	Description	Comments
MDC_Code	service components **shall** set the MDC_ DEV_*_SPEC_PROFILE_* code to MDC_ DEV_SUB_SPEC_PROFILE_STEP_ COUNTER = 4200 (0x1068)	

6.2.3.13 Strength fitness

Table 6-34 – Strength fitness – General requirements

Name	Description	Comments
11073-10442_Reqt	Continua TAN/PAN/LAN strength fitness service and client components **shall** implement [ISO/IEEE 11073-10442]	

6.2.3.14 Activity hub

Table 6-35 – Activity hub – General requirements

Name	Description	Comments
11073-10471_Reqt	Continua TAN/PAN/LAN activity hub service and client components **shall** implement [ISO/IEEE 11073-10471]	

6.2.3.15 Fall sensor

There is no IEEE 11073 device specialization dedicated to a fall sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN fall sensor.

Table 6-36 – Fall sensor – General requirements

Name	Description	Comments
11073-10471_Fall_Reqt	Continua TAN/PAN/LAN fall sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Fall_Sensor_Object	Continua TAN/PAN/LAN fall sensor service and client components **shall** implement the fall sensor enumeration object	
11073_Fall_Sensor_MDC_ Code	Continua TAN/PAN/LAN fall sensor service components **shall** set the MDC_ DEV_*_SPEC_PROFILE_* code to MDC_ DEV_SUB_SPEC_PROFILE_FALL_ SENSOR = 4213 (0x1075)	

6.2.3.16 Motion sensor

There is no IEEE 11073 device specialization dedicated to a motion sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN motion sensor.

Table 6-37 – Motion sensor – General requirements

Name	Description	Comments
11073-10471_Motion_Reqt	Continua TAN/PAN/LAN motion sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Motion_Sensor_ Object	Continua TAN/PAN/LAN motion sensor service and client components **shall** implement the motion sensor enumeration object	
11073_Motion_Sensor_ MDC_Code	Continua TAN/PAN/LAN motion sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_MOTION_SENSOR = 4219 (0x107B)	

6.2.3.17 Enuresis sensor

There is no IEEE 11073 device specialization dedicated to an enuresis sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN enuresis sensor.

Table 6-38 – Enuresis sensor – General requirements

Name	Description	Comments
11073-10471_Enuresis_Reqt	Continua TAN/PAN/LAN enuresis sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Enuresis_Sensor_ Object	Continua TAN/PAN/LAN enuresis sensor service and client components **shall** implement the enuresis sensor enumeration object	
11073_Enuresis_Sensor_ MDC_Code	Continua TAN/PAN/LAN enuresis sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_ENURESIS_SENSOR = 4221 (0x107D)	

6.2.3.18 Contact closure sensor

There is no IEEE 11073 device specialization dedicated to a contact closure sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN contact closure sensor.

Table 6-39 – Contact closure sensor – General requirements

Name	Description	Comments
11073-10471_Contact_Reqt	Continua TAN/PAN/LAN contact closure sensor service and client components **shall** implement ISO/IEEE 11073-10471-2008	
11073_Contact_Closure_ Sensor_Object	Continua TAN/PAN/LAN contact closure sensor service and client components **shall** implement the contact closure sensor enumeration object	
11073_Contact_Closure_ Sensor_MDC_Code	Continua TAN/PAN/LAN contact closure sensor service components **shall** set the MDC_DEV_*_ SPEC_PROFILE_* code to MDC_DEV_SUB_ SPEC_PROFILE_CONTACTCLOSURE_ SENSOR = 4222 (0x107E)	

6.2.3.19 Switch sensor

There is no IEEE 11073 device specialization dedicated to a switch use sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN switch sensor.

Table 6-40 – Switch use sensor – General requirements

Name	Description	Comments
11073-10471_Switch_Reqt	Continua TAN/PAN/LAN switch sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Switch_Sensor_ Object	Continua TAN/PAN/LAN switch sensor service and client components **shall** implement the Switch use sensor enumeration object	
11073_Switch_Sensor_ MDC_Code	Continua TAN/PAN/LAN switch sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_SWITCH_SENSOR = 4224 (0x1080)	

6.2.3.20 Dosage sensor

There is no IEEE 11073 device specialization dedicated to a medication dosage sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN dosage sensor.

Table 6-41 – Dosage sensor – General requirements

Name	Description	Comments
11073-10471_Dosage_Reqt	Continua TAN/PAN/LAN dosage sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Dosage_Sensor_ Object	Continua TAN/PAN/LAN dosage sensor service and client components **shall** implement the medication dosage sensor enumeration object	
11073_Dosage_Sensor_ MDC_Code	Continua TAN/PAN/LAN dosage sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_DOSAGE_SENSOR = 4225 (0x1081)	

6.2.3.21 Water sensor

There is no IEEE 11073 device specialization dedicated to a water sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN water sensor.

Table 6-42 – Water sensor – General requirements

Name	Description	Comments
11073-10471_Water_Reqt	Continua TAN/PAN/LAN Water Sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Water_Sensor_ Object	Continua TAN/PAN/LAN water sensor service and client components **shall** implement the water sensor enumeration object	
11073_Water_Sensor_ MDC_Code	Continua TAN/PAN/LAN water sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_WATER_SENSOR = 4217 (0x1079)	

6.2.3.22 Smoke sensor

There is no IEEE 11073 device specialization dedicated to a smoke sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN smoke sensor.

Table 6-43 – Smoke sensor – General requirements

Name	Description	Comments
11073-10471_Smoke_Reqt	Continua TAN/PAN/LAN smoke sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Smoke_Sensor_ Object	Continua TAN/PAN/LAN smoke sensor service and client components **shall** implement the smoke sensor enumeration object	
11073_Smoke_Sensor_ MDC_Code	Continua TAN/PAN/LAN smoke sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_SMOKE_SENSOR = 4215 (0x1077)	

6.2.3.23 Property exit sensor

There is no IEEE 11073 device specialization dedicated to a property exit sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN property exit sensor.

Table 6-44 – Property exit sensor – General requirements

Name	Description	Comments
11073-10471_Exit_Reqt	Continua TAN/PAN/LAN property exit sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Property_Exit_ Sensor_Object	Continua TAN/PAN/LAN property exit sensor service and client components **shall** implement the property exit sensor enumeration object	
11073_Property_Exit_ Sensor_MDC_Code	Continua TAN/PAN/LAN property exit sensor service components **shall** set the MDC_DEV_*_ SPEC_PROFILE_* code to MDC_DEV_SUB_ SPEC_PROFILE_PROPEXIT_SENSOR = 4220 (0x107C)	

6.2.3.24 Temperature sensor

There is no IEEE 11073 device specialization dedicated to a temperature sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN temperature sensor.

Table 6-45 – Temperature sensor – General requirements

Name	Description	Comments
11073-10471_Temperature_ Reqt	Continua TAN/PAN/LAN temperature sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Temperature_ Sensor_Object	Continua TAN/PAN/LAN temperature sensor service and client components **shall** implement the temperature sensor enumeration object	
11073_Temperature_ Sensor_MDC_Code	Continua TAN/PAN/LAN temperature sensor service components **shall** set the MDC_DEV_*_ SPEC_PROFILE_* code to MDC_DEV_SUB_ SPEC_PROFILE_TEMP_SENSOR = 4226 (0x1082)	

6.2.3.25 Usage sensor

There is no IEEE 11073 device specialization dedicated to a usage sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN usage sensor.

Table 6-46 – Usage sensor – General requirements

Name	Description	Comments
11073-10471_Usage_Reqt	Continua TAN/PAN/LAN usage sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Usage_Sensor_ Object	Continua TAN/PAN/LAN usage sensor service and client components **shall** implement the usage sensor enumeration object	
11073_Usage_Sensor_ MDC_Code	Continua TAN/PAN/LAN usage sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_USAGE_SENSOR = 4223 (0x107F)	

6.2.3.26 PERS sensor

There is no IEEE 11073 device specialization dedicated to a PERS sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN PERS sensor.

Table 6-47 – PERS sensor – General requirements

Name	Description	Comments
11073-10471_PERS_Reqt	Continua TAN/PAN/LAN PERS sensor service and client components **shall** implement ISO/IEEE 11073-10471-2008	
11073_PERS_Sensor_ Object	Continua TAN/PAN/LAN PERS sensor service and client components **shall** implement the PERS sensor enumeration object	
11073_PERS_Sensor_ MDC_Code	Continua TAN/PAN/LAN PERS sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_PERS_SENSOR = 4214 (0x1076)	

6.2.3.27 CO sensor

There is no IEEE 11073 device specialization dedicated to a carbon monoxide sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN CO sensor.

Table 6-48 – CO sensor – General requirements

Name	Description	Comments
11073-10471_CO_Reqt	Continua TAN/PAN/LAN CO Sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_CO_Sensor_Object	Continua TAN/PAN/LAN CO sensor service and client components **shall** implement the CO sensor enumeration object	
11073_CO_Sensor_MDC_ Code	Continua TAN/PAN/LAN CO sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_FALL_SENSOR = 4216 (0x1078)	

6.2.3.28 Gas sensor

There is no IEEE 11073 device specialization dedicated to a gas sensor. This clause describes how to make use of the generic functionality of [ISO/IEEE 11073-10471] to create a TAN/PAN/LAN gas sensor.

Table 6-49 – Gas sensor – General requirements

Name	Description	Comments
11073-10471_Gas_Reqt	Continua TAN/PAN/LAN gas sensor service and client components **shall** implement [ISO/IEEE 11073-10471]	
11073_Gas_Sensor_Object	Continua TAN/PAN/LAN gas sensor service and client components **shall** implement the gas sensor enumeration object	
11073_Gas_Sensor_MDC_ Code	Continua TAN/PAN/LAN gas sensor service components **shall** set the MDC_DEV_*_SPEC_ PROFILE_* code to MDC_DEV_SUB_SPEC_ PROFILE_GAS_SENSOR = 4218 (0x107A)	

6.2.3.29 Adherence monitor

Table 6-50 – Adherence monitor – General requirements

Name	Description	Comments
11073-10472_Reqt	Continua TAN/PAN/LAN adherence monitor service and client components **shall** implement [IEEE 11073-10472]	

6.2.3.30 Sleep apnea breathing therapy equipment (SABTE)

Table 6-51 – SABTE – General requirements

Name	Description	Comments
11073-10424_Reqt	Continua TAN/PAN/LAN SABTE service and client components shall implement [IEEE 11073-10424]	

7 TAN interface design guidelines

7.1 TAN-IF architecture (informative)

This clause lists the design guidelines specific for interoperability across certified CDG devices in the touch area network (TAN) interface.

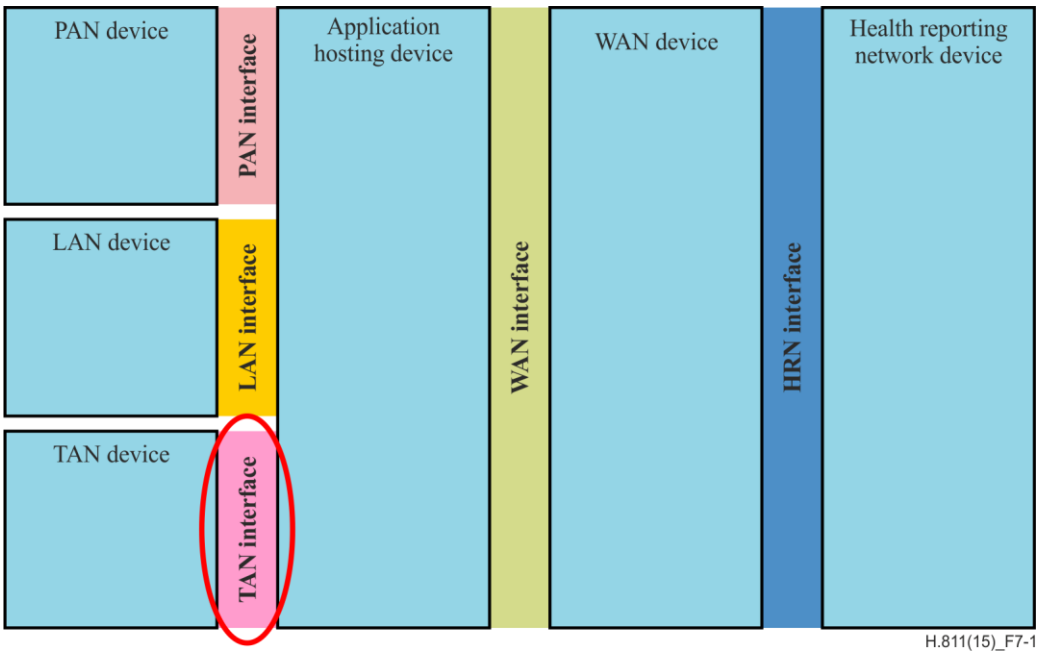

Figure 7-1 – TAN interface

7.1.1 Overview

TAN enables a Continua device to communicate with a Continua application hosting device (AHD), with a short touch. A user brings the two devices into close proximity for a short period of time – touching. While the devices are touching, data may be exchanged bidirectionally. In a typical use case a user would transfer blood pressure readings from their blood pressure meter (Continua device) to a mobile phone (Continua AHD) by simply touching the two devices together. Figure 7-1 illustrates the structure of the TAN interface.

7.1.2 Transport protocols and selected standards

[NFC PHDC] has been selected to serve as the transports for the TAN interface.

The selected protocol for the transport layer ensures interoperable set-up and tear-down of the communication channel for the transfer of control and data messages across all domains.

7.1.3 Exchange protocols and selected standards

For the data and messaging layer of the TAN interface, the IEEE 11073 personal health device family of standards has been selected. For the detailed list of selected data/messaging layer standards; please see clause 6.

7.1.4 Certified device classes

Table 7-1 shows the certified device classes defined for the TAN interface design guidelines. A certification program run by Continua Health Alliance exists for devices that implement the CDG. For TAN devices, the certification testing will be performed on an integrated device, meaning the testing and certification is applied to the hardware and software of the device. Changes to components of the device may require a re-certification. Table 7-1 also references the guidelines that are applicable for each of the certified device classes. An empty table entry would indicate that there is currently no certified device class defined.

