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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

E-health multimedia services and applications – Personal health systems

Interoperability design guidelines for personal connected health systems

Recommendation ITU-T H.810

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Recommendation ITU-T H.810

Interoperability design guidelines for personal connected health systems

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 a missing feature to improve interoperability. These guidelines focus on the following interfaces:

– Personal health devices (PHD) interface – Interface between a personal health device (PHD) and a personal health gateway (PHG).

– Services interface – Interface between a personal health gateway (PHG) and the health and fitness service (HFS).

– Healthcare information system (HIS) interface – Interface between the health and fitness service (HFS) and the healthcare information system (HIS).

Recommendation ITU-T H.810 is part of the "ITU-T H.810 interoperability design guidelines for personal connected health systems" subseries and covers the following areas:

– ITU-T H.810 – Interoperability design guidelines for personal connected health systems: System overview

– ITU-T H.811 – Interoperability design guidelines for personal connected health systems: Personal health devices interface design guidelines

– ITU-T H.812 – Interoperability design guidelines for personal connected health systems: Services interface design guidelines

– ITU-T H.812.1 – Interoperability design guidelines for personal connected health systems: Services interface: Observation upload capability

– ITU-T H.812.2 – Interoperability design guidelines for personal connected health systems: Services interface: Questionnaires capability

– ITU-T H.812.3 – Interoperability design guidelines for personal connected health systems: Services interface: Capability exchange capability

– ITU-T H.812.4 – Interoperability design guidelines for personal connected health systems: Services interface: Authenticated persistent session capability

– ITU-T H.813 – Interoperability design guidelines for personal connected health systems: Healthcare information system interface design guidelines

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.810	2013-12-14	16	11.1002/1000/12067
2.0	ITU-T H.810	2015-11-29	16	11.1002/1000/12651
3.0	ITU-T H.810	2016-07-14	16	11.1002/1000/12911

* 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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0 Introduction

The Continua Design Guidelines (CDG) define a framework of underlying standards and criteria that are required to ensure the interoperability of components[1] used for applications monitoring personal health and wellness. They also contain design guidelines (DGs) that further clarify the underlying standards or specifications by reducing options or by adding missing features to improve interoperability. These guidelines focus on the following interfaces:

– Personal health devices (PHD) interface – Interface between a personal health device (PHD) and a personal health gateway (PHG).

– Services interface – Interface between a personal health gateway (PHG) and a health and fitness service (HFS).

– Healthcare information system (HIS) interface– Interface between a health and fitness service (HFS) and a healthcare information system (HIS).

Figure 0-1 highlights the above-mentioned interfaces in the Continua end-to-end (E2E) reference architecture.

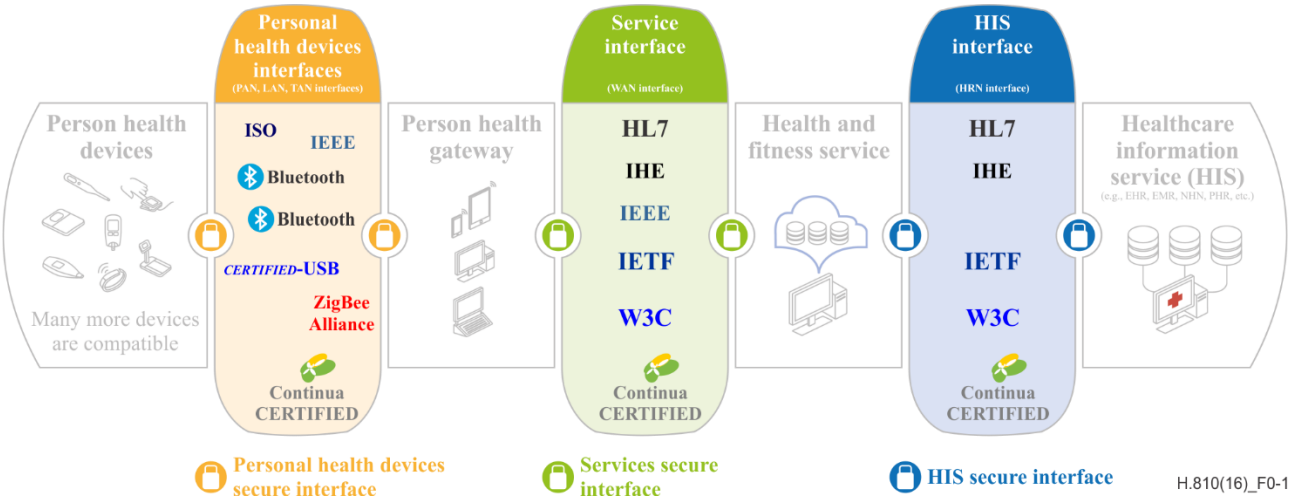

Figure 0-1 – Continua E2E reference architecture

The CDG are a product of the Personal Connected Health Alliance (PCHA), which is an international not-for-profit industry organization enabling end-to-end (E2E), plug-and-play connectivity of devices and services for personal health management and healthcare delivery.

The mission of the PCHA is: "to facilitate the development and adoption of personal health solutions that foster independence and empower people to better manage their health and wellness from anywhere, at any time. Making health and wellness a convenient part of daily life through personal connected health technologies." For more information visit: www.pchalliance.org.

In the DGs, references are made to specifications from: Health Level 7 (HL7), Integrating the Healthcare Enterprise (IHE), ISO/IEEE, Bluetooth, ZigBee, Internet Engineering Task Force (IETF), World Wide Web Consortium (W3C), Organization for the Advancement of Structured Information Standards (OASIS) and Object Management Group (OMG).

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[1] There are two types of components, a client component (e.g., observation sender) and a service component (e.g., observation receiver). A device may implement one or more Continua certified client componets, however it may also implement components not certified by Continua.

0.1 Organization

The CDG is comprised of a series of specifications, which taken as a whole represent a yearly release. Table 0-1 shows the different specifications included in this release.

Table 0-1 – Design specifications

Recommendation	Area covered
ITU-T H.810	System Overview
ITU-T H.811	Personal health devices (PHD) interface
ITU-T H.812	Services interface
ITU-T H.812.1	Observation Upload capability
ITU-T H.812.2	Questionnaire capability
ITU-T H.812.3	Capability Exchange capability
ITU-T H.812.4	Authenticated Persistent Session (APS) capability
ITU-T H.813	Healthcare information system (HIS) interface

This specification is organized in the following manner:

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

– **Clause 6:** System overview – This clause explains the overall end-to-end architecture and scope of the design guidelines.

0.2 Guideline releases and versioning

As guidelines evolve over time, different versions are created. Table 0-2 shows the mapping of guidelines releases to version revisions.

Table 0-2 – Guideline releases and corresponding version numbers

Continua design guidelines	Also known as	Major version	Minor version
1.0		1	0
2010	1.5	1	5
2010 + Errata		1	6
2011	2.0, Adrenaline	2	0
2011 + Errata		2	1
2012	Catalyst	3	0
2012 + Errata		3	1
2014	Endorphin	4	0
2014 + Errata		4	1
2015	Genome	5	0
2016	Iris	6	0
2016 + Errata		6	1

Subsequent to the initial version the yearly release of the CDG includes maintenance updates and additional guidelines that cover new functionalities. Where applicable an Errata release may be published that implements all ratified bugs for the prior release.

0.3 What's new

Compared to preceding versions of the Continua Design Guidelines, the following changes were made to the content of this specification:

Across the personal health devices interface (PHD-IF) the following new capabilities have been introduced:

– Design guidelines for the continuous glucose monitor and the pulse oximeter using Bluetooth low energy (LE) as the transport technology.

– Design guidelines for the continuous glucose monitor and the insulin pump monitor PHD 11073-20601 device specializations.

– All CDG documents being updated with new architecture concepts and terminologies.

– Across the HIS interface, design guidelines for the DIRECT capability have been introduced. DIRECT provides a simple and secure standard based method for sending health information to known and trusted participants over the internet using the healthcare information system interface (HIS-IF).

0.4 White papers

This clause highlights white papers that have been published to facilitate understanding of these design guidelines and to address areas not directly covered by the CDG.

These white papers can be found here: http://www.continuaalliance.org/connected-health-vision/white-papers and they are also listed in the bibliography.

Where relevant, additional links may be found in the appropriate clauses of the CDG.

0.4.1 Fundamentals of data exchange

The purpose of this white paper is to provide a basic description of the data that is being exchanged between sensors, gateways and end services and the added value that Continua provides beyond the referenced standards to make implementations truly interoperable.

0.4.2 Introduction to the Continua Design Guidelines

The purpose of this white paper is to provide a high level overview of the Continua Design Guidelines. This white paper provides an introduction to each of the standards and specifications that were chosen by its members to be part of the design guidelines and the rationale behind their selection.

0.4.3 Implementation guidelines for cellular modems embedded into medical devices

In order to aid members who wish to implement wireless connectivity directly into medical sensors by physically attaching a cellular module to the sensor, a white paper has been published to address device-specific recommendations.