Table 7-1 – Certified device classes

Certified device classes	Relevant guidelines
TAN activity hub service device TAN activity hub client device	6.2.1, 6.2.2, 6.2.3.14, 7.2.1, 7.2.2
TAN adherence monitor service device TAN adherence monitor client device	6.2.1, 6.2.2, 6.2.3.29, 7.2.1, 7.2.2
TAN basic 1-3 lead ECG service device TAN basic 1-3 lead ECG client device	6.2.1, 6.2.2, 6.2.3.2, 7.2.1, 7.2.2
TAN blood pressure monitor service device TAN blood pressure monitor client device	6.2.1, 6.2.2, 6.2.3.4, 7.2.1, 7.2.2
TAN cardiovascular fitness service device TAN cardiovascular fitness client device	6.2.1, 6.2.2, 6.2.3.11, 7.2.1, 7.2.2
TAN cardiovascular fitness step counter service device TAN cardiovascular fitness step counter client device	6.2.1, 6.2.2, 6.2.3.12, 7.2.1, 7.2.2
TAN CO sensor service device TAN CO sensor client device	6.2.1, 6.2.2, 6.2.3.27, 7.2.1, 7.2.2
TAN contact closure sensor service device TAN contact closure sensor client device	6.2.1, 6.2.2, 6.2.3.18, 7.2.1, 7.2.2
TAN enuresis sensor service device TAN enuresis sensor client device	6.2.1, 6.2.2, 6.2.3.17, 7.2.1, 7.2.2
TAN fall sensor service device TAN fall sensor client device	6.2.1, 6.2.2, 6.2.3.15, 7.2.1, 7.2.2
TAN gas sensor service device TAN gas sensor client device	6.2.1, 6.2.2, 6.2.3.28, 7.2.1, 7.2.2
TAN glucose meter service device TAN glucose meter client device	6.2.1, 6.2.2, 6.2.3.7, 7.2.1, 7.2.2
TAN heart-rate sensor service device TAN heart-rate sensor client device	6.2.1, 6.2.2, 6.2.3.3, 7.2.1, 7.2.2
TAN INR meter service device TAN INR meter client device	6.2.1, 6.2.2, 6.2.3.8, 7.2.1, 7.2.2
TAN medication dosage sensor service device TAN medication dosage sensor client device	6.2.1, 6.2.2, 6.2.3.20, 7.2.1, 7.2.2
TAN motion sensor service device TAN motion sensor client device	6.2.1, 6.2.2, 6.2.3.16, 7.2.1, 7.2.2
TAN peak flow meter service device TAN peak flow meter client device	6.2.1, 6.2.2, 6.2.3.10, 7.2.1, 7.2.2
TAN PERS sensor service device TAN PERS sensor client device	6.2.1, 6.2.2, 6.2.3.26, 7.2.1, 7.2.2
TAN property exit sensor service device TAN property exit sensor client device	6.2.1, 6.2.2, 6.2.3.23, 7.2.1, 7.2.2
TAN pulse oximeter service device TAN pulse oximeter client device	6.2.1, 6.2.2, 6.2.3.1, 7.2.1, 7.2.2
TAN smoke sensor service device TAN smoke sensor client device	6.2.1, 6.2.2, 6.2.3.22, 7.2.1, 7.2.2

Table 7-1 – Certified device classes

Certified device classes	Relevant guidelines
TAN strength fitness service device TAN strength fitness client device	6.2.1, 6.2.2, 6.2.3.13, 7.2.1, 7.2.2
TAN switch sensor service device TAN switch sensor client device	6.2.1, 6.2.2, 6.2.3.19, 7.2.1, 7.2.2
TAN temperature sensor service device TAN temperature sensor client device	6.2.1, 6.2.2, 6.2.3.24, 7.2.1, 7.2.2
TAN thermometer service device TAN thermometer client device	6.2.1, 6.2.2, 6.2.3.5, 7.2.1, 7.2.2
TAN usage sensor service device TAN usage sensor client device	6.2.1, 6.2.2, 6.2.3.25, 7.2.1, 7.2.2
TAN water sensor service device TAN water sensor client device	6.2.1, 6.2.2, 6.2.3.21, 7.2.1, 7.2.2
TAN weighing-scales service device TAN weighing-scales client device	6.2.1, 6.2.2, 6.2.3.6, 7.2.1, 7.2.2

7.1.5 Device communication styles

TAN is intended for a batch communication style. This style requires the transport between the device and the AHD to communicate previously collected data points at a later time. The user chooses the moment of communication by touching the devices.

In QoS terms explained in clause 6.1.6 of [ITU-T H.810], TAN is best.medium. Communication is acknowledged and must be complete or the transaction is rejected. Latency is typically <1 second for a TAN application.

7.1.6 TAN-IF security

For a TAN solution, it is assumed that the physical action of the user touching two devices provides a level of security to prevent too easy inadvertent leakage of data to a different AHD.

Designers of TAN devices should take normal care for NFC systems to ensure a robust design that cannot be easily intercepted or interrogated by an antenna that is not in very close physical contact – touching. Typically this is done by managing power and physically shielding components to ensure that only two antennas that are in very close contact are capable of communication exchange.

Note that such measures help to increase the security of the system, but they cannot prevent the effects of all security threats that are inherent to the nature of NFC. It is advised that device manufacturers implement suitable security controls and mechanisms based on a security risk analysis.

7.2 Device and interface guidelines

7.2.1 TAN device guidelines

This clause contains design guidelines that apply to TAN physical devices. These can be personal healthcare devices or application hosting devices.

7.2.1.1 Device to AHD linkage

Table 7-2 – Device to AHD linkage

Name	Description	Comments
TAN_Device_AHD_ Linkage	A Continua TAN service component **shall** connect with only one Continua TAN client component at any given time.	The Continua reference topology as described in [ITU-T H.810] restricts communication to a single client component.

7.2.1.2 User experience

TAN devices communicate in close proximity which is normally caused by the user bringing a TAN service component device close to a TAN client component device, or vice versa. This clause contains design guidelines that strongly recommend specific device behaviour to ensure a satisfying user experience.

Table 7-3 – User experience

Name	Description	Comments
TAN_Device_Taptime	A Continua TAN service component **should** complete data exchange within 3 seconds	Completion of data exchange within an acceptable amount of time is specifically important where the user must hold TAN service and client components in proximity for the duration of the data exchange
TAN_User_Notification	Continua TAN service and client components with appropriate UI capabilities **should** notify the user when data exchange is completed	Appropriate user notifications are specifically important where the user must hold TAN service and client components in proximity for the duration of the data exchange

7.2.2 NFC transport

7.2.2.1 Personal health device communication

This clause contains a general design guideline that points to [NFC PHDC]. All subsequent requirements in clause 7.2.2 refer to this specification.

Table 7-4 – Personal health device communication map

Name	Description	Comments
TAN_NFC_PHDC_ Map	Continua TAN wireless service and client components **shall** implement NFC personal health device communication version 1.0 subject to the design guidelines below	

7.2.2.2 Multi-function devices

This clause defines how devices that implement more than one IEEE 11073 PHD device specialization are represented via [NFC PHDC]. These guidelines require that all multi-function devices expose all device specializations via a single [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] association. In NFC, a single [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] association maps best to a single NFC PHDC agent interface. Thus, a Continua-certified NFC PHDC device has only one NFC PHDC agent interface for Continua

functionality, regardless of whether it exposes a single device specialization or multiple device specializations.

Table 7-5 – Multi-function devices

Name	Description	Comments
TAN_11073-20601_ Multi-Function	A Continua TAN service component **shall** have at most one [ISO/IEEE 11073-20601] and one [IEEE 11073-20601A] association to a TAN client component at any point in time regardless of whether the device is a single function or multi-function device	This guideline prohibits the device from having two concurrent associations. The device may provide different configuration options only in subsequent associations only after closing the currently active association

7.2.2.3 Quality of service

The following requirements describe how quality of service (QoS) attributes are used for Continua TAN service and client components.

Table 7-6 – Quality of service

Name	Description	Comments
TAN_NFC_PHDC_QoS_ Best.Medium	Continua TAN service and client components **shall** provide the Continua best.medium QoS bin	NFC PHDC transport does exchange all data on best.medium QoS bin
TAN_NFC_PHDC_QoS_ Good.Medium	Continua TAN service and client components **shall not** provide the Continua good.medium QoS bin	NFC PHDC transport does exchange all data on best.medium QoS bin

8 PAN interface design guidelines

8.1 PAN-IF architecture (informative)

This clause lists the design guidelines specific for interoperability across certified CDG devices in the personal area network interface.

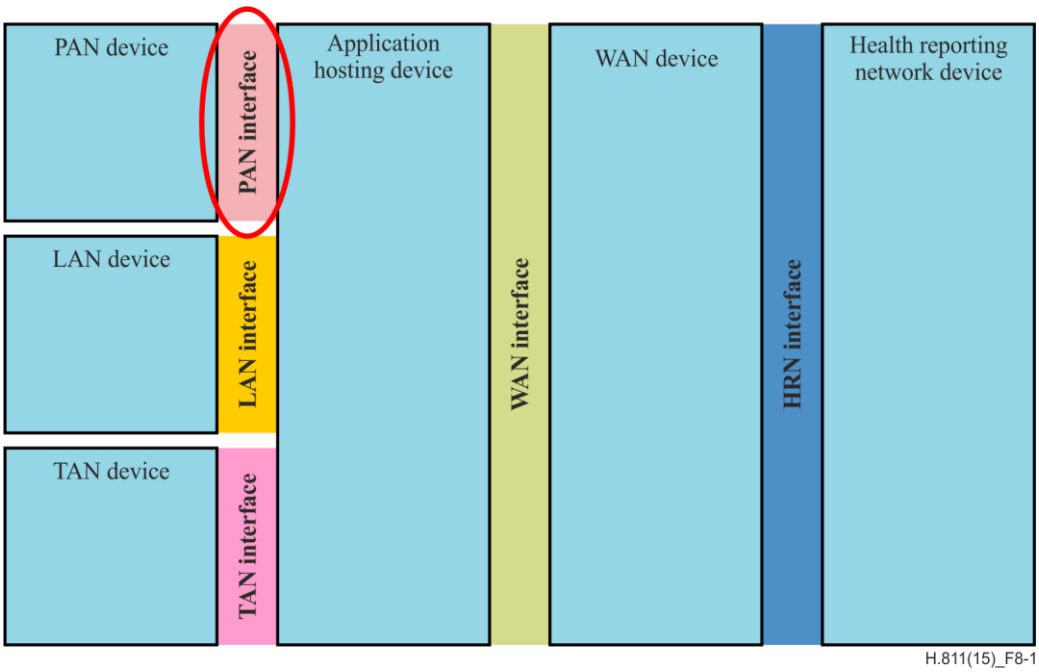

Figure 8-1 – PAN interface

8.1.1 Overview

The connectivity in the PAN interface is tailored to satisfying three basic requirements that are uniform across the application domains serviced by CDG-certified products:

– allow bidirectional sensor control

– allow bidirectional sensor information exchange

– allow appropriate linkage between a PAN device and an application hosting device.

The interface is further structured into three distinct layers, with appropriate standards selected to represent the individual layers and establish interoperability in the personal health ecosystem. Figure 6-1 illustrates the structure of the PAN interface.

8.1.2 Transport protocols and selected standards

The following wired and wireless solutions have been selected to serve as the CDG transport for the PAN interface:

– Wireless – Bluetooth health device profile for wireless PAN and Bluetooth low energy (LE) services and profiles for the low-power (LP) wireless PAN

– Wired – USB personal healthcare device class.

The selected protocols for the transport layer ensure interoperable set-up and tear-down of the communication channel for the transfer of control and data messages across all domains.

8.1.3 Exchange protocols and selected standards

For the data and messaging layer of the standard wireless PAN and wired PAN interface, the standards from the IEEE 11073 personal health device family of standards have been selected. For the detailed list of selected data/messaging layer standards, see clause 6.

The LP wireless PAN interface does not utilize the [ISO/IEEE 11073-20601] or [IEEE 11073-20601A] protocol for data exchange. The LP wireless PAN interface utilizes the Bluetooth low energy protocol with data types compatible to the IEEE 11073-10101 nomenclature and the IEEE 11073-20601 domain information model. For the characteristics defined in the

Bluetooth low energy profiles, the *Personal Health Devices Transcoding White Paper* describes how to transcode into an equivalent IEEE DIM and/or nomenclature representation. At a minimum, this covers the mandatory attributes from the supported [ISO/IEEE 11073-104xx] device specializations.

The following Bluetooth low energy device-specific specifications from the Bluetooth SIG apply to the LP wireless PAN interface.

– Health thermometer profile and service (e.g., temperature)

– Heart rate profile and service (e.g., heart rate, R-R interval)

– Device information service (e.g., manufacturer name, model number, serial number, hardware revision, firmware revision, software revision, system ID)

– Blood pressure profile and service (e.g., blood pressure measurement, intermediate cuff pressure)

– Glucose profile and service (e.g., glucose measurement)

– Weight scale profile, weight ccale service and body composition services (e.g. weight measurement, BMI, body fat mass percentage)

– *Personal Health Devices Transcoding White Paper* describes how to transcode Bluetooth low energy data structures and format into an equivalent IEEE 11073 PHD data representation regarding DIM and/or nomenclature

See clause 2 of [ITU-T H.810] for a full list of normative references.

8.1.4 Certified device classes

Table 8-1 shows the certified device classes defined for the PAN interface design guidelines. A certification program run by Continua Health Alliance exists for devices that implement the CDG. For PAN devices, the certification testing will be performed on an integrated device, meaning the testing and certification is applied to the hardware and software of the device. Changes to components of the device may require a re-certification. Table 8-1 also references the guidelines that are applicable for each of the certified device classes. An empty table entry indicates that there is currently no certified devices class defined. For example, in this version of the guidelines there is not yet defined an LP wireless PAN activity hub service/client device.

Table 8-1 – Certified device classes

	Wireless ***(relevant guidelines)***	**Wired** ***(relevant guidelines)***	**LP wireless PAN** ***(relevant guidelines)***
PAN activity hub service device PAN activity hub client device	6.2.1, 6.2.2, 6.2.3.14, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.14, 8.2.1, 8.2.4, 8.2.5	
PAN adherence monitor service device PAN adherence monitor client device	6.2.1, 6.2.2, 6.2.3.29, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.29, 8.2.1, 8.2.4, 8.2.5	
PAN basic 1-3 lead ECG service device PAN basic 1-3 lead ECG client device	6.2.1, 6.2.2, 6.2.3.2, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.2, 8.2.1, 8.2.4, 8.2.5	

Table 8-1 – Certified device classes

	Wireless ***(relevant guidelines)***	**Wired** ***(relevant guidelines)***	**LP wireless PAN** ***(relevant guidelines)***
PAN blood pressure monitor service device PAN blood pressure monitor client device	6.2.1, 6.2.2, 6.2.3.4, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.4, 8.2.1, 8.2.4, 8.2.5	6.2.2.6, 8.2.1, 8.2.3, 8.2.6.1
PAN cardiovascular fitness service device PAN cardiovascular fitness client device	6.2.1, 6.2.2, 6.2.3.11, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.11, 8.2.1, 8.2.4, 8.2.5	
PAN cardiovascular fitness step counter service device PAN cardiovascular fitness step counter client device	6.2.1, 6.2.2, 6.2.3.12, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.12, 8.2.1, 8.2.4, 8.2.5	
PAN CO sensor service device PAN CO sensor client device	6.2.1, 6.2.2, 6.2.3.27, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.27, 8.2.1, 8.2.4, 8.2.5	
PAN contact closure sensor service device PAN contact closure sensor client device	6.2.1, 6.2.2, 6.2.3.18, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.18, 8.2.1, 8.2.4, 8.2.5	
PAN enuresis sensor service device PAN enuresis sensor client device	6.2.1, 6.2.2, 6.2.3.17, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.17, 8.2.1, 8.2.4, 8.2.5	
PAN fall sensor service device PAN fall sensor client device	6.2.1, 6.2.2, 6.2.3.15, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.15, 8.2.1, 8.2.4, 8.2.5	
PAN gas sensor service device PAN gas sensor client device	6.2.1, 6.2.2, 6.2.3.28, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.28, 8.2.1, 8.2.4, 8.2.5	
PAN glucose meter service device PAN glucose meter client device	6.2.1, 6.2.2, 6.2.3.7, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.7, 8.2.1, 8.2.4, 8.2.5	6.2.2.6, 8.2.1, 8.2.3, 8.2.6.4
PAN heart-rate sensor service device PAN heart-rate sensor client device	6.2.1, 6.2.2, 6.2.3.3, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.3, 8.2.1, 8.2.4, 8.2.5	6.2.2.6, 8.2.1, 8.2.3, 8.2.6.3
PAN INR meter service device PAN INR meter client device	6.2.1, 6.2.2, 6.2.3.8, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.8, 8.2.1, 8.2.4, 8.2.5	