Work has been carried out with leading operators, device vendors and cellular organizations such as Global System for Mobile Communications Alliance (GSMA) to provide an overview of mobile network-specific considerations that should be kept in mind when designing medical sensors with embedded modems, so that they are interoperable and optimized for use with cellular connectivity.

0.4.4 Recommendations for USB PHDC device driver interoperability

This white paper defines a position on USB PHDC driver interoperability pertaining to the CDG. Potential problems with interoperability related to Windows USB PHDC device drivers are evaluated and recommendations are made that developers of the personal health gateway (PHG) using universal serial bus (USB) transport can implement. Based on the analysis of these problems,

recommendations for a strategy are discussed and the handling of generic Windows drivers based on WinUSB and LibUSB are provided. This white paper does not cover application level interoperability beyond the development of USB drivers.

0.5 Certification programme

A test and certification programme is designed and run by the Personal Connected Health Alliance (PCHA) to ensure that certified capability implemented by products conform to the standards and specifications defined in the design guidelines and its underlying standards. Devices featuring the Continua logo indicate that a component implemented by a device has met the Continua conformance requirements as well as basic interoperability requirements with other CDG-compliant devices.

Devices passing this test and certification programme may use the Continua defined logo to indicate their compatibility. Details are provided in clause 6.1.4.

Recommendation ITU-T H.810

Interoperability design guidelines for personal health systems

1 Scope

This version of The Continua Design Guidelines (CDG) includes guidelines for the personal health devices interface (PHD-IF), the services interface known as the Services-IF and the healthcare information system interface (HIS-IF).

These guidelines for PHD-IF also include design guidelines on the use of a transport technology i.e., near-field communication (NFC), USB, Bluetooth, Bluetooth LE and ZigBee for a specific certified capability. An overview of the capability classes defined under each of these transport technologies is shown in Table 1-1.

Table 1-1- Capability classes defined across the PHD-IF

Capability	Transport				
	USB	**Bluetooth**	**Bluetooth LE**	**NFC**	**ZigBee**
Pulse Oximeter	Yes	Yes	Yes	Yes	Yes
Blood Pressure Monitor	Yes	Yes	Yes	Yes	Yes
Thermometer	Yes	Yes	Yes	Yes	Yes
Weighing-scales	Yes	Yes	Yes	Yes	Yes
Glucose Meter	Yes	Yes	Yes	Yes	Yes
Cardiovascular Fitness	Yes	Yes		Yes	Yes
Step Counter	Yes	Yes		Yes	Yes
Strength Fitness	Yes	Yes		Yes	Yes
Activity Hub	Yes	Yes		Yes	Yes
Adherence Monitor	Yes	Yes		Yes	Yes
Peak Flow Meter	Yes	Yes		Yes	Yes
Fall Sensor	Yes	Yes		Yes	Yes
Motion Sensor	Yes	Yes		Yes	Yes
Enuresis Sensor	Yes	Yes		Yes	Yes
Contact Closure Sensor	Yes	Yes		Yes	Yes
Switch Sensor	Yes	Yes		Yes	Yes
Dosage Sensor	Yes	Yes		Yes	Yes
Water Sensor	Yes	Yes		Yes	Yes
Smoke Sensor	Yes	Yes		Yes	Yes
Property Exit Sensor	Yes	Yes		Yes	Yes
Temperature Sensor	Yes	Yes		Yes	Yes
Usage Sensor	Yes	Yes		Yes	Yes
PERS Sensor	Yes	Yes		Yes	Yes
CO Sensor	Yes	Yes		Yes	Yes
Gas Sensor	Yes	Yes		Yes	Yes

Table 1-1- Capability classes defined across the PHD-IF

Capability	Transport				
	USB	**Bluetooth**	**Bluetooth LE**	**NFC**	**ZigBee**
Heart-rate Sensor	Yes	Yes	Yes	Yes	Yes
Basic 1-3 Lead ECG Sensor	Yes	Yes		Yes	Yes
Body Composition Analyser	Yes	Yes		Yes	Yes
INR Meter	Yes	Yes		Yes	Yes
Sleep Apnea Breathing Therapy Equipment (SABTE)	Yes	Yes		Yes	Yes
Continous Glucose Monitor	Yes	Yes	Yes	Yes	Yes
Insulin Pump Monitor	Yes	Yes		Yes	Yes

Services-IF guidelines (see [ITU-T H.812]) are defined for capability classes using different transport technologies such as simple object access protocol (SOAP), RESTful HTTP and message queuing telemetry transport (MQTT). Table 1-2 shows capability classes defined across the Services-IF.

Table 1-2 – Capability classes defined across the Services-IF

Capability	Transport		
	SOAP	**RESTful HTTP**	**MQTT**
Observation Upload	Yes	Yes	
Questionnaires and Questionnaires Responses		Yes	
Consent Management and Enforcement	Yes	Yes	
Authenticated Persistent Session			Yes
Capability Exchange		Yes	

HIS-IF guidelines (see [ITU-T H.813]) are defined for capability classes using different transport technologies such as IHE XDR, IHE XDM and DIRECT. Table 1-3 shows capability classes defined across the HIS-IF.

Table 1-3 – Capability classes defined across the HIS-IF

Capability	Transport		
	IHE XDR	**IHE XDM**	**DIRECT**
Personal Health Monitoring Report (PHMR) Sharing	Yes	Yes	Yes
Consent Management and Enforcement	Yes		

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.811] Recommendation ITU-T H.811 (2016), *Interoperability design guidelines for personal health systems: Personal health devices interface*.

[ITU-T H.812] Recommendation ITU-T H.812 (2016), *Interoperability design guidelines for personal health systems: Services interface: Common certified capability class*.

[ITU-T H.812.1] Recommendation ITU-T H.812.1 (2016), *Interoperability design guidelines for personal health systems: Services interface: Observation upload certified capability class*.

[ITU-T H.812.2] Recommendation ITU-T H.812.2 (2016), *Interoperability design guidelines for personal health systems: Services interface: Questionnaires*.

[ITU-T H.812.3] Recommendation ITU-T H.812.3 (2016), *Interoperability design guidelines for personal health systems: Services interface: Capability exchange certified capability class*.

[ITU-T H.812.4] Recommendation ITU-T H.812.4 (2016), *Interoperability design guidelines for personal health systems: Services interface: Authenticated persistent session capability*.

[ITU-T H.813] Recommendation ITU-T H.813 (2016), *Interoperability design guidelines for personal health systems: Healthcare Information System (HIS) interface*.

[ANSI/HL7 CDA] ANSI/Health Level Seven (2005-04), *HL7 Clinical Document Architecture, Release 2.0*.
http://www.hl7.org/documentcenter/private/standards/cda/r2/cda_r2_normativewebedition2010.zip

[Bluetooth BCS] Bluetooth SIG, Body Composition Service, Version 1.0.
https://www.bluetooth.org/Technical/Specifications/adopted.htm

[Bluetooth BPP] Bluetooth SIG, *Blood Pressure Profile, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=243125

[Bluetooth BPS] Bluetooth SIG, *Blood Pressure Service, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=243126

[Bluetooth CGMP] Bluetooth SIG, *Continuous Glucose Monitoring Profile, Version 1.0.*
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=294793

[Bluetooth CGMS] Bluetooth SIG, *Continuous Glucose Monitoring Service, Version 1.0.*
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=294794

[Bluetooth CS2.1] Bluetooth SIG (2007), *Core Specification Version 2.1*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=241363

[Bluetooth CS4.0] Bluetooth SIG (2010), *Core Specification Version 4.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=229737

[Bluetooth CTS] Bluetooth SIG, *Current Time Service, Version 1.1*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=241871

[Bluetooth DIS] Bluetooth SIG, *Device Information Service, Version 1.1*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=244369

[Bluetooth GLP] Bluetooth SIG, *Glucose Profile, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=248025

[Bluetooth GLS] Bluetooth SIG, *Glucose Service, Version 1.0.*
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=248026

[Bluetooth HDPv1.1] Bluetooth SIG, *Health Device Profile, version 1.1*.
https://www.bluetooth.org/docman/handlers/DownloadDoc.ashx?doc_id=260864&vId=290095

[Bluetooth HRP] Bluetooth SIG, Heart Rate Profile, Version 1.0.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=239865

[Bluetooth HRS] Bluetooth SIG, *Heart Rate Service, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=239866

[Bluetooth HTP] Bluetooth SIG, *Health Thermometer Profile, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=238687

[Bluetooth HTS] Bluetooth SIG, *Health Thermometer Service, Version 1.0*.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=238688

[Bluetooth MCAP] Bluetooth SIG, *Multi-Channel Adaptation Protocol, Version 1.0. Bluetooth SIG*.
https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=119995

[Bluetooth PHDT] Bluetooth SIG (in force), *Personal Health Devices Transcoding White Paper*.