Table 8-1 – Certified device classes

	Wireless ***(relevant guidelines)***	**Wired** ***(relevant guidelines)***	**LP wireless PAN** ***(relevant guidelines)***
PAN medication dosage sensor service device PAN medication dosage sensor client device	6.2.1, 6.2.2, 6.2.3.20, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.20, 8.2.1, 8.2.4, 8.2.5	
PAN motion sensor service device PAN motion sensor client device	6.2.1, 6.2.2, 6.2.3.16, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.16, 8.2.1, 8.2.4, 8.2.5	
PAN peak flow meter service device PAN peak flow meter client device	6.2.1, 6.2.2, 6.2.3.10, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.10, 8.2.1, 8.2.4, 8.2.5	
PAN PERS sensor service device PAN PERS sensor client device	6.2.1, 6.2.2, 6.2.3.26, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.26, 8.2.1, 8.2.4, 8.2.5	
PAN property exit sensor service device PAN property exit sensor client device	6.2.1, 6.2.2, 6.2.3.23, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.23, 8.2.1, 8.2.4, 8.2.5	
PAN pulse oximeter service device PAN pulse oximeter client device	6.2.1, 6.2.2, 6.2.3.1, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.1, 8.2.1, 8.2.4, 8.2.5	
PAN smoke sensor service device PAN smoke sensor client device	6.2.1, 6.2.2, 6.2.3.22, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.22, 8.2.1, 8.2.4, 8.2.5	
PAN strength fitness service device PAN strength fitness client device	6.2.1, 6.2.2, 6.2.3.13, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.13, 8.2.1, 8.2.4, 8.2.5	
PAN switch sensor service device PAN switch sensor client device	6.2.1, 6.2.2, 6.2.3.19, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.19, 8.2.1, 8.2.4, 8.2.5	
PAN temperature sensor service device PAN temperature sensor client device	6.2.1, 6.2.2, 6.2.3.24, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.24, 8.2.1, 8.2.4, 8.2.5	
PAN thermometer service device PAN thermometer client device	6.2.1, 6.2.2, 6.2.3.5, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.5, 8.2.1, 8.2.4, 8.2.5	6.2.2.6, 8.2.1, 8.2.3, 8.2.6.2

Table 8-1 – Certified device classes

	Wireless ***(relevant guidelines)***	**Wired** ***(relevant guidelines)***	**LP wireless PAN** ***(relevant guidelines)***
PAN usage sensor service device PAN usage sensor client device	6.2.1, 6.2.2, 6.2.3.25, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.25, 8.2.1, 8.2.4, 8.2.5	
PAN water sensor service device PAN water sensor client device	6.2.1, 6.2.2, 6.2.3.21, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.21, 8.2.1, 8.2.4, 8.2.5	
PAN weighing-scales service device PAN weighing-scales client device	6.2.1, 6.2.2, 6.2.3.6, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.6, 8.2.1, 8.2.4, 8.2.5	6.2.2.6, 8.2.1, 8.2.3, 8.2.6.5
PAN SABTE Service Device PAN SABTE Client Device	6.2.1, 6.2.2, 6.2.3.30, 8.2.1, 8.2.2, 8.2.5	6.2.1, 6.2.2, 6.2.3.30, 8.2.1, 8.2.4, 8.2.2, 8.2.5	

8.1.5 Device communication styles

The protocols selected in the PAN interface permits the device to transfer data in the following three communication styles:

– Transaction communication style: When it is required that the transport between the device and the AHD communicates a single data point immediately.

– Streaming communication style: When it is required that the transport between the device and the AHD communicates several data points continuously.

– Batch communication style: When it is required that the transport between the device and the AHD communicates previously collected data points at a later time.

The specific requirements pertaining to the QoS for each of the transports (Bluetooth and USB) for the various communication styles are outlined in clauses 8.2.2.5 and 8.2.4.4. For LP wireless PAN, the QoS is defined within the applicable Bluetooth LE profile.

8.1.6 PAN-IF security

For a wired USB solution, it is assumed that the physical action of the user connecting a wired PAN device to the AHD provides the necessary security to prevent inadvertent leakage of data to a different AHD. For a wireless solution, the specific requirements pertaining to accurate pairing and security are outlined in clause 8.2.2.2 for Bluetooth basic rate/enhanced data rate (BR/EDR) and in clauses 8.2.3.2 and 8.2.3.4 for Bluetooth LE.

8.2 Device and interface guidelines

8.2.1 PAN device guidelines

8.2.1.1 Overview

This clause contains design guidelines that apply to PAN physical devices. These can be personal healthcare devices or application hosting devices. In general, device design guidelines are kept in

the clause corresponding to the standard that applies to the guideline. However, these design guidelines apply generically to devices in the PAN interface.

8.2.1.2 Device to AHD linkage

Table 8-2 – Device to AHD linkage

Name	Description	Comments
ContinuaStructType	A Continua PAN service component **shall** connect with only one Continua PAN client component at any given time.	The Continua reference topology as described in [ITU-T H.810] restricts communication to a single client component.

8.2.2 Wireless PAN transport

8.2.2.1 Bluetooth health device profile

This clause contains a general design guideline that points to [Bluetooth HDPv1.1. All subsequent requirements in clause 8.2.2 refer to this specification. For further guidance on implementing the Bluetooth health device profile the reader is referred to the white paper [b-Bluetooth HDPIP].

Throughout this clause, some common Bluetooth terms are used:

When the term "discovery" is used, this is meant to describe its use of the Bluetooth inquiry substate to learn of the existence of other Bluetooth devices within transmission range. This is sometimes called "device discovery" to distinguish from service discovery. A Bluetooth device is discoverable if it periodically enters the inquiry scan substate. A discoverable device will respond to inquiry procedures (usually a general inquiry) from any device that wants to search.

A Bluetooth device enters the inquiry substate to discover other Bluetooth devices. Discoverable devices will periodically enter the inquiry scan substate.

Service discovery creates a baseband connection to a specific device (may be paired, but does not need to be) to discover details about services offered on that device.

When the term "pairing" is used, this is meant to describe the exchange of link keys to establish a future trust relationship with a known device. Except in legacy cases, this is performed with secure simple pairing (SSP).

When the term "connectable" is used, this is meant to describe a previously paired device that is periodically entering the page scan substate and responds to pages from devices that address it specifically (by Bluetooth MAC address). For a device to be connected, it must first be paired.

Table 8-3 – Bluetooth health device profile map

Name	Description	Comments
Wireless_PAN_BT_Map	Continua PAN wireless service and client components **shall** be compliant with Bluetooth 2.1.	Later versions of the Bluetooth specification can be used as long as version 2.1 functionality is fully supported.
Wireless_PAN_BT_HDP_Map	Continua PAN wireless service and client components **shall** be compliant with Bluetooth Health Device Profile version 1.1 subject to the design guidelines below.	Later versions of the Bluetooth HDP specification can be used as long as version 1.1 functionality is fully supported.

8.2.2.2 Discovery and pairing

PAN wireless Continua devices transfer measurement data to partner devices. These partnerships are formed either following a search initiated by the client component that will receive the data or through an out-of-band configuration.

This specification requires a process of discovery of the service component by the client component for all Bluetooth CDG devices. This ensures a consistent and user-friendly pairing procedure.

The guidelines throughout this clause create a single and universally supported technique for pairing devices that give a minimum of surprise or inconvenience to users. These guidelines apply to Bluetooth versions 2.0 and 2.1.

Table 8-4 – Bluetooth pairing guidelines

Name	Description	Comments
Wireless_PAN_BT_ Discovery_Initiation_ Client	Continua PAN wireless client components **shall** initiate discovery (a Bluetooth "Inquiry")	
Wireless_PAN_BT_ Discovery_Initiation_ Service	Continua PAN wireless service components **should not** initiate discovery (a Bluetooth "Inquiry")	
Wireless_PAN_BT_ Pairing_Service	Continua PAN wireless service components **shall** have a documented way (decided by the vendor) to initiate a mode of "discoverable by the client component" Once a service component has been made discoverable in this way, it **shall** support pairing with compatible client components, as shown in Figure 8-2	The words 'compatible client components' refer to client components that share the same device specialization as the service component
Wireless_PAN_BT_ Pairing_Client	Continua PAN wireless client components **shall** have a documented way (decided by the vendor) to initiate a search for service components that are "discoverable" Once the client component has discovered such service component, it **shall** support pairing with compatible service components, as shown in Figure 8-3	The words 'compatible service components' refer to service components that share the same device specialization as the client component Client components may be pre-configured to pair with a specific service component; however, they are required to provide support for discovery and pairing of any compatible service component.

Table 8-4 – Bluetooth pairing guidelines

Name	Description	Comments
Wireless_PAN_BT_ All_Pairing_Client	Continua PAN wireless client components **shall** support all pairing methods for Bluetooth 2.1, including Just Works, Numeric Comparison and Passkey Entry, if the client component has the appropriate I/O capabilities	I/O capabilities include display, keyboard, yes/no. See the Bluetooth core specification [Bluetooth CS2.1] and secure simple pairing white papers for further information. This pairing guideline is necessary to ensure interoperability and give reasonable assurance that a service component's chosen pairing method will be supported by client components
Wireless_PAN_BT_ Legacy_Pairing_Client	Continua PAN wireless client components **shall** support legacy (BT 2.0) pin entry pairing	This guideline is necessary to ensure backward compatibility with existing Continua BT 2.0 service components
Wireless PAN BT_ Pairing_Service_2	Continua PAN wireless service components **shall** support at least one of the following Bluetooth 2.1 pairing methods depending on their I/O capabilities and appropriate security for the service component device type: Just Works, Numeric Comparison, or Passkey Entry	I/O capabilities include display, keyboard, yes/no. See the Bluetooth core specification [Bluetooth CS2.1] and secure simple pairing white papers for further information
Wireless_PAN_BT_Re-Pairing	Once a Continua PAN wireless service component has been paired with a client component, it **shall** remain possible to re-initiate the mode "discoverable by the client component"	
Wireless_PAN_BT_ Data_Exchange_ Service	Continua PAN wireless service component data (not including HDP service discovery record or static information like capabilities, service names, etc.) **shall not** be exchanged with client components for which a pairing has not been established	
Wireless_PAN_BT_ Discoverability_Mode_ Service	By default, Continua PAN wireless service components **should not** be discoverable unless put in that mode as documented above	
Wireless_PAN_BT_ Discoverability_Mode_ Client	Continua PAN wireless client components **should not** be discoverable unless put in that mode as documented above	
Wireless_PAN_BT_ Discoverability_ Duration	Continua PAN wireless service components **should** provide a documented minimum duration (decided by the vendor) for this discoverable mode, once initiated, after which it ceases to be discoverable	

Table 8-4 – Bluetooth pairing guidelines

Name	Description	Comments
Wireless_PAN_BT_ Paired	When a Continua PAN wireless service component is discoverable and successfully completes a pairing procedure, it **should** immediately become undiscoverable	

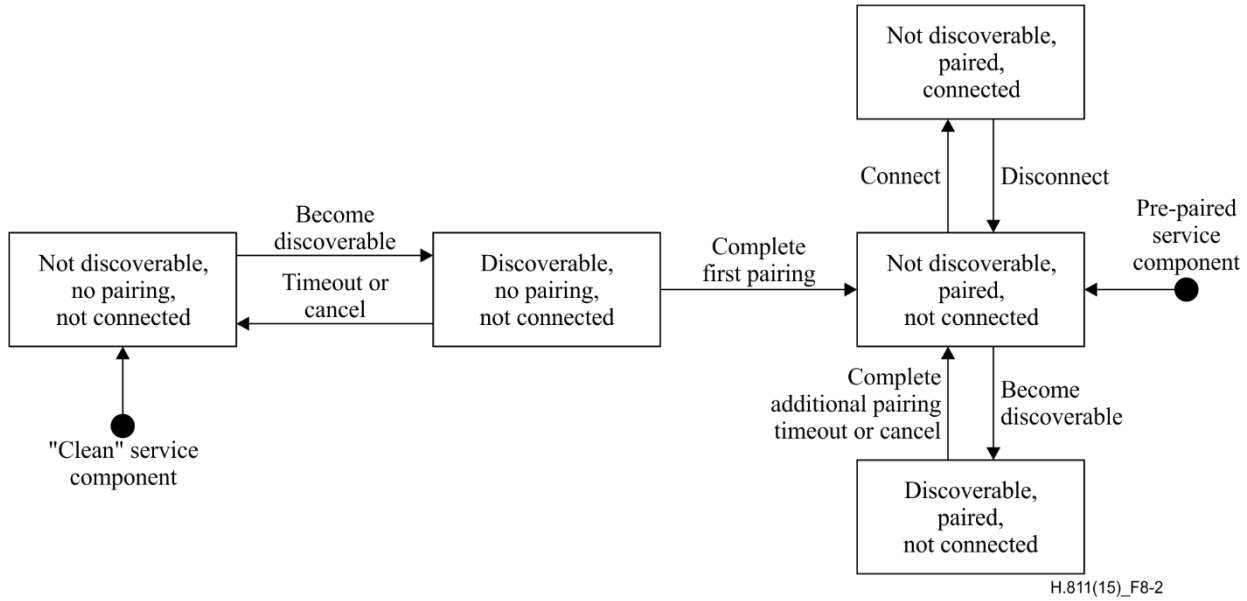

Figure 8-2 – Continua Bluetooth pairing process for service components

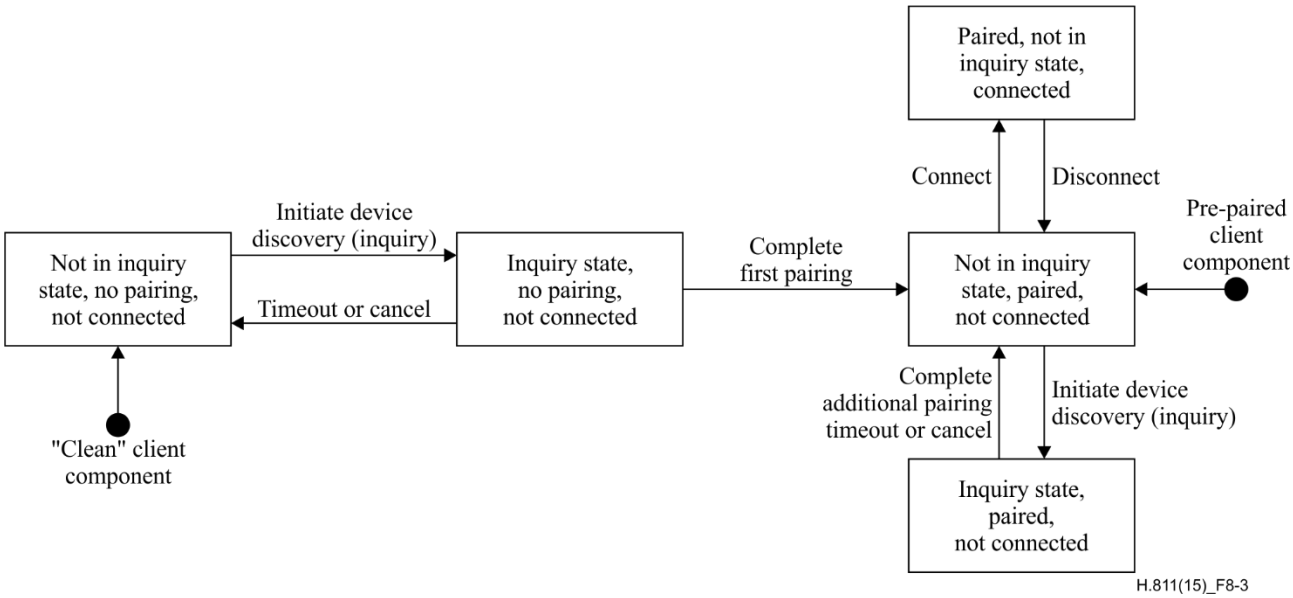

Figure 8-3 – Continua Bluetooth pairing process for client components

The diagram in Figure 8-2 shows the behaviour of a Continua PAN wireless service component in the pairing process and the diagram in Figure 8-3 shows the behaviour of a PAN wireless client component in the pairing process. Some Bluetooth devices may permit pairing from non-discoverable states, if the partner device knows the MAC address of the service component (either through out-of-band configuration or from a previous device discovery operation). These transitions

are not shown, although technically possible, for simplicity. Because they represent a non-standard operation of the device, they may present asecurity vulnerability for some applications.