[Bluetooth PHDT v1.4] Bluetooth SIG, *Personal Health Devices Transcoding White Paper, v1.4*
https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=294539

[Bluetooth PHDT v1.5] Bluetooth SIG, *Personal Health Devices Transcoding White Paper, v1.5*.
https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=272346

[Bluetooth POXP] Bluetooth SIG, *Pulse Oximeter Profile, Version 1.0.*
https://www.bluetooth.org/Technical/Specifications/adopted.htm

[Bluetooth POXS] Bluetooth SIG, *Pulse Oximeter Service, Version 1.0.*

[Bluetooth WSP] Bluetooth WSP 1.0 (2014), Weight Scale Profile.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=293525

[Bluetooth WSS] Bluetooth WSS 1.0 (2014), Weight Scale Service.
https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=293526

[ETSI TS 123 040] ETSI TS 123 040 V11.3.0 (2012-10), *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Technical realization of the Short Message Service (SMS)*. (3GPP TS 23.040 version 11.3.0 Release 11).
http://www.etsi.org/deliver/etsi_ts/123000_123099/123040/11.03.00_60/ts_123040v110300p.pdf

[FIPS PUB 180-4] FIPS PUB 180-4 (2012), *Secure Hash Standard (SHS).*
http://csrc.nist.gov/publications/fips/fips180-4/fips-180-4.pdf

[HL7 2.6] ANSI/HL7 2.6 (2007), *An Application Protocol for Electronic Exchange in Healthcare Environments.*
http://www.hl7.org/documentcenter/private/standards/V26/HL7_Messaging_v26_PDF.zip

[HL7 CDA-CCD] HL7 CDA-CCD (2007-04), Health Level Seven, *HL7 Implementation Guide for CDA Release 2: Continuity of Care Document (CCD). A CDA implementation of ASTM E2369-05*.
http://www.hl7.org/Library/General/HL7_CCD_final.zip

[HL7 CDA IG] HL7 CDA IG (2011), Health Level Seven, *HL7 Implementation Guide for Clinical Document Architecture, Release 2: Consent Directives, Release 1, HL7 Draft Standard for Trial Use*.
http://www.hl7.org/documentcenter/public/standards/dstu/CDAR2_IG%20_CONSENTDIR_DSTU_2011JAN.pdf

[HL7 CDA-PHMR] HL7 CDA-PHMR (2010-10), Health Level Seven, *HL7 Implementation Guide for CDA Release 2: Personal Healthcare Monitoring Report, DSTU Release 1.1*.
http://www.hl7.org/documentcenter/public/standards/dstu/CDAR2_IG_PHMRPTS_R1.1_DSTU_2010OCT.zip

[HL7 CDA QFD] HL7 CDA QFD, *HL7 Implementation Guide for CDA Release 2: Questionnaire Form Definition Document, Release 1*. http://www.hl7.org/dstucomments/showdetail.cfm?dstuid=116

[HL7 CDA QRD] HL7 CDA QRD, *HL7 Implementation Guide for CDA Release 2: Questionnaire Response Document, Release 1* http://www.hl7.org/dstucomments/showdetail.cfm?dstuid=117

[HL7 CDA R2_QA] Release 2: CDA Framework for Questionnaire Assessments (Universal Realm) and CDA Representation of the Minimum Data Set Questionnaire (U.S. Realm). Based on HL7 CDA Release 2.0. http://www.hl7.org/documentcenter/ballots/2009JAN/downloads/CDAR2_QA_R1_DSTU_2009APR.zip

[HL7 RLUS] HL7 RLUS (2013), *Health Level 7 Service Functional Model Specification – Retrieve, Locate, and Update Service (RLUS) Release 1*. http://www.hl7.org/implement/standards/product_brief.cfm?product_id=89.

[HL7 V3 HRF] Health Level Seven (2014), *HL7 Version 3 Specification: hData Record Format, Release 1*. http://www.hl7.org/documentcenter/private/standards/v3/V3_ITS_HDATA_RF_R1_2014JUN.pdf

[IEEE 11073-10406] IEEE 11073-10406-2011, *Health informatics – Personal health device communication Part 10406: Device specialization – Basic Electrocardiograph (ECG) (1 to 3-lead ECG)*. http://standards.ieee.org/findstds/standard/11073-10406-2011.html

[IEEE 11073-10417] IEEE 11073-10417-2011, *Health informatics – Personal health device communication – Part 10417: Device specialization – Glucose meter*. http://standards.ieee.org/findstds/standard/11073-10417-2011.html

[IEEE 11073-10418] IEEE 11073-10418-2011, *Health informatics – Personal health device communication Part 10418: Device specialization - International Normalized Ratio (INR) monitor*. http://standards.ieee.org/findstds/standard/11073-10418-2011.html

[IEEE 11073-10420] IEEE 11073-10420-2010, *Health informatics – Personal health device communication Part 10420: Device specialization – Body composition analyser*. http://standards.ieee.org/findstds/standard/11073-10420-2010.html

[IETF RFC 1305] IETF RFC 1305 (1992), *Network Time Protocol (Version 3) Specification, Implementation and Analysis*. https://datatracker.ietf.org/doc/rfc1305

[IETF RFC 2030] IETF RFC 2030 (1996), *Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI*. https://datatracker.ietf.org/doc/rfc2030/

[IETF RFC 2246] IETF RFC 2246 (1999), *The TLS Protocol version 1.0*. https://datatracker.ietf.org/doc/rfc2246

[IETF RFC 2818] IETF RFC 2818 (2000), IETF Network Working Group HTTP over TLS. http://tools.ietf.org/html/rfc2818

[IETF RFC 2988] IETF RFC 2988 (2000), *Computing TCP's Retransmission Timer*. https://datatracker.ietf.org/doc/rfc2988

[IETF RFC 3164] IETF RFC 3164 (2001), *The BSD Syslog Protocol*. https://datatracker.ietf.org/doc/rfc3164

[IETF RFC 3195] IETF RFC 3195 (2001), *Reliable Delivery for syslog*. https://datatracker.ietf.org/doc/rfc3195

[IETF RFC 3211] IETF RFC 3211 (2001), *Password-based Encryption for CMS*. https://datatracker.ietf.org/doc/rfc3211

[IETF RFC 3268] IETF RFC 3268 (2002), *Advanced Encryption Standard (AES) Ciphersuites for Transport Layer Security (TLS)*.
https://datatracker.ietf.org/doc/rfc3268

[IETF RFC 3339] IETF RFC 3339 (2004), *Date and Time on the Internet: Timestamps*.
http://www.ietf.org/rfc/rfc3339.txt

[IETF RFC 3881] IETF RFC 3881 (2004), *Security Audit and Access Accountability Message XML Data Definitions for Healthcare Applications*.
https://datatracker.ietf.org/doc/rfc3881

[IETF RFC 4330] IETF RFC 4330 (2006), *Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI*.
https://datatracker.ietf.org/doc/rfc4330

[IETF RFC 4614] IETF RFC 4614 (2006), *A Roadmap for Transmission Control Protocol (TCP) Specification Documents*.
https://datatracker.ietf.org/doc/rfc4614

[IETF RFC 4346] IETF RFC 4346 (2006), *The Transport Layer Security (TLS) Protocol Version 1.1, T. Dierks, E. Rescorla*.
http://www.ietf.org/rfc/rfc4346.txt

[IETF RFC 6749] IETF RFC 6749 (2012), *The OAuth 2.0 Authorization Framework*.
http://tools.ietf.org/html/rfc6749

[IETF RFC 6750] IETF RFC 6750 (2012), *The OAuth 2.0 Authorization Framework: Bearer Token Usage*.
http://tools.ietf.org/html/rfc6750

[IHE ITI DEN] IHE ITI DEN (2011-08), Integrating the Healthcare Enterprise, *IHE IT Infrastructure Technical Framework, Supplement for Trial Implementation - Document Encryption (DEN)*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_Suppl_DEN_Rev1-1_TI_2011-08-19.pdf

[IHE ITF PIX PDQ] IHE ITF PIX PDQ (2010-08), Integrating the Healthcare Enterprise, *IHE IT Infrastructure Technical Framework, Supplement for Trial Implementation – Patient Identifier Cross-Reference HL7 V3 (PIXV3) and Patient Demographic Query HL7 V3 (PDQV3)*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_Suppl_PIX_PDQ_HL7v3_Rev2-1_TI_2010-08-10.pdf

[IHE ITI TF-1 PIX] IHE ITI TF-1 PIX (2010), Integrating the Healthcare Enterprise, *IHE Patient Identifier Cross-Reference (PIX) profile*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_Suppl_PIX_PDQ_HL7v3_Rev2-1_TI_2010-08-10.pdf

[IHE ITI TF-1 XDM] IHE ITI TF-1 XDM (2009), Integrating the Healthcare Enterprise, *IHE IT Infrastructure (ITI) Technical Framework Volume 1 (ITI TF-1) Integration Profiles, Revision 6.0, IHE Cross-Enterprise Document Media Interchange (XDM) profile*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_6-0_Vol1_FT_2009-08-10-pdf.pdf