Table 8-5 – Bluetooth pairing in non-discoverable states

Name	Description	Comments
Wireless_PAN_BT_ Non-Discovery	If a Continua PAN wireless service component is able to prevent pairing while in non-discoverable states, it **should** do so	

The reason for this procedure is to provide security and privacy for users while optimizing the ease of use by providing predictable behaviour and by minimizing the time and effort required to execute the pairing.

Another ease-of-use issue is the frequency required for a user to go through the pairing procedure. To avoid unnecessary re-pairings following battery replacements or power failures, persistent storage on sensors is important.

Table 8-6 – Bluetooth pairing data

Name	Description	Comments
Wireless_PAN_BT_ Pairing_Data_Service	Continua PAN wireless service components **shall** store the pairing data from at least the most recently paired device in such a way that the data will be retained through normal power interruptions, including battery replacement	
Wireless_PAN_BT_ Pairing_Data_Client	Continua PAN wireless client components **shall** store the pairing data from at least the most recently paired device in such a way that the data will be retained through normal power interruptions, including battery replacement Continua wireless PAN client components **should** store pairing data for at least the number of devices for which they are intended to simultaneously support	

8.2.2.3 Bluetooth discoverable mode

The requirements in clause 8.2.2.2 refer to a mode where a device is "discoverable by the client component". In Bluetooth terms, this means the device is in both "discoverable mode" and "pairable mode" (also known as "bondable mode"). When a device is in Bluetooth "discoverable mode", other devices can perform inquiries to learn its MAC address. From a CDG point of view, since all communication is between paired devices, it does not make sense for a service component to be discoverable unless it is willing to pair with devices that discover it.

Leaving a device in the discoverable (and pairable) state opens the device to hackers who may attempt to connect. Being discoverable is a security risk, as well as a privacy risk.

Table 8-7 – Bluetooth discovery disable

Name	Description	Comments
Wireless_PAN_BT_ Discovery_Disable	Continua PAN wireless service components that may become discoverable in the course of normal use **should** offer users a mechanism to disable this behaviour	

To avoid pairing with devices that cannot be used, it is helpful for devices to allow access to their HDP service discovery protocol (SDP) record to enable a connecting device, to query the capability of devices and identify the device specializations supported.

Table 8-8 – Bluetooth SDP access

Name	Description	Comments
Wireless_PAN_BT_ SDP_Access	When possible, Continua PAN wireless service components in "discoverable mode" **should** allow access to their SDP entries without first requiring a pairing to be established	

The Bluetooth HDP SDP record includes a list of supported [ISO/IEEE 11073-104xx] specializations under the SDP attribute "MDEP Data Type". This list is used to filter devices for suitability and is required by the Bluetooth HDP specification [Bluetooth HDPv1.1] to match the list of [ISO/IEEE 11073-104xx] specializations actually supported by the implementation.

Table 8-9 – Bluetooth SDP record

Name	Description	Comments
Wireless_PAN_BT_ SDP_Record	The specializations claimed in Continua certification **shall** match the list of specializations advertised in the Continua PAN wireless service component HDP SDP record	
Wireless_PAN_BT_ SDP_Extensions	The Continua PAN wireless service component HDP SDP record **may** contain additional specialization identifiers that are not Continua certified	

8.2.2.4 Notifying the user

Establishing a new pairing relationship is an important event. Because of the potential for confusion, extreme care should be used before automating the pairing procedure. To allow users reasonable control of their Continua systems, AHDs are required to provide a facility for alerting users of significant events (see PAN_Device_UI_Interaction). Because discovery may be difficult for users to understand, it is important to inform them of new pairings and reasons for failure. The design guidelines in this clause intentionally leave the nature of notifying and informing the user to be defined by the manufacturer.

Table 8-10 – Bluetooth user notification

Name	Description	Comments
Wireless_PAN_BT_ Pairing_Creation_Alert_ Client	Continua PAN wireless client components **shall** inform the user when a new pairing relationship is created	
Wireless_PAN_BT_ Pairing_Creation_Alert_ Service	Continua PAN wireless service components **should** notify the user, whenever possible, when a new pairing relationship is created	
Wireless_PAN_BT_ Pairing_Failure_Alert_ Client	When a pairing fails, Continua PAN wireless client components **shall** inform the user whether the failure was because no service component was found (discovery failed), no data types are supported in common by both the client component and service component (incompatible device), or the pairing failed (pairing failure)	
Wireless_PAN_BT_ Pairing_Failure_Alert_ Service	Whether or not pairing fails, Continua PAN wireless service components **should** inform the user, whenever possible, if no data types are supported in common by both the client component and service component (incompatible device), or the pairing failed (pairing failure)	

Actual use of devices varies widely and it is not always clear which device is more physically convenient to the user during these pairing events. For this reason and also to increase the chance that a user will notice improper use of a device, pairing notifications should be made as noticeable as possible.

Table 8-11 – Bluetooth authentication/security failure notification

Name	Description	Comments
Wireless_PAN_BT_ Security_Failure_Client	When any authentication/security failure is encountered by Continua PAN wireless client components, client components **shall** notify the user	
Wireless_PAN_BT_ Security_Failure_Service	When any authentication/security failure is encountered by Continua PAN wireless service components, service components **should** notify the user whenever possible	

8.2.2.5 Quality of service

Table 8-12 – Bluetooth quality of service

Name	Description	Comments
Wireless_PAN_ BT_QoS_ Best.Medium	Continua PAN wireless service and client components that implement the Continua *best.medium* QoS bin **shall** utilize the HDP reliable data channel type to do this	See clause 6.1.6.2 in [ITU-T H.810] for a definition of the QoS bins.
Wireless_PAN_ BT_QoS_ Good.Medium	Continua PAN wireless service and client components that implement the Continua *good.medium* QoS bin **shall** utilize the HDP streaming data channel type to do this	See clause 6.1.6.2 in [ITU-T H.810] for a definition of the QoS bins

While the Bluetooth core specification [Bluetooth CS2.1] specifies the use of a 16-bit FCS by default, it is optional in HDP [Bluetooth HDPv1.1] for "Reliable" and "Streaming" data channel types to disable the FCS (frame check sequence) if both sides agree during negotiation. The baseband already uses a CRC to detect bit errors in the data frames and FCS implements a second CRC to increase the probability of error detection. While devices that can tolerate an occasional

error (e.g., a pedometer counting the number of steps walked) and have limited processor or battery resources may opt not to use FCS, FCS is recommended for all other cases. This will significantly improve (estimated to be on the order of thousands of times) the probability that an error is detected.

Table 8-13 – Bluetooth error detection

Name	Description	Comments
Wireless_PAN_BT_FCS	When possible and appropriate to the device, Continua PAN wireless service and client components **should** use FCS for all data channels	

8.2.2.6 Secure simple pairing debug mode

If a device compliant with Bluetooth version 2.1 connects to another device also compliant with Bluetooth version 2.1, the use of SSP in Bluetooth is mandatory. SSP results in an encrypted link requiring a Private Key to decrypt packets. To make the decryption of over-air packets possible for the purposes of test and debug when SSP is used (e.g., via a sniffer or protocol analyser), devices compliant with Bluetooth 2.1 would need to implement the SSP debug mode. Debug mode only needs to be supported by one of the two sides of the link for over-air decryption to be possible.

8.2.3 Low-power (LP) wireless PAN transport

8.2.3.1 Bluetooth low energy and profiles

Bluetooth low energy technology has been selected as the low-power (LP) wireless PAN technology. The specifications relating to Bluetooth low energy are in version 4.0 (or later) of the core Bluetooth specifications [Bluetooth CS4.0]. Any related profile specifications are detailed in separate documents. Bluetooth devices that support Bluetooth low energy can be either a dual mode device, which is a device that supports both standard BR/EDR Bluetooth and Bluetooth low energy, or a single mode device, which is a device that supports Bluetooth low energy only. It is envisioned that service components supporting Bluetooth low energy will mostly be single mode devices.

Table 8-14 – LP Wireless PAN transport

Name	Description	Comments
LP_Wireless_PAN_BT_LE_Map	Continua LP wireless PAN service and client components **shall** implement Bluetooth low energy as described in Bluetooth *Core Version 4.0* [Bluetooth CS4.0] subject to the design guidelines below.	Note that later backwards-compatible versions of the Bluetooth low energy specification can also be used to meet this requirement.

8.2.3.2 Device discovery, pairing and service discovery

LP wireless PAN Continua service devices transfer measurement data to client devices. Continua LP wireless PAN client and service components are required to pair with each other, either following a search initiated by the client component that obtains a list of compatible devices or through an out-of-band configuration.

A process of discovery of the service component by the client component is required for all Continua LP wireless PAN devices. This ensures a consistent and user-friendly pairing procedure.

The guidelines throughout this clause create a single and universally supported technique for pairing devices that give a minimum of surprise or inconvenience to users.

Table 8-15 – LP Wireless PAN device discovery, pairing and service discovery

Name	Description	Comments
LP_Wireless_PAN_BT_LE_ Pairing_Start_Client	Once a Continua LP wireless PAN client component has discovered a Continua LP wireless PAN service component that supports a compatible service, it **shall** support pairing with that Continua LP wireless PAN service component	
LP_Wireless_PAN_BT_LE_ Enter_Discoverability_Service	A Continua LP wireless PAN service component **shall** have a documented way to be set to be discoverable and a documented way to pair with a Continua LP wireless PAN client component	
LP_Wireless_PAN_BT_LE_ Initiate_Discovery_Pairing_Client	A Continua LP wireless PAN client component **shall** have a documented way to initiate a search for discoverable Continua LP wireless PAN service component and a documented way of initiating pairing with a Continua LP wireless PAN service component	
LP_Wireless_PAN_BT_LE_ Discoverability_Mode_Service	A Continua LP wireless PAN service component **shall not** be discoverable unless initiated by a user	
LP_Wireless_PAN_BT_LE_ Delete_Pairing_Service	A Continua LP wireless PAN service component **should** have a way to delete pairings	
LP_Wireless_PAN_BT_LE_ Delete_Pairing_Client	A Continua LP wireless PAN client component **should** have a way to delete pairings	
LP_Wireless_PAN_BT_LE_ Additional_Pairing_Service	A Continua LP wireless PAN service component **shall** support replacing its pairing	Pairing is not exclusive for the lifetime of the service component to enhance interoperability
LP_Wireless_PAN_BT_LE_No_ Data_Exchange_Before_Pairing_ Service	Continua LP wireless PAN service component data (other than service discovery data or capability or service name from the advertising packet) **shall not** be exchanged with a Continua LP wireless PAN client component prior to pairing	
LP_Wireless_PAN_BT_LE_ Disc_Mode_Max_Duration_ Service	A Continua LP wireless PAN service component **should** have a documented maximum duration for discoverable mode whereby after the maximum time, the Continua LP wireless PAN service component ceases to be discoverable until put back into that mode by the user	

Table 8-15 – LP Wireless PAN device discovery, pairing and service discovery

Name	Description	Comments
LP_Wireless_PAN_BT_LE_ After_Pairing_Undiscoverable_ Service	After a Continua LP wireless PAN service component is successfully paired, it **shall** immediately (e.g., within 1 second) become undiscoverable until made discoverable again by the user	
LP_Wireless_PAN_BT_LE_ Store_Pairing_Service	Continua LP wireless PAN service components **should** store pairing data from at least the most recently paired device such that the data is persistent (e.g., with loss of power, including removal of a battery)	
LP_Wireless_PAN_BT_LE_ Store_Pairing_Client	Continua LP wireless PAN client components **should** store pairing data from at least the most recently paired device such that the data is persistent (e.g., with loss of power including removal of a battery)	
LP_Wireless_PAN_BT_LE_ Number_Store_Pairing_Client	Continua LP wireless PAN client components **should** store pairing data for at least the number of devices they are intended to simultaneously support	
LP_Wireless_PAN_BT_LE_ Supported_Services_Profiles_ Service	Continua LP wireless PAN service component's Attribute database **shall** list all supported LE services/profiles claimed in Continua certification documentation	

8.2.3.3 User notification

Establishing a new pairing relationship is an important event. Because of the potential for confusion, extreme care should be used before automating the pairing procedure. To allow users reasonable control of their CDG systems, AHDs are required to provide a facility for alerting users of significant events. Because discovery may be difficult for users to understand, it is important to inform them of new pairings and reasons for failure. The guidelines in this clause intentionally leave the nature of notifying and informing the user to be defined by the manufacturer.

Table 8-16 – LP wireless PAN user notification

Name	Description	Comments
LP_Wireless_PAN_BT_LE_ Inform_Pairing_Success_ Service	If supported by the UI, Continua LP wireless PAN service components **should** inform the user that pairing and authentication was successful	
LP_Wireless_PAN_BT_LE_ Inform_Pairing_Success_ Client	If supported by the UI, Continua LP wireless PAN client components **shall** inform the user that a pairing and authentication was successful	
LP_Wireless_PAN_BT_LE_ Filter_Compatible_Client	Continua LP wireless PAN client components in a mode of device discovery **should** filter discovered Continua LP wireless PAN service components to include only those that have compatible services/profiles	
LP_Wireless_PAN_BT_LE_ Inform_User_Pairing_ Failure_Client	If there is a failure during the discovery, pairing and authentication process and if supported by the UI, the Continua LP wireless PAN client component **shall** inform the user whether the failure is because 1) no compatible Continua LP wireless PAN service components was found (compatible device not found) or 2) the pairing failed (pairing failure) or 3) the authentication process timed out (authentication timeout) or 4) the user entered the incorrect passkey (incorrect PIN)	

8.2.3.4 Authentication

In Bluetooth LE profiles referenced in these guidelines, the service component chooses the mode of security it desires and the client component is required to accept this. Bluetooth LE profiles can mandate Just Works authentication, Passkey Entry of a six-digit PIN or an out-of-band obtained passkey. While in Bluetooth there are various authentication options, CDG places more requirements on authentication to ensure interoperability as follows.

Table 8-17 – LP wireless PAN authentication

Name	Description	Comments
LP_Wireless_PAN_ BT_LE_ Authentication_ Support_Service	Continua LP wireless PAN service components **shall** support at least one of the following Bluetooth 4.0 pairing methods depending on its I/O capabilities and the appropriate security for the service component device type: Just Works or Passkey Entry	I/O capabilities include display, keyboard, yes/no. See Bluetooth Core Specification 4.0 [Bluetooth CS4.0] for further information.
LP_Wireless_PAN_ BT_LE_ Authentication_ Support_Client	Continua LP wireless PAN client components **shall** support Just Works and Passkey Entry pairing methods for Bluetooth 4.0 if the client component has the appropriate I/O capabilities	I/O capabilities include display, keyboard, yes/no. See Bluetooth Core Specification 4.0 [Bluetooth CS4.0] for further information. This pairing guideline is necessary to ensure interoperability and give reasonable assurance that a service component's chosen pairing method will be supported by client components.

8.2.3.5 OEM requirements

Bluetooth LE profiles referenced in these guidelines may define some OEM characteristics within the Bluetooth SIG device information service as optional. This clause describes the guidelines that are targeted at the OEM characteristics. All of the fields defined in this clause are from the Bluetooth SIG device information service.

Table 8-18 – LP wireless PAN OEM requirements

Name	Description	Comments
LP_Wireless_PAN_ 11073-20601_ Manufacturer	Continua LP wireless PAN service components **shall** support and set the manufacturer name string defined in the Bluetooth SIG device information service to the device's original manufacturer's name. If this capability is available, the manufacturer name string **may** be overwritten to the customer facing company's name by the customer facing company	
LP_Wireless_PAN_ 11073-20601_Model	Continua LP wireless PAN service components **shall** set the model number string defined in the Bluetooth SIG device information service to the device's original manufacturer's model number. The model number string field **may** be overwritten to the customer facing company's model by the customer facing company	
LP_Wireless_PAN_ 11073-20601_SYSID	Continua LP wireless PAN service components **shall** include the System ID characteristic defined in the Bluetooth SIG device information service	
LP_Wireless_PAN_ 11073-20601_OUI	The organizationally unique identifier (OUI) field of the System ID characteristic defined in the Bluetooth SIG device information service in a Continua LP wireless PAN service component **shall** be set and remain unchanged from the value set by the original manufacturer	This is a unique identifier, which is obtained by the IEEE registration authority and which is associated with a company. This attribute maps to the OUI part (first 24 bits) of the EUI-64 attribute
LP_Wireless_PAN_ 11073-20601_DID	The 40 bit manufacturer defined identifier field in the System ID characteristic defined in the Bluetooth SIG device information service of a Continua LP wireless PAN service component **shall** be set and remain unchanged from the value set by the original manufacturer	In combination with the OUI part above, this is a unique identifier associated with the device. It is required in order to facilitate data quality analysis. This attribute maps to the company defined part (last 40 bits) of the EUI-64 attribute
LP_Wireless_PAN_ 11073-20601_Serial_ Number	Continua LP wireless PAN service components **shall** set the serial number string characteristic defined in the Bluetooth SIG device information service to the serial number of the device	

Table 8-18 – LP wireless PAN OEM requirements

Name	Description	Comments
LP_Wireless_PAN_ 11073-20601_FW_ Revision	Continua LP wireless PAN service components that provide a firmware identifier **shall** set the firmware revision string characteristic defined in the Bluetooth SIG device information service to the firmware identifier of the device	The firmware identifier is the version of the firmware deployed on the PAN device. The firmware release deployed on a PAN device is uniquely identified by the firmware identifier

8.2.3.6 Date and time requirements

Bluetooth LE devices which report time-stamped measurements must provide the means to report the current date and time of the device. The following guidelines are intended to provide the means for this support.

Table 8-19 – LP wireless PAN date and time requirements

Name	Description	Comments
LP_Wireless_PAN_ BT_LE_Date_Time	Continua LP wireless PAN service components that report time-stamped measurements shall support the Current Time Service [Bluetooth CTS] or shall include the "Date Time" characteristic in the service component for the purpose of reporting the current date and time of the service component.	Transcoding of time specified in the Personal Health Devices Transcoding White Paper from the Bluetooth SIG [Bluetooth PHDT v1.5]. Newer versions of this whitepaper require support of CTS by the service component when reporting time-stamped measurements. For newer designs the use of CTS is the preferred choice. Continua still allows use of the Date-Time characteristic for legacy devices that report time-stamped measurements as described in [Bluetooth PHDT V1.4].

8.2.3.7 Certification and regulatory aspects

Since Bluetooth LE profiles referenced in these guidelines define as optional the IEEE 11073-20601 Regulatory Certification Data List characteristic within the Bluetooth SIG device information service, this clause describes the guidelines that are targeted at certification and regulatory aspects including those specific to this characteristic.

For this purpose, the following abstract syntax notation one (ASN.1) definitions are introduced and referenced in Table 8-20.

```
ContinuaStructType ::= INT-U8 {
     continua-version-struct(1),   -- auth-body-data is a ContinuaBodyStruct
     continua-reg-struct(2)          -- auth-body-data is a ContinuaRegStruct

}
ContinuaBodyStruct ::= SEQUENCE {
        major-IG-version      INT-U8,
        minor-IG-version      INT-U8,
        certified-devices     CertifiedDeviceClassList
}

CertifiedDeviceClassList ::= SEQUENCE OF CertifiedDeviceClassEntry

-- See guideline  11073-20601_DeviceClassEntry for the algorithm to compute the
value
CertifiedDeviceClassEntry ::= INT-U16

ContinuaRegStruct ::= SEQUENCE {
        regulation-bit-field     RegulationBitFieldType
}


RegulationBitFieldType  ::= BITS-16 {
     unregulated-device (0)  -- This bit shall be set if the device is not
regulated }
```

Figure 8-4 – ASN.1 notation of Continua certification structures for Bluetooth LE

Table 8-20 – LP wireless PAN certification and regulation

Name	Description	Comments
LP_Wireless_PAN_BT_ LE_Support_Reg_Cert_ Data_Service	Continua LP wireless PAN service components **shall** support and fill the IEEE 11073-20601 Regulatory Certification Data List characteristic defined in the Bluetooth SIG device information service with an MDER encoded version of the IEEE 11073-20601 RegCertDataList data structure. The RegCertDataList data structure **shall** contain a RegCertData element with the *auth-body-continua* and the *auth-body-struc-type* field set to *continua-version-struct* from a ContinuaStructType as defined above. The field *auth-body-data* **shall** be filled in as a *ContinuaBodyStruct* as defined above	This is used to indicate whether a device is Continua certified and (if so) which version of the Continua Design Guidelines it is certified to
LP_Wireless_PAN_BT_ LE _DeviceClassList	Continua LP wireless PAN service components **shall** list all implemented and only the implemented certified device classes in the IEEE 11073-20601 Regulatory Certification Data List characteristic within the Bluetooth SIG device information service	

Table 8-20 – LP wireless PAN certification and regulation

Name	Description	Comments
LP_Wireless_PAN_BT_ LE _DeviceClassEntry	Continua LP wireless PAN service components **shall** assign the following certified device class field value within the IEEE 11073-20601 Regulatory Certification Data List characteristic within the Bluetooth SIG device information service to an implemented Certified Device Class: MDC_DEV_*_SPEC_PROFILE_* - 4096 + TCode x 8192, where MDC_DEV_*_SPEC_PROFILE_* denotes the IEEE 11073 PHD nomenclature code for the corresponding device (sub-) specialization and TCode denotes the corresponding transport standard, with TCode = {4 for LP wireless PAN}	See [Bluetooth PHDT]
LP_Wireless_PAN_BT_ LE_Report_Regulated_ Service	All Continua LP wireless PAN service components **shall** report information on whether or not they are regulated. This is a single Boolean entitled unregulated-device, which is set to 1 if not regulated and 0 if regulated and contained as part of IEEE 11073-20601 Regulatory Certification Data List defined in the Bluetooth SIG device information service	

8.2.3.8 Transcoding

Bluetooth LE profiles referenced in these guidelines are designed to be compatible with the IEEE 11073 device information model (DIM) and nomenclature of a corresponding IEEE 11073 device specialization. The Bluetooth SIG published document [Bluetooth PHDT] contains the information showing how the applicable LE characteristics can be mapped to the device information model (DIM) and nomenclature of the corresponding IEEE 11073 device specializations. From a Bluetooth LE profile perspective this mapping information is included as informative text for profiles targeted for usage in CDG. However, when Bluetooth LE profiles are used within the CDG and transcoding is required, this mapping information is normative for implementations that transcode LE data.

Table 8-21 – LP wireless PAN transcoding

Name	Description	Comments
LP_Wireless_PAN_ BT_LE_Transcode	The guidelines for interfaces in the Continua E2E architecture assume that data coming from the PAN interface are IEEE 11073 nomenclature and DIM representations and then specify necessary data conversions for each of the interfaces. Any solution that interacts with the LP wireless PAN interface and passes the data over other Continua interfaces **shall** follow [Bluetooth PHDT] during the translation process from LE data to final representation for the supported interface(s). Transcoded data **shall** be compliant to the IEEE 11073 nomenclature and DIM corresponding specifically with [b-ISO/IEEE 11073-20601 (2008)] and [ISO/IEEE 11073-20601A]	[Bluetooth PHDT] is informative from the Bluetooth SIG perspective, but is normative for the purposes of these guidelines. This white paper specifies how to convert the Bluetooth LE data into full IEEE 11073 compliant data, which then supports the use of the data for the Continua WAN and HRN interfaces. Note that this guideline does not require an AHD to actually create the DIM, objects and attributes indicated by the white paper. However, the data generated for transmission over the subsequent Continua interface must match the data that would have been generated from such a DIM

8.2.4 Wired PAN transport - USB

8.2.4.1 USB general requirements

This clause contains a general design guideline that points to the USB personal healthcare device class (PHDC) v1.0 [USB DevClass]. All subsequent requirements in clause 8.2.4 refer to this specification.

For more information about [USB DevClass] device drivers please see Appendix III and in [b-CHA USB-PHDC].

Table 8-22 – USB personal healthcare device class v1.0 map

Name	Description	Comments
Wired_PAN_USB_ Personal Healthcare_ v1.0	Continua PAN wired USB service and client components **shall** implement the USB personal healthcare device class v1.0 plus the Feb. 15, 2008 errata, subject to the requirements listed below	

8.2.4.2 Map to ISO/IEEE 11073-20601

This clause requires that a Continua-compliant device send only [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] data and messages over USB PHDC. In addition, driver software implementing the USB PHDC transport should not need to parse the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] data to fully function.

Table 8-23 – ISO/IEEE 11073-20601 messaging layer

Name	Description	Comments
Wired_PAN_USB_ PHDC_20601_Map_ Service	Continua PAN wired USB service components **shall** set the USB PHDC v1.0 bPHDCDataCode field of the PHDC Class Function descriptor equal to PHDC_11073_20601	
Wired_PAN_USB_ PHDC_20601_Map_ Client	Continua PAN wired USB client components **shall** accept PHDC Class Function descriptors with the USB PHDC v1.0 bPHDCDataCode field equal to PHDC_11073_20601	
Wired_PAN_USB_ PHDC_20601_ Device_Spec_Cert_ Dev_Classes	Continua PAN wired USB service components **shall** set the wDevSpecializations field(s) to the corresponding [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] *MDC_DEV_ SPEC_PROFILE_** value(s) corresponding to the certified device class(es) that the component supports	
Wired_PAN_USB_ PHDC_20601_ Device_Spec_Not_ Cert	Continua PAN wired USB service components **may** add additional [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] *MDC_DEV_SPEC_ PROFILE_** value(s) corresponding to supported IEEE specializations that are not Continua certified in the wDevSpecializations array	
Wired_PAN_USB_ PHDC_20601_10101_ Client	Continua PAN wired USB client components **shall not** pre-filter and reject a service component based on the wDevSpecializations field(s) value(s)	The rejection of unsupported device specializations happens in the higher layers via the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] Optimized exchange protocol
Wired_PAN_USB_ EndOfTransfer	Continua PAN wired USB service and client components **shall** signify the end of a bulk transfer by transferring a payload of size less than wMaxPacketSize or a zero-length packet	USB service and client components are not required to read the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] data to obtain the length

8.2.4.3 Sending metadata via USB PHDC

The USB PHDC specification [USB DevClass] contains a feature to enable the sending of QoS information with IEEE 11073 ([ISO/IEEE 11073-20601] and [IEEE 11073-20601A]) data and messages. The USB PHDC specification states that this feature is optional for service components to support and mandatory for client components to support.

It is not expected that Continua PAN service components will implement the feature or Continua PAN client components will enable the feature; however, if a service component or client component chooses to make use of the feature, the following design guidelines apply.

Table 8-24 – Using USB PHDC metadata/QoS feature

Name	Description	Comments
Wired_PAN_USB_ PHDC_Enable_ Meta-Data_ Preamble	Continua PAN wired USB client components that choose to enable the USB PHDC Meta-Data Message Preamble feature **shall** attempt to enable the feature by sending the USB PHDC SET_FEATURE (FEATURE_ PHDC_METADATA) request after the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] Association Request message has been received and before it sends the [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] Association Response message	
Wired_PAN_USB_ PHDC_Disable_ Meta-Data_ Preamble	Continua PAN wired USB client components that choose to enable the USB PHDC Meta-Data Message Preamble feature **shall** disable the feature *when in the Unassociated state* only by sending the USB PHDC CLEAR_ FEATURE (FEATURE_PHDC_ METADATA) request	
Wired_PAN_USB_ bQoSEncoding VersionOOB	Continua PAN wired USB client components that receive a bQoSEncodingVersion field that is not 01h **shall** ignore the bmLatencyReliability bitmap as it could have a different meaning in a future version of the specification	This replaces the text "In order to remain forward compatible, if a host implementing 01h QoS information encoding receives a bQoSEncodingVersion field that is not 01h, it shall ignore the descriptor." on page 22, 1st paragraph, of [USB DevClass]

8.2.4.4 Quality of service

The following requirements describe how QoS attributes are used for Continua PAN wired USB service and client components.

Table 8-25 – Mapping of USB PHDC QoS bins into Continua QoS bins

Name	Description	Comments
Wired_PAN_USB_QoS_ Best.Medium	Continua PAN wired USB service and client components that implement the Continua *best.medium* QoS bin **shall** utilize the USB PHDC *best.medium* QoS bin to do this	
Wired_PAN_USB_QoS_ Good.Medium	Continua PAN wired USB service and client components that implement the Continua *good.medium* QoS bin **shall** utilize the USB PHDC *good.medium* QoS bin to do this	

8.2.4.5 Multi-function devices

This clause defines how devices that implement more than one IEEE 11073 PHD device specialization are represented via USB PHDC. CDG requires that all multi-function devices expose all device specializations via a single [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] association. In USB, a single [ISO/IEEE 11073-20601] and [IEEE 11073-20601A] association maps best to a single USB PHDC interface. Thus, a Continua-certified USB PHDC device has only

one USB PHDC interface for CDG functionality, regardless of whether it exposes a single device specialization or multiple device specializations. This is shown in Figure 8-5.