[IHE ITI TFS XDR] IHE ITI TFS XDR (2009), Integrating the Healthcare Enterprise, *IHE Information Technology Infrastructure (ITI), Technical Framework Supplement 2009-2010, Cross-Enterprise Document Reliable Interchange (XDR) Trial Implementation Supplement, Release 4.0*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_Supplement_Cross_Enterprise_Document_Reliable_Interchange_XDR_TI_2009-08-10.pdf

[IHE ITI TF-1 XUA] IHE ITI TF-1 XUA (2009-08), Integrating the Healthcare Enterprise, *IHE IT Infrastructure (ITI) Technical Framework Volume 1 (ITI TF-1) Integration Profiles, IHE Cross Enterprise User Assertion (XUA) profile*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_6-0_Vol1_FT_2009-08-10-2.pdf

[IHE ITI-TF-1] IHE ITI-TF-1 (2009-08), Integrating the Healthcare Enterprise, *IHE IT Infrastructure Technical Framework, Volume 1 (ITI TF-1): Integration Profiles, Revision 6.0*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_6-0_Vol1_FT_2009-08-10-2.pdf

[IHE ITI-TF-2] IHE ITI-TF-2 (2009-08), Integrating the Healthcare Enterprise, *IHE IT Infrastructure Technical Framework, Volume 2x (ITI TF-2), Revision 6.0 (in particular, Appendix V, Web Services for IHE Transactions)*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_6-0_Vol2x_FT_2009-08-10.pdf

[IHE PCD-01] See [IHE PCD-TF-2]

[IHE PCD TF 2012 1] IHE PCD TF 2012 1 (2012-08), Integrating the Healthcare Enterprise, *IHE Patient Care Device Technical Framework – Revision 2.0. Volume 1: Integration Profiles*.
<http://www.ihe.net/Technical_Framework/upload/IHE_PCD_TF_Rev2-0_Vol1_FT_2012-08-16.pdf>

[IHE PCD TF 2012 2] IHE PCD TF 2012 2 (2012-08), Integrating the Healthcare Enterprise, *IHE Patient Care Device Technical Framework – Revision 2.0. Volume 2: Transactions*.
http://www.ihe.net/Technical_Framework/upload/IHE_PCD_TF_Rev2-0_Vol2_FT_2012-08-16.pdf

[IHE PCD TF 2012 3] IHE PCD TF 2012 3 (2012-08), Integrating the Healthcare Enterprise, *IHE Patient Care Device Technical Framework – Revision 2.0. Volume 3: Semantic Content*.
http://www.ihe.net/Technical_Framework/upload/IHE_PCD_TF_Rev2-0_Vol3_FT_2012-08-16.pdf

[IHE PCD-TF-1] IHE PCD-TF-1 (2006-08), Integrating the Healthcare Enterprise, *IHE Patient Care Device Technical Framework, Volume 1: Integration Profiles (Revision 1.1)*.
http://www.ihe.net/Technical_Framework/upload/IHE_PCD_TF_rev1.pdf

[IHE PCD-TF-2] IHE PCD-TF-2 (2011-08), Integrating the Healthcare Enterprise, *IHE Patient Care Device (PCD) Technical Framework, Volume 2 (PCD TF-2): Transactions, Revision 1.0*.
http://www.ihe.net/Technical_Framework/upload/IHE_PCD_TF_Vol2_FT_2011-08-12.pdf

[IHE RPM Profile] IHE RPM Profile (08/2015), *IHE Patient Care Coordination Technical Framework Supplement – Remote Patient Monitoring (RPM) – Trial Implementation*.
http://ihe.net/uploadedFiles/Documents/PCC/IHE_PCC_Suppl_RPM.pdf

[IHE TFS DSG] IHE TFS DSG (2009), IHE IT Infrastructure (ITI), *Technical Framework Supplement: Document Digital Signature 2009-2010. Trial Implementation Supplement*.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_Supplement_Digital_Signature-2009-08-10.pdf

[IHE TFS XUA++] IHE TFS XUA++ (2010), IHE IT Infrastructure (ITI), *Technical Framework Supplement: Cross-Enterprise User Assertion - Attribute Extension (XUA++). Trial Implementation.*
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_Suppl_XUA-_Rev1-1_TI_2010-08-10.pdf

[ISO 639] ISO 639, *Codes for the representation of names of languages*.
NOTE - In six parts.

[ISO/IEEE 11073-10404] ISO/IEEE 11073-10404:2010, *Health informatics – Personal health device communication – Part 10404: Device specialization – Pulse oximeter*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=54572

[ISO/IEEE 11073-10407] ISO/IEEE 11073-10407:2010, *Health informatics – Personal health device communication – Part 10407: Device specialization – Blood pressure monitor*.
http://www.iso.org/iso/catalogue_detail.htm?csnumber=54573

[ISO/IEEE 11073-10408] ISO/IEEE 11073-10408:2010, *Health informatics – Personal health device communication – Part 10408: Device specialization – Thermometer*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=54309

[ISO/IEEE 11073-10415] ISO/IEEE 11073-10415:2010, Health informatics – *Personal health device communication – Part 10405: Device specialization – Weighing scale*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=54310

[ISO/IEEE 11073-10417] ISO/IEEE 11073-10417:2014, *Health informatics – Personal health device communication – Part 10417: Device specialization – Glucose meter*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=61896

[ISO/IEEE 11073-10419] ISO/IEEE 11073-10419:2016, *Health informatics - Personal health device communication - Part 10419: Device specialization - Insulin pump*. http://www.iso.org/iso/catalogue_detail.htm?csnumber=69528

[ISO/IEEE 11073-10421] ISO/IEEE 11073-10421:2012, *Health informatics – Personal health device communication – Part 10421: Device specialization – Peak expiratory flow monitor (peak flow)*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=61056

[ISO/IEEE 11073-10424] ISO/IEEE 11073-10424:2016, *Health informatics – Personal health device communication – Part 10424: Device specialization – Sleep apnoea breathing therapy equipment (SABTE)*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=68906

[ISO/IEEE 11073-10425] ISO/IEEE 11073-10425:2016, *Health informatics – Personal health device communication – Part 10425: Device specialization – Continuous glucose monitor (CGM)*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=67821

[ISO/IEEE 11073-10441] ISO/IEEE 11073-10441:2015, *Health informatics – Personal health device communication – Part 10441: Device specialization – Cardiovascular fitness and activity monitor, (Revision of IEEE Std 11073-10441-2008)*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=64868
(also available as http://standards.ieee.org/findstds/standard/11073-10441-2013.html)

[ISO/IEEE 11073-10442] ISO/IEEE 11073-10442:2015, *Health informatics – Personal health device communication – Part 10442: Device specialization – Strength fitness equipment*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=66212

[ISO/IEEE 11073-10471] ISO/IEEE 11073-10471:2010, *Health informatics – Personal health device communication – Part 10471: Device specialization – Independent living activity hub*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=54328

[ISO/IEEE 11073-10472] ISO/IEEE 11073-10472:2012, *Health informatics – Personal health device communication – Part 10472: Device specialization – Medication Monitor*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=54364

[ISO/IEEE 11073-104xx] ISO/IEEE 11073-104xx (in force), *Health informatics – Personal health device communication – Device specialization*.

NOTE – Shorthand to refer to the collection of device specialization standards that utilize IEEE 11073-20601, where xx can be any number from 01 to 99, inclusive.

[ISO/IEEE 11073-20601] ISO/IEEE 11073-20601:2010, *Health informatics – Personal health device communication – Part 20601: Application profile – Optimized exchange profile*.
http://www.iso.org/iso/catalogue_detail.htm?csnumber=54331 (same as https://standards.ieee.org/findstds/standard/11073-20601-2008.html)

[ISO/IEEE 11073-20601-2015A] ISO/IEEE 11073-20601A:2015, *IEEE Health informatics – Personal health device communication Part 20601: Application profile – Optimized Exchange Protocol Amendment 1*.
(Same as http://standards.ieee.org/findstds/standard/11073-20601a-2010.html)

[ISO/IEEE 11073-20601-2016] ISO/IEEE 11073-20601:2016, *IEEE Health informatics – Personal health device communication Part 20601: Application profile – Optimized Exchange Protocol.*
http://www.iso.org/iso/catalogue_detail.htm?csnumber=66717l

[ISO/IEEE 11073-20601-2016 Cor.1-2016] ISO/IEEE 11073-20601:2016, *IEEE Health informatics – Personal health device communication Part 20601: Application profile – Optimized Exchange Protocol – Corrigendum 1*
http://www.iso.org/iso/catalogue_detail.htm?csnumber=71886

[NFC PHDC] NFC PHDC (2013), NFC Forum, *Personal Health Device Communication 1.0*.
http://nfc-forum.org/product/nfc-personal-health-device-communication-technical-specification

[OASIS MQTT] OASIS MQTT specification (December 2013), *Committee Specification Draft 01 / Public Review Draft 01*. http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/csprd01/mqtt-v3.1.1-csprd01.pdf