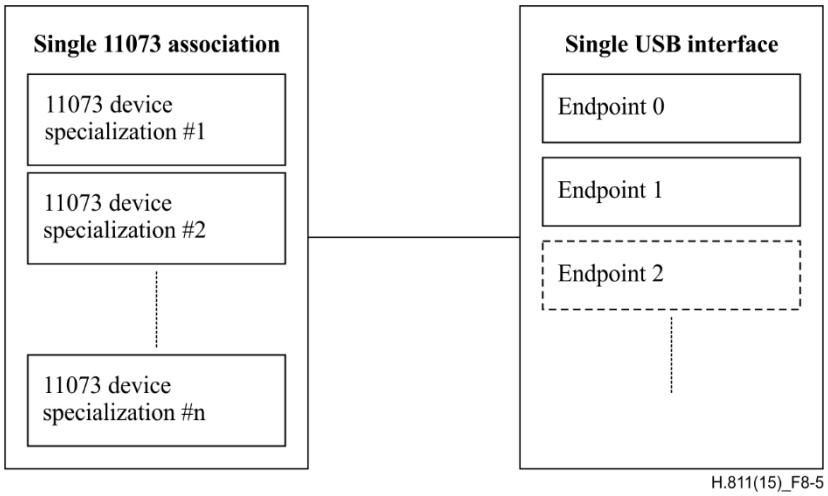

Figure 8-5 – USB PHDC mapping to [ISO/IEEE 11073-20601] associations

Table 8-26 – Multi-function devices

Name	Description	Comments
Wired_PAN_USB_ PHDC_Multi_ Function_Single_ Interface	Continua PAN wired USB service components, whether multi-function or single function, **shall** implement one and only one USB PHDC interface for the component's [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] association	CDG requires that all USB multi-function devices expose all functions via a single [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] association. See 11073-20601_Multi-Function.

8.2.4.6 Connectors

USB contains a few connector options on the service and client side. The following design guidelines give guidance on connector choices for implementation.

Table 8-27 – USB connectors

Name	Description	Comments
Wired_PAN_USB_B_ Connector_ Connectivity	A Continua PAN USB device **should** be shipped with a mechanism for connecting themselves to an application hosting device assuming a standard-A connector to the application hosting device	Example connectivity mechanisms include a cable that connects to the device and exposes a standard-A connector and an integral cable on the device that exposes a standard-A connector
Wired_PAN_USB_B_ Connector_ Mechanism_to_Obtain_ Connectivity	If a Continua PAN USB device does not ship with a mechanism for connectivity as defined in Wired_PAN_USB_B_Connector_ Connectivity, it **shall** ship with a mechanism for obtaining such connectivity	Example mechanisms for obtaining connectivity include documentation on the type of cable needed and possibly, a phone number, mail in the form or website for requesting and/or purchasing that cable

Table 8-27 – USB connectors

Name	Description	Comments
Wired_PAN_USB_A_ Connector_ Connectivity	Continua PAN USB application hosting devices that do not accept a Standard-A female connector **should** be shipped with a mechanism for converting to accept a Standard-A female connector	Example mechanisms include a converter from the A connector on the application hosting device to standard-A
Wired_PAN_USB_A_ Connector_ Mechanism_to_Obtain_ Connectivity	If a Continua PAN USB application hosting device that does not accept a Standard-A female connector does not ship with a mechanism for converting to Standard-A female connector, it **shall** be shipped with a mechanism for obtaining a conversion to accept a Standard-A female connector	Example mechanisms include documentation on the converter necessary and possibly, a phone number, mail in the form or website for requesting and/or purchasing that converter

8.2.4.7 Data rates

USB 2.0 provides full speed and high speed data rates. USB 1.1 provides low speed and full speed data rates. This clause describes the requirements CDG places on the data rates to use.

Table 8-28 – USB data rates

Name	Description	Comments
Wired_PAN_USB_ Low_Speed	Continua PAN wired USB service and client components **shall not** use low speed	Low speed is mostly used for keyboards, mice and joysticks. Low speed does not support all data rates required by the CDG. Max packet size for low-speed is 8 bytes. Low-speed also has behavioural differences with full and high speed. NOTE - Low speed is only available in USB 1.1
Wired_PAN_USB_ USB_2.0	Continua PAN wired USB service and client components **should** implement USB 2.0	
Wired_PAN_USB_ USB_1.1	Continua PAN wired USB service and client components **shall** implement at least USB 1.1 or any superior version compatible with USB 1.1	

8.2.5 PAN data/messaging layer

NOTE – This clause does not apply to "LP wireless PAN" devices as any applicable requirements are handled elsewhere.

8.2.5.1 PAN wired/wireless sensor component – communication capabilities

This clause contains guidelines for general communications capabilities of sensor components.

Table 8-29 – Communication capabilities association and configuration

Name	Description	Comments
PAN_11073-20601_ Complete_Config_ Object_List	Continua PAN service components **shall** always populate the ConfigObjectList of a configuration message with the complete set of objects and attributes supported by the configuration	[ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] allow an agent to send a configuration event with an empty ConfigObjectList if the configuration-id is within the range of standard-config-start and standard-config-end. This mechanism was designed in [IEEE 11073-20601] to optimize bytes transferred. However this mechanism is likely to cause interoperability problems as the feature is not well known. It is believed that the enhancement to interoperability outweighs the optimization.

8.2.5.2 PAN wired/wireless sensor component multi-function devices

This clause describes guidelines for multi-function devices (e.g., how to make combined use of [ISO/IEEE 11073-104xx] to create multi-function devices, or how to use the [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] mechanisms for association in this case).

Table 8-30 – Multi-function devices

Name	Description	Comments
PAN_11073-20601_ Multi-Function	A Continua PAN service component **shall** have at most one [ISO/IEEE 11073-20601] and [ISO/IEEE 11073-20601A] association to a PAN client component at any point in time regardless of whether the device is a single function or multi-function device	This guideline prohibits the device from having two concurrent associations. The device may provide different configuration options only in subsequent associations only after closing the currently active association

8.2.6 Low-power wireless PAN devices

8.2.6.1 Blood pressure monitor

Table 8-31 – Blood pressure general requirements for LP wireless PAN

Name	Description	Comments
LP_Wireless_PAN_ Blood Pressure_Service	Continua LP wireless PAN blood pressure service components **shall** implement the blood pressure service from [Bluetooth BPS]	
LP_Wireless_PAN_ Blood Pressure_Client	Continua LP wireless PAN blood pressure client components **shall** implement the blood pressure profile from [Bluetooth BPP]	

8.2.6.2 Thermometer

Table 8-32 – Thermometer general requirements for LP wireless PAN

Name	Description	Comments
LP_Wireless_PAN_ Thermometer_Service	Continua LP wireless PAN thermometer service components **shall** implement the health thermometer service from [Bluetooth HTS]	
LP_Wireless_PAN_ Thermometer_Client	Continua LP wireless PAN thermometer client components **shall** implement the health thermometer profile from [Bluetooth HTP]	

8.2.6.3 Heart-rate sensor

Table 8-33 – Heart-rate sensor general requirements for LP wireless PAN

Name	Description	Comments
LP_Wireless_PAN_ Heart_rate_Sensor_ Service	Continua LP wireless PAN heart-rate sensor service components **shall** implement the heart-rate service from [Bluetooth HRS]	
LP_Wireless_PAN_ Heart_Rate_Sensor_ Client	Continua LP wireless PAN heart-rate client components **shall** implement the heart-rate profile from the [Bluetooth HRP]	

8.2.6.4 Glucose meter

Table 8-34 – Glucose meter general requirements for LP wireless PAN

Name	Description	Comments
LP_Wireless_PAN_ Glucose_Meter_Service	Continua LP wireless PAN glucose meter service components **shall** implement the glucose service from the [Bluetooth GLS]	
LP_Wireless_PAN_ Glucose_Meter_Client	Continua LP wireless PAN glucose meter client components **shall** implement the glucose meter profile from [Bluetooth GLP]	

8.2.6.5 Weight scale

Table 8-35 – Weight Scale general requirements for LP wireless PAN

Name	Description	Comments
LP_Wireless_PAN_ Weight_Scale_Service	Continua LP wireless PAN weight scale meter service components **shall** implement the weight scale service from the Bluetooth SIG [Bluetooth WSS]	
LP_Wireless_PAN_ Weight_Scale_Body_ Composition_Service	Continua LP wireless PAN weight scale meter_service components **may** implement the body composition service from the Bluetooth SIG [Bluetooth BCS]	
LP_Wireless_PAN_ Weight_Scale_Client	Continua LP wireless PAN weight scale client components **shall** implement the weight scale profile from the Bluetooth SIG [Bluetooth WSP]	

9 Sensor-LAN interface design guidelines

9.1 Architecture (informative)

9.1.1 Introduction

This clause lists the design guidelines specific for interoperability across Continua certified devices in the sensor-LAN interface. Figure 9-1 illustrates the LAN interface in the context of the Continua E2E architecture. The sensor-LAN interface is a particular sub-class of the Continua LAN-interface and connects sensor-LAN devices to Continua application hosting devices across all three CDG domains, disease management, ageing independently and health and fitness.

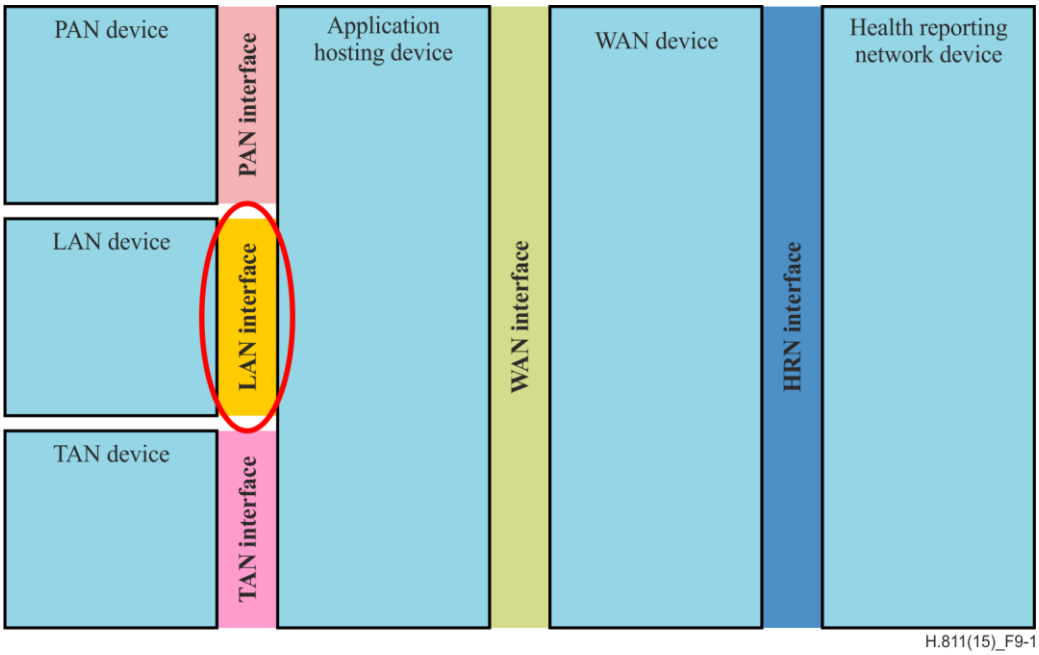

Figure 9-1 – LAN interface

9.1.2 Scope

The sensor-LAN interface enables sensors (or actuators) to send their measured data to (or to be controlled by) one or many Continua AHDs that are placed around the same house, building, facility or campus. In this respect, the sensor-LAN interface provides wireless infrastructure based connectivity in an area around a location. The network coverage area can scale up to several hundreds of meters, with several tens, and up to several thousands of devices being a part of that network. The location of sensors/actuators connected via the sensor-LAN interface can be fixed as well as mobile, with the latter case referring to devices (e.g., body worn) roaming throughout the network up to walking/running speed. Furthermore, up to years of battery lifetime is enabled for sensors/actuators connected via the sensor-LAN interface. See Figure 9-2 for a high-level illustrative diagram of the sensor-LAN conceptual set-up. In Figure 9-2(a) sensor-LAN devices are utilizing an existing wireless infrastructure network for communication and in Figure 9-2(b) sensor-LAN devices are being part of and contributing to the wireless infrastructure network.

The use of the sensor-LAN interface is not limited to large-scale, long-range networks. Rather it can be used to establish direct short-range connections between sensors and AHDs as well.

In version 2010 of the CDG, the scope of the sensor-LAN interface was restricted to many-to-one connectivity. According to this, an AHD may connect to one or more sensor-LAN devices at the same time, but a Continua sensor-LAN device was allowed to connect to only a single Continua AHD at the same time. In this version of the CDG; the extension to many-to-many connectivity is

defined, i.e., the simultaneous connection of a sensor-LAN device to multiple AHDs at the same time.

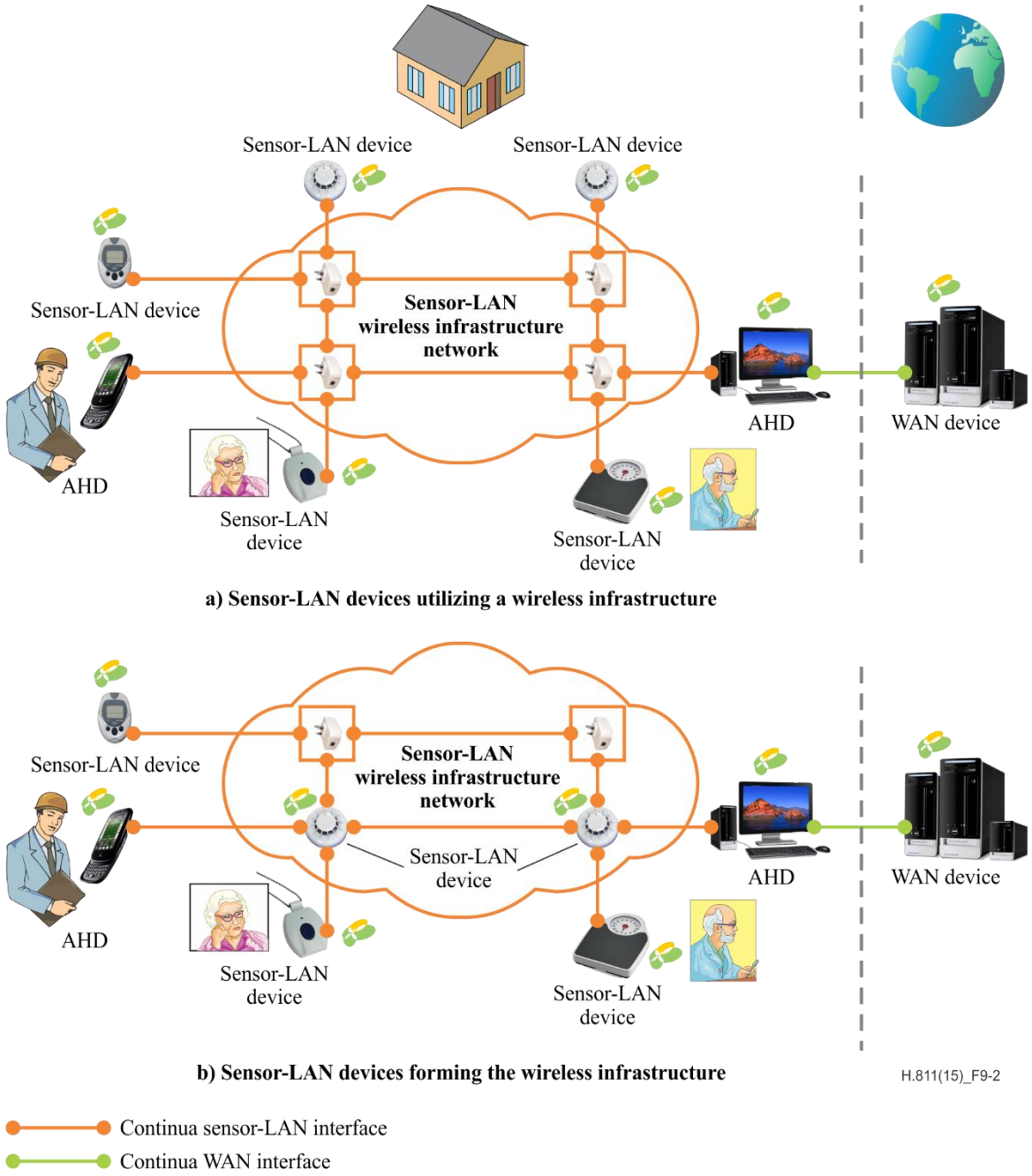

Figure 9-2 – Sensor-LAN conceptual set-up

9.1.3 Overview

The interface is structured into distinct layers. Appropriate standards are selected for the individual layers and establish interoperability in the personal health ecosystem. See Figure 6-1 for an overview of the protocol stack of the sensor-LAN interface.