[OASIS SAMLTP] OASIS SAMLTP (2006-02), *Web Services Security: SAML Token Profile 1.1*.
http://www.oasis-open.org/committees/download.php/16768/wss-v1.1-spec-os-SAMLTokenProfile.pdf

[OASIS/WS-I BP] OASIS/WS-I (2006-04), *Basic Profile Version 1.1*.
http://www.ws-i.org/Profiles/BasicProfile-1.1.html

[OASIS WS-I BSP] OASIS/WS-I BSP (2007-03), *WS-I Basic Security Profile Version 1.0*.
http://www.ws-i.org/Profiles/BasicSecurityProfile-1.0.html

[OASIS WS-I MC] OASIS WS-I MC (2009-02), *Web Services Make Connection (WS-MakeConnection) Version 1.1*.
http://docs.oasis-open.org/ws-rx/wsmc/200702/wsmc-1.1-spec-os.html

[OASIS WS-I RM] OASIS WS-I RM (2009-02), *ReliableMessaging Version 1.2*.
http://docs.oasis-open.org/ws-rx/wsrm/200702/wsrm-1.2-spec-os.html

[OMG/hData BIND] OMG hData REST Binding for RLUS (2011/08), *hData REST Binding for RLUS*.
http://www.omg.org/cgi-bin/doc?health/2011-09-04

[OMG/hData RESTful Trans] OMG (2013), *OMG hData RESTful Transport*.
http://www.omg.org/spec/HData/1.0/

[OMG/hData RLUS] OMG Retrieve, Locate, and Update Service (RLUS) Specification 1.0.1 (2011/07), *Retrieve, Locate, and Update Service (RLUS) Specification*.
http://www.omg.org/spec/RLUS/1.0.1

[TIA-637-C] TIA-637-C, 3GPP2 C.S0015-C v1.0, *Short Message Service (SMS) for Wideband Spread Spectrum Systems* (3GPP2 C.S0015-C v1.0). http://www.3gpp2.org/public_html/specs/C.S0015-C_v1.0_20121126.pdf

[USB DevClass] USB Implementers Forum (2007-11), *Universal Serial Bus Device Class Definition for Personal Healthcare Devices, Release 1.0,* plus Errata (15 February 2008), *Personal Healthcare section*. http://www.usb.org/developers/docs/devclass_docs/Personal_Healthcare_1.zip

[W3C XMLENC] W3C XMLENC Recommendation (2002), *XML Encryption Syntax and Processing*. http://www.w3.org/TR/2002/REC-xmlenc-core-20021210/

[WS-I RSP] OASIS WS-I RSP (2010), *Reliable Secure Profile Version 1.0*. http://www.ws-i.org/Profiles/ReliableSecureProfile-1.0-2010-11-09.html

[XPath 2.0] W3C XML *Path Language (XPath) 2.0 (Second Edition)*. http://www.w3.org/TR/2010/REC-xpath20-20101214/

[ZigBee HCP] ZigBee Alliance (2010), *Health Care Profile Specification, version 1.0,* revision 15. https://docs.zigbee.org/zigbee-docs/dcn/10/docs-10-5619-00-0zhc-zigbee-health-care-profile-1-0-public.pdf

[ZigBee Spec] ZigBee Alliance (2008-01), *ZigBee Specification*. http://old.zigbee.org/Specifications/ZigBee/Overview.aspx

2.1 Equivalent IEEE and ISO specifications

ISO adopts certain IEEE specifications under the "ISO/IEEE Partner Standards Development Organization Cooperation Agreement". Table 2-1 shows ISO equivalents of IEEE 11073 personal health device specifications referenced by the Continua Design Guidelines. Typically ISO versions are published one or more years after the IEEE version.

Table 2-1 – ISO equivalent specifications for IEEE 11073 personal health device specifications

Description	IEEE 11073 standard	Reference	ISO equivalent	Reference
10101 Nomenclature	-	-	ISO/IEEE 11073-10101:2004	[b-ISO/IEEE 11073-10101]
20601 Protocol (v1)	IEEE 11073-20601-2008	[IEEE 11073-20601-2008]	ISO/IEEE 11073-20601:2010	[ISO/IEEE 11073-20601-2010]
20601 Protocol Amendment (v2)	IEEE 11073-20601a-2010	[IEEE 11073-20601A]	ISO/IEEE 11073-20601:2010/Amd 1:2015	[ISO/IEEE 11073-20601-2015A]
20601 Protocol (v3)	IEEE 11073-20601-2014	[IEEE 11073-20601-2014]	ISO/IEEE 11073-20601:2016	[ISO/IEEE 11073-20601-2016]
20601 Protocol Corrigendum (v3)	IEEE 11073-20601-2014/ Cor.1-2015	[IEEE 11073-20601-2014]	ISO/IEEE 11073-20601:2016/Cor.1:2016	[ISO/IEEE 11073-20601-2016/Cor.1:2016]
10404 Pulse oximeter	IEEE 11073-10404-2008	[IEEE 11073-10404]	ISO/IEEE 11073-10404:2010	[ISO/IEEE 11073-10404]
10406 Basic Electrocardiograph (ECG) (1	IEEE 11073-10406-2011	[IEEE 11073-10406]	ISO/IEEE 11073-10406:2012	[ISO/IEEE 11073-10406]

Table 2-1 – ISO equivalent specifications for IEEE 11073 personal health device specifications

Description	IEEE 11073 standard	Reference	ISO equivalent	Reference
to 3-lead ECG)				
10407 Blood Pressure Monitor	IEEE 11073-10407-2008	[IEEE 11073-10407]	ISO/IEEE 11073-10407:2010	[ISO/IEEE 11073-10407]
10408 Thermometer	IEEE 11073-10408-2008	[IEEE 11073-10408]	ISO/IEEE 11073-10408:2010	[ISO/IEEE 11073-10408]
10415 Weighing scale	IEEE 11073-10415-2008	[IEEE 11073-10415]	ISO/IEEE 11073-10415:2010	[ISO/IEEE 11073-10415]
10417 Glucometer	IEEE 11073-10417-2011	[IEEE 11073-10417]	ISO/IEEE 11073-10417:2014	[ISO/IEEE 11073-10417]
10418 INR monitor	IEEE 11073-10418-2011	[IEEE 11073-10418]	ISO/IEEE 11073-10418:2014	[ISO/IEEE 11073-10418]
10419 Insulin Pump	IEEE 11073-10419-2015	[IEEE 11073-10419]	ISO/IEEE 11073-10419:2016	[ISO/IEEE 11073-10419]
10420 Body composition analyzer	IEEE 11073-10420-2010	[IEEE 11073-10420]	ISO/IEEE 11073-10420:2012	[ISO/IEEE 11073-10420]
10421 Peak flow monitor	IEEE 11073-10421-2010	[IEEE 11073-10421]	ISO/IEEE 11073-10421:2012	[ISO/IEEE 11073-10421]
10424 Sleep Apnea Breathing Therapy Equipment	IEEE 11073-10424-2014	[IEEE 11073-10424]	ISO/IEEE 11073-10424:2016	[ISO/IEEE 11073-10424]
10425 Continuous Glucose Monitor	IEEE 11073-10425-2015	[IEEE 11073-10425]	ISO/IEEE 11073-10425:2016	[ISO/IEEE 11073-10425]
10441 Cardiovascular Fitness and Activity monitor	IEEE 11073-10441-2013	[IEEE 11073-10441]	ISO/IEEE 11073-10441:2015	[ISO/IEEE 11073-10441]
10442 Strength fitness equipment	IEEE 11073-10442-2008	[IEEE 11073-10442]	ISO/IEEE 11073-10442:2015	[ISO/IEEE 11073-10442]
10471 Independent living activity hub	IEEE 11073-10471-2008	[IEEE 11073-10471]	ISO/IEEE 11073-10471:2010	[ISO/IEEE 11073-10471]
10472 Medication Monitor	IEEE 11073-10472-2010	[IEEE 11073-10472]	ISO/IEEE 11073-10472:2012	[ISO/IEEE 11073-10472]

3 Definitions

3.1 Terms defined elsewhere

The design guidelines uses the following terms defined elsewhere:

3.1.1 audit trail and node authentication (ATNA)*:* Used in the context of the IHE IT infrastructure technical framework [IHE ITI-TF-1], audit trail and node authentication (ATNA) integration profile establishes security measures which, together with the security policy and procedures, provide patient information confidentiality, data integrity and user accountability.

3.1.2 relative time [ISO/IEEE 11073-20601]*:* This represents a number of ticks from some time reference point, but each device may have a different reference point. To convert to a *date & time*, one must know the duration of each counter tick and correlate some initial counter tick with a known reference point in *Universal Time*. Complementary to *Universal Time*.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 actor*:* Actors are information systems or components of information systems that produce, manage, or act on information associated with operational activities (adapted from [IHE PCD-TF-2]).

3.2.2 actuator: See actuator service component.

3.2.3 actuator information*:* The information accepted by an actuator service component for initiating external actions.