9.1.4 Transport protocol and selected standards

The ZigBee Health Care profile version 1.0 has been selected as the wireless lower layer protocol to serve as the transport for the sensor-LAN interface. The selected protocol for the transport layer ensures interoperable set-up and tear-down of the communication network for transfer of control information and transfer of data messages across all domains.

9.1.5 Data exchange protocol and selected standards

For the data and messaging layer of the sensor-LAN interface, the standards from the IEEE 11073 personal health device family of standards have been selected. For the detailed list of selected data/messaging layer standards please see clause 6.

9.1.6 Certified device classes

Table 9-1 shows the certified device classes defined for the sensor-LAN interface design guidelines. A certification program run by Continua Health Alliance exists for devices that implement the CDG. For sensor-LAN devices, the certification testing will be performed on an integrated device, meaning the testing and certification is applied to the hardware and software of the device. Changes to components of the device may require a re-certification.

Table 9-1 also references the guidelines (clause numbers) that are applicable for each of the certified device classes on the service as well as the client side.

Table 9-1 – Certified device classes

Certified device classes	Relevant guidelines
Sensor-LAN activity hub service device, Sensor-LAN activity hub client device	6.2.1, 6.2.2, 6.2.3.14, 9.2
Sensor-LAN adherence monitor service device, Sensor-LAN adherence monitor client device	6.2.1, 6.2.2, 6.2.3.29, 9.2
Sensor-LAN basic 1-3 lead ECG service device, Sensor-LAN basic 1-3 lead ECG client device	6.2.1, 6.2.2, 6.2.3.2, 9.2
Sensor-LAN blood pressure monitor service device, Sensor-LAN blood pressure monitor client device	6.2.1, 6.2.2, 6.2.3.4, 9.2
Sensor-LAN body composition analyser service device, Sensor-LAN body composition analyser client device	6.2.1, 6.2.2, 6.2.3.9, 9.2
Sensor-LAN cardiovascular fitness service device, Sensor-LAN cardiovascular fitness client device	6.2.1, 6.2.2, 6.2.3.11, 9.2
Sensor-LAN cardiovascular step counter service device, Sensor-LAN cardiovascular step counter client device	6.2.1, 6.2.2, 6.2.3.12, 9.2
Sensor-LAN CO sensor service device, Sensor-LAN CO sensor client device	6.2.1, 6.2.2, 6.2.3.27, 9.2
Sensor-LAN contact closure sensor service device, Sensor-LAN contact closure sensor client device	6.2.1, 6.2.2, 6.2.3.18, 9.2
Sensor-LAN dosage sensor service device, Sensor-LAN dosage sensor client device	6.2.1, 6.2.2, 6.2.3.20, 9.2
Sensor-LAN enuresis sensor service device, Sensor-LAN enuresis sensor client device	6.2.1, 6.2.2, 6.2.3.17, 9.2
Sensor-LAN fall sensor service device, Sensor-LAN fall sensor client device	6.2.1, 6.2.2, 6.2.3.15, 9.2
Sensor-LAN gas sensor service device, Sensor-LAN gas sensor client device	6.2.1, 6.2.2, 6.2.3.28, 9.2
Sensor-LAN glucose meter service device, Sensor-LAN glucose meter client device	6.2.1, 6.2.2, 6.2.3.7, 9.2
Sensor-LAN heart-rate sensor service device, Sensor-LAN heart-rate sensor client device	6.2.1, 6.2.2, 6.2.3.3, 9.2

Table 9-1 – Certified device classes

Certified device classes	Relevant guidelines
Sensor-LAN INR meter service device, Sensor-LAN INR meter client device	6.2.1, 6.2.2, 6.2.3.8, 9.2
Sensor-LAN motion sensor service device, Sensor-LAN motion sensor client device	6.2.1, 6.2.2, 6.2.3.16, 9.2
Sensor-LAN pulse oximeter service device, Sensor-LAN pulse oximeter client device	6.2.1, 6.2.2, 6.2.3.1, 9.2
Sensor-LAN peak flow monitor service device, Sensor-LAN peak flow monitor client device	6.2.1, 6.2.2, 6.2.3.10, 9.2
Sensor-LAN PERS sensor service device, Sensor-LAN PERS sensor client device	6.2.1, 6.2.2, 6.2.3.26, 9.2
Sensor-LAN property exit sensor service device, Sensor-LAN property exit sensor client device	6.2.1, 6.2.2, 6.2.3.23, 9.2
Sensor-LAN smoke sensor service device, Sensor-LAN smoke sensor client device	6.2.1, 6.2.2, 6.2.3.22, 9.2
Sensor-LAN strength fitness service device, Sensor-LAN strength fitness client device	6.2.1, 6.2.2, 6.2.3.13, 9.2
Sensor-LAN switch sensor service device, Sensor-LAN switch sensor client device	6.2.1, 6.2.2, 6.2.3.19, 9.2
Sensor-LAN temperature sensor service device, Sensor-LAN temperature sensor client device	6.2.1, 6.2.2, 6.2.3.24, 9.2
Sensor-LAN thermometer service device, Sensor-LAN thermometer client device	6.2.1, 6.2.2, 6.2.3.5, 9.2
Sensor-LAN usage sensor service device, Sensor-LAN usage sensor client device	6.2.1, 6.2.2, 6.2.3.25, 9.2
Sensor-LAN water sensor service device, Sensor-LAN water sensor client device	6.2.1, 6.2.2, 6.2.3.21, 9.2
Sensor-LAN weighing-scales service device, Sensor-LAN weighing-scales client device	6.2.1, 6.2.2, 6.2.3.6, 9.2

9.2 Device and interface guidelines

9.2.1 Sensor-LAN transport layer

9.2.1.1 ZigBee health care profile

This clause contains a general design guideline that points to the ZigBee Health Care (HC) Profile version 1.0 [ZigBee HCP]. All subsequent requirements in clause 9.2.1 refer to this specification.

Because the commissioning of sensor-LANs can be challenging, in particular for large-scale networks due to the wireless nature of the connections, it is important to specify the proper procedures for the commissioning of sensor-LAN devices, which include network-joining and application pairing of devices and device discovery, as well as security mechanisms. It is equally important to inform the users and installers of relevant events related to commissioning, such as the successful application pairing of devices and the reasons for failure. These required procedures and notifications are defined in the ZigBee Health Care Profile version 1.0.

Table 9-2 – ZigBee health care profile map

Name	Description	Comments
SensorLAN_ZigBee_HC_ Map	Continua sensor-LAN service and client components **shall** implement ZigBee Health Care Profile version 1.0 subject to the design guidelines below	

9.2.1.2 Quality of service

The following requirements describe how QoS attributes are used for Continua sensor-LAN components.

Table 9-3 – ZigBee quality of service

Name	Description	Comments
SensorLAN_ZigBee_QoS_ Best.Medium	Continua sensor-LAN service and client components that implement the Continua *best.medium* QoS bin **shall** utilize ZigBee APS acknowledgements	
SensorLAN_ZigBee_QoS_ Good.Medium	Continua sensor-LAN service and client components that implement the Continua *good.medium* QoS bin **shall not** utilize ZigBee APS acknowledgements	

9.2.1.3 Multiple connections

The following requirements describe how the ZigBee health care profile is used for multiple concurrent sensor-LAN interface connections.

Table 9-4 – Multiple connections

Name	Description	Comments
SensorLAN_ZigBee_ MultipleConnections	Continua sensor-LAN service components that establish multiple sensor-LAN interface connections as described in clause 9.2.2.1 **shall** use a separate ZigBee endpoint for each	

9.2.2 Sensor-LAN data/messaging layer

This clause contains data/messaging layer design guidelines that are specific to the sensor-LAN interface and thus it is not part of the set of common data/messaging layer design guidelines in clause 6.2.

9.2.2.1 Sensor-LAN component one-to-many connectivity

This clause describes guidelines for a sensor entering a one-to-many connectivity relationship, i.e., a sensor-LAN service component establishing multiple concurrent sensor-LAN interface connections at the same instant in time. Example scenarios include multi-function sensors providing different functionality to multiple AHDs, as well as single-function sensors providing its single functionality to multiple AHDs at the same instant in time. How to use the ISO/IEEE 1073-20601 mechanisms for association, sensor time control and PM-store usage in a one-to-many connectivity scenario are described.

9.2.2.1.1 Dominant association

The "dominant association" concept is introduced for managing on the service component multiple simultaneous associations with one or more client components. Only through a dominant

association, will a service component grant a client component control over its clock and persistently stored data. A service component can have zero or one dominant association. In this way, potential conflicts of multiple client components trying to control these resources on the agent are prevented. Client components are largely unaffected by the dominant association concept. Almost all guidelines within this clause apply to service components only.

Table 9-5 – Dominant association

Name	Description	Comments
SensorLAN-11073-20601_One-to-Many_Connect	Any Continua sensor-LAN service component that establishes more than one, simultaneous connection to one or more sensor-LAN client components at the same point in time **shall** create an ISO/IEEE 11073-20601 association to a sensor-LAN client component per connection and follow the guidelines in the remainder of this table	This guideline provides guidance for a device to establish multiple concurrent sensor-LAN connections
SensorLAN-11073-20601_One-to-Many_SingleAHD	A Continua sensor-LAN service component that connects to a single sensor-LAN client component **may** create a single connection or multiple connections for providing its functions	The use of multiple connections allows turning on and off the connection of individual functions of the agent without affecting the connection of the other functions. However, in some cases, using a single connection only can be required, e.g., in case the sensor-LAN client component rejects the request for more than a single connection due to the fact that it is compliant to the 2010 CDG release and does not expect multiple connection requests from a single sensor-LAN service component
SensorLAN-11073-20601_One-to-Many_ConnectionSetup	Continua sensor-LAN service components that establish more than one, simultaneous connection to one sensor-LAN client components at the same point in time **shall** create a new association to that sensor-LAN client component, if and only if, all other connections are in the *Unassociated* or *Operating* state	This guideline ensures that connection set-up is completed before the creation of an additional connection and thus reduces unnecessary complexity on the client side to deal with multiple associations simultaneously

Table 9-5 – Dominant association

Name	Description	Comments
SensorLAN-11073-20601_ DominantAssoc	Continua sensor-LAN service components **shall** have at most a single dominant ISO/IEEE 11073 association at a single point in time	A sensor-LAN service component provides the AHD control of its resources (e.g., setting of real time clock and removal of PM-Store data) via its dominant association only. An ISO/IEEE 11073 association becomes the dominant association if one or more of the following MDS-Time-Info attribute bits or PM-Store-Capab attribute bits are set: *mds-time-mgr-set-time, mds-time-capab-set-clock, pmsc-clear-segm-by-list-sup, pmsc-clear-segm-by-time-sup, pmsc-clear-segm-remove, pmsc-clear-segm-all-sup*
SensorLAN-11073-20601_ DominantAssoc_ ControlBits	Continua sensor-LAN service components **shall not** set any of following MDS-Time-Info attribute bits or PM-Store-Capab attribute bits for other than its dominant association: *mds-time-mgr-set-time, mds-time-capab-set-clock, pmsc-clear-segm-by-list-sup, pmsc-clear-segm-by-time-sup, pmsc-clear-segm-remove, pmsc-clear-segm-all-sup*	
SensorLAN-11073-20601_ DominantAssoc_ SetTime	Continua sensor-LAN service components that modified their clock based on the reception of a Set-Time action via its dominant association **shall** send an event report that contains the new *Date-and-Time* attribute value for all their non-dominant associations prior to sending any temporarily stored measurements and prior to starting a new transfer of a PM-Segment	In case the service component receives the Set-Time action during an ongoing PM-Segment transfer, see SensorLAN-11073-20601_ DateAndTimeUpdate_PMSegmentTransfer_* for further guidance
SensorLAN-11073-20601_ DominantAssoc_ Closing	Continua sensor-LAN service components **may** close their dominant association	

Table 9-5 – Dominant association

Name	Description	Comments
SensorLAN-11073-20601_ DominantAssoc_ Downgrading	Continua sensor-LAN service components **may** downgrade their dominant association to become a non-dominant association	Downgrading of the dominant association to a non-dominant association is achieved by sending an event report containing corresponding updates for the MDS-Time-Info attribute bits, so that the conditions of SensorLAN-11073-20601_DominantAssoc_ ControlBits for non-dominant associations are met. Note that the PM-Store-Capab attribute is static. Changing its bit values requires releasing the association and associating again, using a different configuration
SensorLAN-11073-20601_ DominantAssoc_ Upgrading	Continua sensor-LAN service components that do not have a dominant association **may** upgrade an existing non-dominant association to become the dominant association	Upgrading an existing association to a dominant association is achieved by sending an event report containing corresponding updates for the MDS-Time-Info attribute bits. Note that the PM-Store-Capab attribute is static. Changing its bit values requires releasing the association and associating again, using a different configuration

9.2.2.1.2 Time-stamping

This clause describes additional requirements for the use of time stamps as specified in [ISO/IEEE 11073-20601].

Table 9-6 – Time-stamping

Name	Description	Comments
SensorLAN-11073-20601_DataDuplicate_ Timestamping	Continua sensor-LAN service components **shall** time-stamp data that is intended to be sent multiple times, over different connections	Sending the same data multiple times can be done over the same connection or over different connections. If time stamps were missing and if the same data was sent multiple times over different connections to separate AHDs, then those AHDs would be responsible for time-stamping and might have different notions of time. To cover scenarios like this, this guideline sets more restrictions for the time-stamping of data sent multiple times. According to [ISO/IEEE 11073-20601] data needs to be time-stamped only if it is locally stored or persistently stored on an agent before being transmitted

Table 9-6 – Time-stamping

Name	Description	Comments
SensorLAN-11073-20601_ FixedTimeStamps	Continua sensor-LAN service components **shall** use the same time stamp for data that is transmitted multiple times	An example scenario where this guideline applies is the case that a service component sends the same data to multiple different clients and assigns time stamps while transmitting the data instead of while sampling the data. According to this guideline, the time stamps used for the same data are required to be identical

9.2.2.1.3 Timeout management

This clause describes additional requirements improving interoperability in cases where timeouts as specified in [ISO/IEEE 11073-20601] are not met.