3.2.4 actuator service component: An actuator service component accepts control messages to initiate an external action. This includes, for example, displaying output on a screen, creating an audible notification, producing a tactile output, or controlling other systems (e.g., raising or lowering the heat in a home). This is represented in Continua as an actuator service component in a personal health device.

3.2.5 aging independently (AI): One of the three vertical domains supported by Continua. It is complementary to disease management and health and fitness.

3.2.6 alarm: The external enunciation of physiological conditions, equipment conditions, or other conditions that need attention. Alarm is complementary to alert and event.

3.2.7 alert: When an attempt should be made to notify somebody of a condition (e.g., an event), an alert is distributed within the system to actuator devices (either in the home or in a remote monitoring environment). Alert is complementary to alarm and event.

3.2.8 batch communication: Collecting several documents or store–and-forward information together and transmitting them at the same time to increase the efficiency of bandwidth usage. Batch communication is complementary to transaction communication and streaming communication.

3.2.9 certified capability class: Entity in the Continua E2E architecture for which a complete set of guidelines has been defined such that a device or application can be certified to comply with that set of guidelines via the Continua certification programme.

3.2.10 client component: The Continua architecture uses a client/server (service) communication model across interfaces. A client component on one end interacts with a service component on the other end, via one of the defined interfaces (e.g., PHD-IF, HIS-IF or Services-IF).

3.2.11 clock: Refers to an entity that measures time.

3.2.12 clock synchronization: Refers to the process of updating a device's clock with other clocks in the environment.

3.2.13 command and response: An action or information is explicitly requested by another component in the environment. Commands and responses include the ability to get information, set configurations and execute actions. Command and response are complementary to notification.

3.2.14 comparable local time: Comparable local time refers to time (and date) that is specific to a physical device which can be compared and synchronized to Universal Time. The time zone and daylight savings time status for the physical device may not be known, but an offset to Universal Time can be obtained by querying the devices current time.

3.2.15 component: A component is an entity contained within a device as defined within the Continua architecture. In general, for any interface, there is a service component, with a well-defined set of functions on one side of the interface and one (or more) client components on the other side.

3.2.16 Continua personal health devices interface (PHD-IF): The Continua PHD-IF connects one or more personal health device (e.g., sensor/actuator) client components to one or more personal health device (sensor/actuator) service components using transport media such as USB, BLE, Bluetooth, ZigBee or NFC. Examples of sensor service components include glucose meters, weighing-scales and heart rate monitors.

3.2.17 Continua services interface: The Continua services interface is an interface between a personal health gateway (e.g., smart phone, tablet or dedicated hub) and a health and fitness service (e.g., disease management service, ageing independently service or wellness service). The health and fitness service could be hosted in the cloud. IP based connectivity is assumed between the personal health gateway and the health and fitness service and Continua focuses on defining the behavior of the OSI layers above IP.

3.2.18 Continua healthcare information system interface (HIS-IF): HIS-IF is an interface between a health and fitness service (e.g., disease management service, ageing independently service and wellness service) and a healthcare information system (HIS) such as an electronic medical record (EMR), an electronic health record (EHR) or a pharmacy information system).

3.2.19 continuous data collection: Continuous data collection takes samples at regular intervals. Continuous data collection is complementary to episodic data collection.

3.2.20 control: Control messages provide a mechanism to exchange commands and responses (e.g., get/set commands). These commands may be associated with physiology information or with equipment functionality.

3.2.21 counter*:* A counter is used to measure relative times (see the definition for relative time). Each counter tick is a very short length of time and may vary from counter to counter. It must be possible to query for the duration of each tick used by a counter.

3.2.22 counter synchronization: Refers to the process of synchronizing two or more counters within the environment. This is useful to ensure that the relative times from multiple devices can be correlated with one another.

3.2.23 cross-enterprise document media interchange (**XDM)**: The XDM protocol is published by the IHE. It provides a transport protocol for indirect communication of personal health record (PHR) documents transferred over the HIS interface.

3.2.24 cross-enterprise document reliable interchange (**XDR)**: The XDR protocol is published by the IHE. It provides a transport protocol for direct communication of health reports transferred over the HIS interface.

3.2.25 device: A device is a physical entity (box) and contains one or more components (functionality).

3.2.26 disease management: One of the three vertical domains supported by Continua. Disease management is complementary to health and fitness and aging independently.

3.2.27 document: A document holds summaries, reports, or histories for printing or sharing with other parties. A document is complementary to event and sensor information.

3.2.28 electronic health record (EHR): The electronic health record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter as well as supporting other care-related activities directly or indirectly via the interface including evidence-based decision support, quality management and outcomes reporting.

3.2.29 electronic medical record (EMR)*:* EMRs are computerized legal clinical records created in care delivery organizations (CDOs) such as hospitals and physician offices. An electronic medical record is owned by the organization, practice or corporation that provided the health care be it a clinic, a hospital or a doctor.

3.2.30 episodic data collection: Episodic data collection corresponds to an episode, usually at irregular intervals. The time between samples can vary widely from seconds to weeks or longer. Episodic data collection is complementary to continuous data collection.

3.2.31 event: The occurrence of a condition. An event is complementary to alert and alarm.

3.2.32 health device profile (HDP)*:* Bluetooth HDP is a standard profile defined by the Bluetooth SIG for health devices that use Bluetooth as an underlying transport standard. Bluetooth HDP may be used by Continua X73-IF devices.

3.2.33 health and fitness: One of the three vertical domains supported by Continua. Health and fitness is complementary to disease management and aging independently.

3.2.34 Health and fitness service: A health and fitness service (HFS) is a remote monitoring service (e.g., disease management, ageing independently and fitness services), hosted on a remote server (in the cloud), that may implement at least one of the Continua defined capabilities in order to communicate with the personal health gateway (PHG) and/or healthcare information system (HIS).

3.2.35 health and fitness service application: This is an application running on the health and fitness service. The application may implement a number of health and fitness service components and/or HIS client components for purposes such as data collection, analysis and sharing.

3.2.36 IHE transaction: (definition adapted from [IHE PCD-TF-1]) An IHE transaction is a set of interactions between IHE actors that transfers required information through standards-based messages.

3.2.37 integrity: A part of system reliability that relates to information consistency and assuring that information will not be accidentally or maliciously altered or destroyed. Incorrect, corrupted data cannot be mistaken for correct data.

3.2.38 interoperability: The ability of client components in a device to communicate and share data with service components in an unambiguous and predictable manner to exchange data accurately, effectively and consistently; and to understand and use the information that is exchanged. Continua has created and selected requirements to incorporate into these design guidelines to ensure that Continua certified devices embody the principal of interoperability.

3.2.39 interface: An interface is an information interchange point between two components.

3.2.40 local time: Local time refers to a time (and date) that is specific to a geographic location. The time zone for that location may or may not be known. If it is known, converting to Universal Time is straightforward.

3.2.41 measurement*:* A measurement is a measurable observation that is received from a device.

3.2.42 non-certified interface: This represents any interface whose service and client components will not be certified by Continua. In some cases, these are proprietary interfaces that are unlikely to become certified at any time in the future. In other cases, it may represent an interface that has not been addressed by Continua yet, but could be in the future.

3.2.43 notification: Information is sent to one or more components in the environment via regular packets in a data stream, or via some non-deterministic mode such as publishing events and measurements to subscribers. Notification is complementary to command and response.

3.2.44 observation*:* An observation is an observable datum from the physical world.

3.2.45 personal health gateway (PHG): One of the Continua reference capability classes. A personal health gateway is a central point of control in the Continua architecture. The personal health gateway contains a number of client components that use personal health devices (PHD-IFs) and services interfaces to access one or more services on other devices to coordinate data collection, data analysis, data sharing and alerting.

3.2.46 PHG application: This is an application or a piece of software/program that is running on the PHG. The application implements a specific capability and implements one or more (client and/or service) components for the purposes of data collection, analysis and sharing.

3.2.47 personal health device (PHD): A personal health device is a device that houses a PHD interface service component that exposes the PHD interface. Examples of personal health devices are glucose meters or blood pressure monitors.

3.2.48 personal health devices interface (PHD-IF): Interface between a personal health device (PHD) and personal health gateway (PHG). See the Continua PHD interface clause of this Recommendation.

3.2.49 persistent session: A component in the conceptual model of a personal health gateway (PHG) that is administratively created. A persistent session stores and forwards observations to a health and fitness service (HFS). Observations enter a persistent session for forwarding when the observation meets a set of criteria defined in admission rules associated with the particular persistent session.

3.2.50 personal healthcare monitoring report (PHMR): An XML document conforming to "HL7 Implementation Guide for Personal Healthcare Monitoring Report (PHMR) International Realm Based on HL7 CDA Release 2.0" The personal healthcare monitoring report is a document that carries personal health monitoring data. The data transmitted from sender is either in the form of a summary or in the form of raw data. The summarization may be a result of analysis by an authentic disease management service provider. The data has multiple characteristics including: representation of measurements captured by devices; representation of notes, summaries and other types of narrative information that may be added by care givers or by the user themselves; and representation of graphs that may be added by intermediary devices that represent user health trends.

3.2.51 personal health record (PHR): The personal health record (PHR) is an electronic, universally available, lifelong resource of health information needed by individuals to make health decisions. Individuals own and manage the information in the PHR, which comes from healthcare providers and the individual. The PHR is maintained in a secure and private environment, with the individual determining rights of access. The PHR is separate from and does not replace the legal record of any provider.

3.2.52 privacy: An aspect of system security (preventing undesired system use) that deals with providing access to the parties to which the information belongs and to parties that have explicitly been allowed access to certain information (also known as confidentiality).

3.2.53 quality of service (QoS): Quality of service is the collection of properties that define characteristics of an interface connection. This set of these properties includes aspects of the communication link such as reliability, latency, bandwidth, etc.

3.2.54 reference capability class: The basis of the guidelines framework includes a number of reference capability classes where topology constraints are explicitly noted.

3.2.55 sensor: See sensor service component.

3.2.56 sensor information: The information provided by a sensor service component.

3.2.57 sensor service component: A sensor service component allows access to digital representations of external conditions and events. This includes measurements of temperature, motion or electrical conditions.

3.2.58 service component: A service component is a specific type of component used in the Continua architecture for any component that provides a service to a client component.

3.2.59 simplicity: Simplicity is the property, condition, or quality of being simple or un-combined. It often denotes beauty, purity or clarity. Simple things are usually easier to explain and understand than complicated ones.

3.2.60 store and forward: This is a technique that is often used by a device when the connection to a partner may be intermittent. The sender stores the data and transmits all stored data to its partner at a later moment in time (e.g., when connection is available again). The most typical use of store and forward is with episodic data; however, this technically can also be used with continuous data.

3.2.61 streaming communication: A continuous, uninterrupted flow of data (e.g., measurements and/or events) from one component to another. Typically this data is sent in near real-time and contains data sampled at regular intervals. Multiple samples may be placed in a single communication packet to utilize the network bandwidth efficiently. Streaming communication is complementary to transaction communication and batch communication.

3.2.62 time code: When relative time data is communicated, a time code is added to the data to indicate the relative time at which the data was collected, transmitted, or received.

3.2.63 time mark: The term time mark is used in instances where either a time code or timestamp can be used.

3.2.64 timestamp: When comparable local time or Universal Time data is communicated, a timestamp is added to indicate the time at which the data was collected, transmitted or received.

3.2.65 transaction communication: A communication method where one component exchanges acknowledged notifications or command and responses with another component to ensure reliability. Transaction communication is complementary to streaming communication and batch communication.

3.2.66 Universal Time*:* This represents time (and date) with respect to some well-known reference point (e.g., UTC). Once synchronized, all devices that support Universal Time report the same time within the limits of clock drift error. Universal Time is complementary to relative time.

4 Abbreviations and acronyms

The design guidelines use the following abbreviations and acronyms:

AA	HL7 Acknowledgement Accepted
AES	Advanced Encryption Standard
AHD	Application Hosting Device
AI	Ageing Independently

AMM	Adherence Medication Monitor
APB	Authenticated Persistent Binding
APBI	Authenticated Persistent Binding Identifiers
APDU	Application Protocol Data Unit
API	Application Programming Interface
APS	Authenticated Persistent Session
ASTM	American Society for Testing and Materials
ATNA	Audit Trail and Node Authentication
BMI	Body Mass Index
BPM	Blood Pressure Monitor
BR/EDR	Basic Rate/Enhanced Data Rate
CCC	Certified Capability Class
CCD	Continuity of Care Document
CCR	Continuity of Care Record
CDA	Clinical Document Architecture
CDG	Continua Design Guidelines
CDO	Care Delivery Organization
CE	Compute Engine (deprecated)
CGM	Continuous Glucose Monitor
CO	Carbon monoxide
CRC	Cyclic Redundancy Check
UTC	Coordinated Universal Time
DEC	Device Enterprise Communications
DEN	Document Encryption
DG	Design Guideline
DMO	Disease Management Organization
DOC	Device Observation Consumer
DOR	Device Observation Reporter
E2E	End-to-End
ebXML	electronic business using extensible Markup Language
ECC	Error Correcting Code
ECG	Electrocardiograph
EDI	Electronic Data Interchange
EHR	Electronic Health Record
EMR	Electronic Medical Record
EUI	Extended Unique Identifier
FCS	Frame Check Sequence

FTP	File Transfer Protocol
GMDN	Global Medical Device Nomenclature
GUID	Globally Unique Identifier
HC	Health Care
HDH	hData Hierarchy
HDP	Health Device Profile
HF	Health and Fitness
HFS	Health and Fitness Service
HIE	Healthcare Information Exchange
HIPAA	Health Insurance Portability and Accountability Act
HIS	Healthcare Information System
HIS-IF	Healthcare Information System Interface
HR	Health Report
HTTP	Hypertext Transfer Protocol
HRF	hData Record Format
HTTPS	Hypertext Transfer Protocol over Secure Socket Layer
IF	Interface
IIHI	Individually Identifiable Health Information
INR	International Normalized Ratio
ITI	IT Infrastructure
N-IF	Network Interface
IP	Internet Protocol
L2CAP	Logic Link Control and Adaptation Protocol
LE	Low Energy
LP	Low Power
MAC	Media Access Control
MCAP	Multi-Channel Adaptation Protocol
MDEP	MCAP Data End Point
MDS	Medical Device System
MITM	Man In The Middle
MQTT	Message Queuing Telemetry Transport
MSH	Message Header
MTOM	Message Transmission Optimization Mechanism
NHIN	Nationwide Health Information Network
NFC	Near-field communication
OBR	Observation request
OBX	Observation result

OEM	Original Equipment Manufacturer
OSI	Open Systems Interconnection
OUI	Organizationally Unique Identifier
PC	Personal Computer
PCC	Patient Care Coordination
PCD	Patient Care Device
PCD-01	IHE Patient Care Device Transaction 01
PERS	Personal Emergency Response System
PHD	Personal Health Device
PHDC	Personal Health Device Communications
PHD-IF	Personal Health Devices Interface
PHG	Personal Health Gateway
PHM	Personal Healthcare Monitoring
PHMR	Personal Healthcare Monitoring Report
PHR	Personal Health Record
PID	Patient Identifier
PIN	Personal Identification Number
POTS	Plain Old Telephone Service
PROM	Patient Reported Outcome Measure
QoS	Quality of Service
REST	Representational State Transfer
RHIO	Regional Health Information Organization
RLUS	Retrieve, Locate and Update Service
RPM	Remote Patient Monitoring
SAML	Security Assertion Markup Language
SDP	Service Discovery Protocol
SDU	Service Data Unit
SDWG	Structured Documents Workgroup
SOAP	Simple Object Access Protocol
SpO2	Percentage of Oxygen Saturation in blood
SSL	Secure Socket Layer
SSP	Secure Simple Pairing
ST	Shoulder Tap
STS	Security Token Service
TCP	Transmission Control Protocol
TCWG	Test and Certification Working Group
TLS	Transport Level Security

TWG	Technical Working Group
UCUM	Unified Code for Units of Measure
UDH	User Data Header
UDP	User Datagram Protocol
USB	Universal Serial Bus
UTC	Coordinated Universal Time
v1	Version 1
VMD	Virtual Medical Device
XDM	cross-enterprise Document Media interchange
XDR	cross-enterprise Document Reliable interchange
XDS	cross-enterprise Document Sharing
XDS.b	cross-enterprise Document Sharing-b
XML	extensible Markup Language
XUA	cross enterprise User Assertion
WSDL	Web Services Description Language

5 Conventions

5.1 Design Guidelines terminology and conventions

This clause defines the format and terminology for the Design Guidelines (DGs) where the term *Continua* is used to designate the functionality and architectural elements defined in the DGs, or devices that are implemented according to it.

5.1.1 DG compliance classifiers

The details of each design guideline will carry a compliance classifier from the following set (adapted from [b-IETF RFC 2119]):

– **Shall** – This term designates the minimum set of requirements that ensure interoperability and/or robust operation between components. All components and interfaces are expected to comply with these requirements when expressed in unconditional form. A conditional requirement expressed in the form, "If X, then Y "shall" be implemented", means that the requirement "Y" must be met when the conditional aspect "X" applies to a given implementation.

– **Should** – This term designates strongly recommended items. Under most circumstances, implementations include "should" requirements; however, it is recognized that there may exist valid reasons in particular circumstances where it is preferable not to implement a "should" requirement. These conditions must be carefully understood and weighed up given that this may reduce the interoperability of that product.

– **May** – The use of this term highlights to product implementers features that "may" exist in the marketplace. All products must be prepared to interoperate with implementations that have and have not implemented the requirement. If optional features are included in a product, they must comply with the requirement to ensure interoperability with other implementations.

5.1.2 DG font usage conventions

The following font usage conventions are used within the CDG to provide additional clarity:

Requirement terms are in **bold** font. The terms described in clause 5.1.1 are in **bold** font when used in the requirement sense.