Table 9-7 – Timeout management

Name	Description	Comments
SensorLAN-11073-20601_ TimeoutIndication	Continua sensor-LAN service components **shall** not cause a timeout on a particular connection, due to activity related to another existing connection	Here, timeouts caused by service components relate to an expected response to a GET request, a confirmed SET command, or a confirmed Action command, invoked by a sensor-LAN client component being in the operating state
SensorLAN-11073-20601_ PM-Store_ TransferTimeout	Continua sensor-LAN service components that implement and use the PM-Store model **should** correctly initialize the PM-Segment object *Transfer-Timeout* attribute to a value accounting for the maximum number of entries stored in the segment, as well as the maximum number of supported ongoing segment transfers via other associations	The size of a segment, as well as the amount of traffic due to potential concurrent segment transfer via other connections affects the time needed for transferring a complete PN-Segment

Appendix I

Additional Bluetooth BR/EDR information

(This appendix does not form an integral part of this Recommendation.)

I.1 Bluetooth terminology

BR/EDR: Abbreviation for Basic Rate/Enhanced Data Rate. BR/EDR is usually used as a way to describe "Classic" Bluetooth, as opposed to Bluetooth high speed or Bluetooth low energy.

Discoverable: A Bluetooth device is discoverable if it is periodically entering the Inquiry Scan substate. Inquiry Scan requires an active receiver for about 11.25 ms (default) and is entered at least once every 2.56 s. If a device is discoverable, it will respond to Inquiry procedures (usually a general Inquiry) from any device that wants to search.

Connectable: A Bluetooth device is connectable if it is periodically entering the Page Scan substate. Page Scan requires an active receiver for about 11.25 ms (default) and can be entered continuously or periodically. Normal periods are in the one second range (modes R2 <= 2.56 s, R1 <= 1.28 s, R0 is continuous). If a device is connectable, it will respond to pages from devices that address it specifically (by Bluetooth MAC).

Limited discoverable: A Bluetooth term for devices that are sometimes discoverable and sometimes not.

Discovery: Using the Inquiry substate to learn of the existence of other Bluetooth devices within transmission range. May take up to thirty seconds. Sometimes called "device discovery" to distinguish from service discovery.

Pairing: Exchanging link keys to establish a future trust relationship with a known device. Performed with Secure Simple Pairing (SSP), except in legacy cases.

Service discovery: Creating a baseband connection to a specific device (may be paired, but does not need to be) to discover details about services offered on that device.

Out-of-band connection: A data link other than the Bluetooth connection. This may include Bluetooth near-field communication (NFC), patch cables, removable media, or any other mechanism for transferring data between the two devices.

I.2 Bluetooth pairing methods

Starting with Bluetooth 2.1+EDR, pairing uses secure simple pairing (SSP) which (as the name implies) improved both the security and the simplicity of the Bluetooth pairing procedure. Older devices use a legacy pairing procedure. Both of these procedures result in a shared "link key" that is unique to the pair of devices and can be used both to authenticate future connections and to create session keys for encrypting traffic over the air.

Whichever procedure is used, the user experience will depend heavily on how it is implemented. To produce an adequate level of trust between the two devices while also giving a good user experience, the following factors are particularly relevant:

Security against eavesdropping refers to the required protection from listening devices that are present during the pairing procedure. Legacy pairing offers moderate protection only if long PINs are used (at least six digits), although attacks are still possible. SSP is always secure against eavesdropping.

Security against active man-in-the-middle (MITM) refers to the required protection from a device that inserts itself between the two parties on the physical link, so instead of pairing with each other (as intended), they both pair with the attacker. The attacker may relay data as if the connection were

working correctly, but would be able to intercept or even change that data during transmission. Legacy pairing is not secure against this type of attack. SSP may be secure against it.

Security against confusion refers to the required protection against allowing a device to pair with a device other than the intended partner.

For additional information on Bluetooth discovery and pairing, including device user interface input/output capabilities, see the following Bluetooth SIG documentation as formally referenced in clause 2 and the Bibliography of [ITU-T H.810].

– Bluetooth Core Specification, v2.1 or later, Vol. 3, Part C: Generic Access Profile [Bluetooth CS2.1]

– Bluetooth Discovery White Paper [b-Bluetooth Discovery]

– Bluetooth Secure Simple Pairing User Terminology White Paper [b-Bluetooth SSP UT]

– Bluetooth User Interface Flow Diagrams for Bluetooth Secure Simple Pairing Devices White Paper [b-Bluetooth SSP UI]

– Bluetooth Secure Simple Pairing Usability Metric White Paper [b-Bluetooth SSP UM]

I.3 Bluetooth legacy pairing procedures

Legacy pairing requires keys from both devices. If a device has a user interface, a unique PIN can be entered. It is not recommended that well-known values (like "0000") are used for groups of devices, as this may cause erroneous pairings. PINs should be at least six digits long and selected in such a way that each individual PIN will be re-used only about once in 1 000 000 devices (or less). The PIN for each device should be clearly identified on the device packaging, although that identification may be made removable.

I.4 Supporting Bluetooth OEM subsystems and components

The Bluetooth SIG currently allows the certification of "profile subsystems" devices that completely implement a profile, but are not themselves an "End Product". It is expected that some implementers will develop and market HDP modules that include the entire HDP implementation with the exception of the ISO/IEEE 11073-20601 data layer and ISO/IEEE 11073-104xx device specializations. Others may develop the ISO/IEEE 11073-20601 data layer and device specializations such that when the two implementations are combined, they form an End Product. The Bluetooth Qualification System allows for two partial implementations to be combined forming an "End Product" through the combination of appropriate subsystems or through the use of "subsetting". However, some testing of the combined implementations may be required. Refer to the Bluetooth SIG for further information regarding the Bluetooth qualification process.

I.5 Quality of service bins for Bluetooth

For Bluetooth, the expected quality of service (QoS) for a data connection is identified through the use of the two recognized QoS bins (see clause 8.2.2.5). Achieving this QoS (knowing what is expected from a channel, policing what is being delivered and flagging exceptional situations) is the responsibility of both ends of the connection.

In the case where a connection is point-to-point, this can often be delegated to the underlying transport layer implementation. For example, when a Bluetooth connection is established between two devices (by a successful pairing procedure), the link manager protocol can request the "supported features" of the partner device. These features would include information about which enhanced data rate modes are supported and therefore allow the local device (which already knows its own capabilities) to make a good guess at the throughput it can expect over that link. This is the recommended method for this version of the Continua Design Guidelines.

When the data is routed via intermediate nodes, but the QoS is important from end-to-end, some higher-layer function is required to accumulate and correlate the QoS expected from the various components, or at least to assign expected bounds to each hop. This will require communication of QoS characteristics at the end-to-end (transport layer). This version of the CDG support, at maximum, two cascaded transport technologies: PAN and LAN. The overall end-to-end latency is statically managed by splitting the end-to-end transport latency budget between these two transports.

See clause 6.1.6.5 in [ITU-T H.810] for a definition of the QoS bins supported by this version of the Continua Design Guidelines.

The two channel types provided for in the Bluetooth HDP specification [Bluetooth HDPv1.1] are reliable and streaming. On the reliable channel, latency will be most sensitive to retransmission times. On the streaming channel (which never retransmits data), it will be most sensitive to buffer sizes and local latency. A 10% margin is reasonable to include when making latency calculations to account for the software latency for handling of messages. The latency expected on the streaming channel can be calculated from the poll interval taking software latency into consideration.

The poll interval is the maximum number of slots that will normally be allowed to separate consecutive opportunities for a slave to begin a transmission. A slave may request a new poll interval from the master (by sending an LMP_quality_of_service_req packet) and will be informed of its value. However, the master sets that value. Legal values are any even number of slots in the range 6 through 4096 (3.75 ms - 2.56 s) and the default value is 40 (25 ms).

The streaming channel may be configured to have a polling interval short enough that, when combined with the actual transmission duration, will provide "Low" latency. However, in some particular configurations this may not be possible. For example, if the device is itself a slave and connects to a master that does not support polling intervals other than the default, it may have the opportunity to start a new data packet only once every 25 ms.

"Medium" or longer latency should always be possible (for reasonable packet sizes) on the streaming channel.

Latency on the reliable data channel depends on retransmission. If an out-of-sequence packet is received, it will trigger retransmission of the intervening lost packets reasonably quickly. In the worst case, however, the last packet of the message may be lost (for example, if only one L2CAP packet were transmitted). In this case, retransmission would not occur until the retransmission timeout period had elapsed. This time is communicated in the option configuration information for L2CAP Enhanced Retransmission mode option and may be in the hundreds of milliseconds range. If the retransmit timer expires in the sending device and unacknowledged frames exist, they will be retransmitted.

Over a normal connection, loss of the same packet twice should be unusual, so a reliable connection should be able to deliver an average latency in the "Medium" range, if its retransmission timeout is around 100 ms. Setting the MaxTransmit value to 2 would require the connection to be closed if the same packet were ever lost twice. However, very few scenarios would benefit from using this feature and MaxTransmit should usually be larger than 2.

For reliability, the Bluetooth channel has a basic bit error rate of less than 0.1% and the data packets are protected with a 16-bit CRC. The SDU (recombined higher-layer data packet) is further protected by another 16-bit CRC (the FCS). This is true on both the reliable and streaming channels, so the probability of a bit-error in any packet should be less than 10^{-9}.

The streaming channel may lose packets (particularly due to buffer overflows) but the reliable channel will not lose packets.

Either channel may be broken due to range or extreme interference. Neither the Bluetooth health device profile, nor these guidelines currently require devices to seek a reconnection following an unintentional disconnect, although the possibility is provided for in the protocols.

Before committing to an upper layer that any of these QoS bins is supported by a particular channel, an implementation shall check the relevant configuration parameters of the actual L2CAP channel (once it is established) to verify its commitment is supported.

Appendix II

Additional ZigBee information

(This appendix does not form an integral part of this Recommendation.)

II.1 ZigBee networking

The 802.15.4/ZigBee network provides facilities for commissioning, data transfer and maintenance. Use of a certified ZigBee platform provides a robust self-healing mesh network. The ZigBee health care profile mandates use of the 11073 protocol tunnel and reuses components of the ZigBee cluster library.

Commissioning details depend on the deployment scenario. Three deployment scenarios are addressed by this profile, as follows.

1. Service provider scenario. In this scenario, a service provider that provides patient monitoring services is responsible for providing all the devices that are part of the network and preloading these devices with all the information that they need to securely join the network and work together.
2. In-house commissioning scenario. In this scenario, the network owner (e.g., a medical care facility) has its own in-house commissioning facility, to configure the devices with all the information that they need to securely join the network and work together.
3. Consumer scenario. This scenario covers the case of small networks, where the network owner does not have a service provider and wishes to purchase devices from multiple providers and install them himself. This case is typical of the home environment.

For example, in the consumer scenario, a typical deployment may be as follows:

1. The coordinator or router sends a command to the ZigBee network to allow joining of new device for a limited period.
2. A ZigBee healthcare device will first do a scan for networks and build a list of available networks that allow joining.
3. The ZigBee healthcare device will then pick a network and associate to the nearest node (router or coordinator) that allows joining and start the security authentication process.
4. The router/coordinator parent will now send an update-device (device joined) message to the ZigBee security trust centre in encrypted form.
5. The trust centre will now determine if it will allow the device in the network or not.
6. If the device is allowed in the network the trust centre will send the network security key to the device. Note this is done using a predefined link key.
7. The device is now an active participant in the network.

II.2 ZigBee pairing process/service discovery types

A sensor_LAN device consists of one or more ZigBee device descriptions (e.g., thermometer and pulse oximeter) and their corresponding application profile(s), optionally on a separate endpoint, that share a single physical IEEE802.15.4 radio. Each device has a unique 64-bit IEEE address and contains a collection of clusters and associated functionality implemented on a ZigBee endpoint. Device descriptions are defined in the scope of the ZigBee health care application profile. Each device description has a unique identifier that is exchanged as part of the discovery process.

The ZigBee specification [ZigBee Spec] provides the facility for devices to find out information about other nodes in a network, such as their addresses, which types of applications are running on them, their power source and sleep behaviour. This information is stored in descriptors on each node and is used by the requesting node to tailor its behaviour to the requirements of the network.

Discovery is typically used when a node is being introduced into a health care network. Once the device has joined the network, its integration into the network may require the user to start the integration process by pressing a button or similar, in order to discover other devices that it can talk to. For example, a device implementing a weigh scale conforming to the ZHC profile tries to find devices containing ZHC aggregation devices (similar to the Continua AHD) to which it could potentially send its measurement data.

The ZigBee pairing process allows for fast and easy association between devices. There are a variety of routing algorithms for data packets to find the correct destination, including neighbour and table-based routing. These approaches result in a high degree of flexibility and stability ensuring that devices in the network stay connected and that network performance remains constant even as it is dynamically changing. ZigBee health care offers several way of "pairing" devices.

– End device bind
    - This is a simple push button pair when a button is pressed on 2 devices within a time window and if their services match a "binding" is created
– Service discovery
    - A health care device can build a list of health care devices on the network, for example by listening for new devices to join the network, or by sending a service discovery broadcast to which matching device will respond. The device can now pick which device it would like to communicate with
– Commissioning tool
    - Mandatory primitives in the ZigBee stack allow for a device to query other devices for their services and set up "bindings" and relationships between devices

II.3 ZigBee security

ZigBee security [ZigBee HCP], which is based on a 128-bit AES algorithm, adds to the security model provided by [b-IEEE 802.15.4]. ZigBee's security services include methods for key establishment and transport, device management and frame protection. Security for health care applications is specified as part of the default ZigBee stack profiles, with support for a network key and link keys for point-to-point secure links. In a health care network, the aggregator device (often the Continua AHD) will contain a function called the trust centre. The trust centre decides whether to allow or disallow new devices into its network. The trust centre may periodically update and switch to a new network key and controls deployment of link keys. The trust centre is usually also the network coordinator.

Appendix III

Recommendation for use of generic USB drivers

(This appendix does not form an integral part of this Recommendation.)

It is recommended that managers for USB PHDC that provide a USB PHDC driver based on a generic USB driver use the following values in the INF file:

Attribute	INF file element	WinUSB value	LibUSB value
Device Class GUID	[Version]/ ClassGUID	{182A3B42-D570-4066-8D13-C72202B40D78}	{EB781AAF-9C70-4523-A5DF-642A87ECA567}
Device Class Text	[Version]/Class [Strings]/ClassName	PHDC	libusb-win32 devices
Interface GUID	[Dev_AddReg]	{B8B610DE-FB41-40A1-A4D6-AB28E87C5F08}	N/A
Device GUID	[Strings]/DeviceGUID	N/A	{D0C36FAA-CE6D-4887-A3AA-6FC42D3037E5}

For more information see [b-CHA USB-PHDC].

Bibliography

For a list of non-normative references and publications that contain further background information, see [ITU-T H.810].

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Printed in Switzerland
Geneva, 2016