5.1.3 DG format

This clause details the format of a DG, see an example in Table 5-1.

Table 5-1 – Design guideline example

Name	Description	Comments
PHD-IF-USB-Personal-Healthcare-v1.0	Continua USB service and client components **shall** implement the USB Personal Healthcare Device Class v1.0 plus the 15 Feb. 2008 errata, subject to the requirements listed below.	

The design guideline table heading categories are as follows:

– **Name** – A unique label for the design guideline

– **Description** – Text that describes the design guideline

– **Comments** – Supplementary information about a design guideline such as a justification for it, dependencies, etc.

6 System overview

6.1 E2E system architecture

This clause defines the end-to-end (E2E) architecture for the Continua ecosystem. The Continua architecture is used for several purposes:

– definition of common concepts

– definition of topology constraints for the Continua ecosystem

– serves as a basis for the guidelines framework by providing a basic structure, providing rules for refinement and extension of this structure and the association of guidelines with elements in this structure.

NOTE – In this Recommendation, "Continua architecture" and " Continua E2E architecture" are used interchangeably.

6.1.1 Devices, components, applications and interfaces

The Continua architecture distinguishes devices (physical entities) from components (logical entities) and applications (a software program). This distinction is general and not specific for Continua reference capability classes, Continua certified device classes, or Continua logo-ed device classes that are defined later in this Recommendation (see clause 6.1.4). Devices may host zero or more applications. An application may have one or more capabilities. A capability may then implement client and/or service components depending on the use case.

Devices, components and applications are depicted in Figure 6-1.

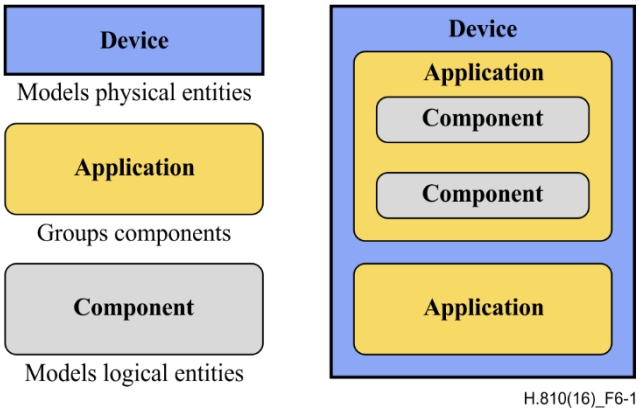

Figure 6-1 – Device, component and application

Components implement and require the implementation of a number of interfaces as shown in Figure 6-2.

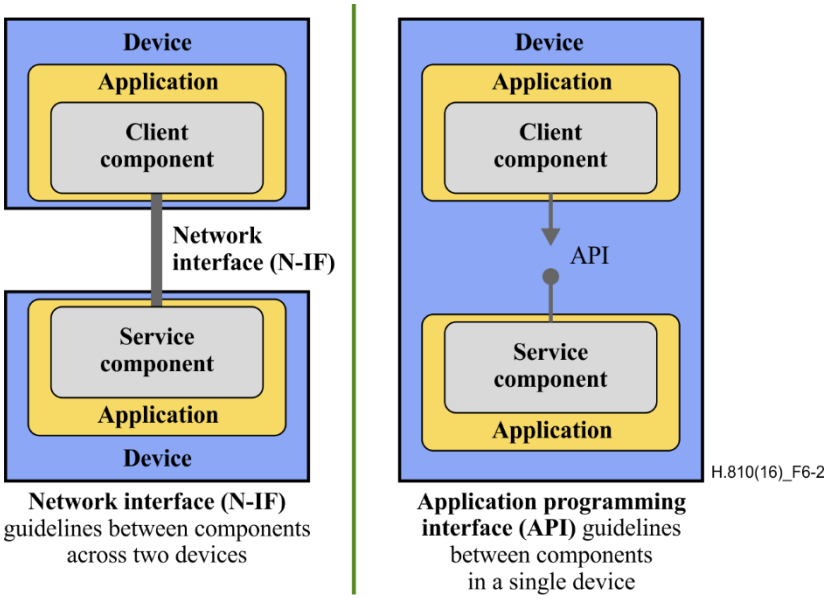

Figure 6-2 – Interfaces between components

The CDG makes the distinction between network interface (N-IF) guidelines and application programming interface (API) guidelines. Figure 6-1 to Figure 6-6 show the graphical representations of the components that constitute the Continua architecture.

The graphical notation for a component implementing an API is depicted by Figure 6-3.

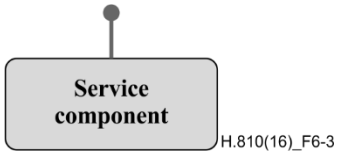

Figure 6-3 – Component implements API

The graphical notation for a component requiring the implementation of an API shown in Figure 6-4.

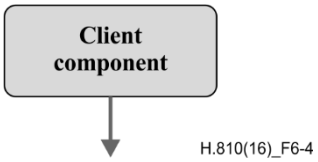

Figure 6-4 – Component requires the implementation of an API

The graphical notation for a component implementing a network interface specification is shown by Figure 6-5.

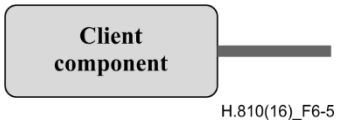

Figure 6-5 – Component implements N-IF

The graphical notation for a component requiring the implementation of an N-IF is shown in Figure 6-6.

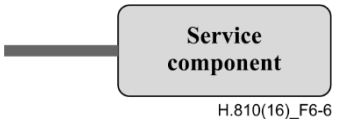

Figure 6-6 – Component requires implementation of an N-IF

The main difference between an API and N-IF is that an API is an interface between components within a single device and N-IF is the interface between components on multiple devices.

For these design guidelines, the focus is on the interoperability between devices. Interoperability is enabled via the characteristic behaviour of devices found in a communications system. There are fundamental characteristics that manifest as part of the interface specifications that define the configuration and formats to facilitate interoperability. These specifications are the contracts between devices that ensure that a dialogue can occur.

Figure 6-7 shows the current focus of Continua design guidelines. For Continua the current focus is on the interoperability between two devices i.e., network interface guidelines. In future versions of Continua there might be a need for a common middleware, which would provide interfaces to different applications running on the same device, hence the API guidelines might fall under the scope of Continua.

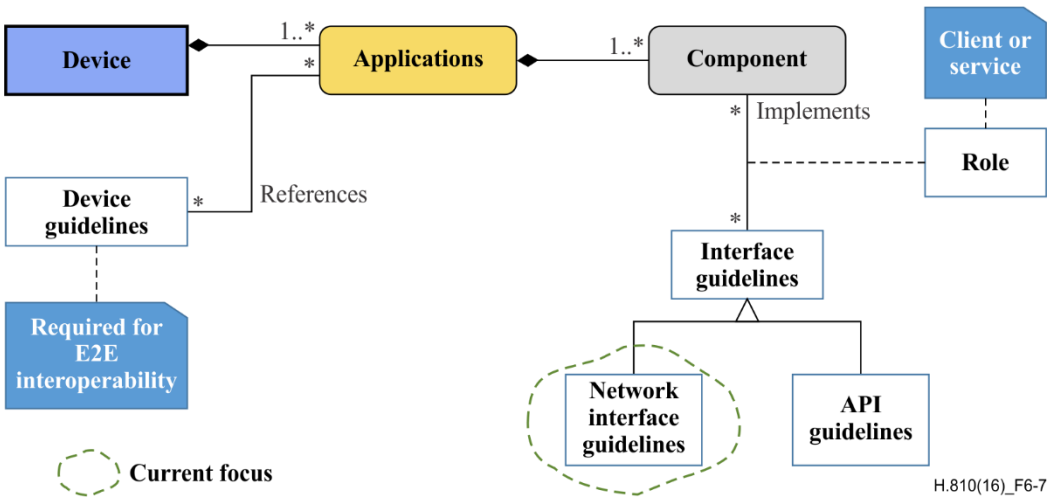

Figure 6-7 – Current focus of Continua design guidelines

6.1.2 Design guideline types

Interface guidelines are implemented by zero or more components and a component may implement zero or more interface guidelines. Interface guidelines can be created for APIs as well as N-IFs.

For the CDG, the focus is on device interoperability. This implies a focus on N-IF guidelines. In future versions of the CDG, there may be a need for common middleware that gives a unified view for services and clients on the different service N-IFs. The API guidelines will then fall under the CDG scope as well.

Interface guidelines enable interoperability across a single interface. Device guidelines are specified to enable E2E interoperability (interoperability across interfaces) and interaction with the environment.

This version of the CDG contains both interface guidelines and device guidelines.

6.1.3 Reference capability classes and system topology

Devices are physical entities that can host a number of applications, where an application is a program that implements a specific functionality and implements one or more (client and/or service) components. The Continua E2E architecture distinguishes different reference capability classes based on the component classes hosted on that device.

The current Continua E2E architecture distinguishes the following reference capability classes:

– **Personal Health Device (PHD):** This is a reference capability class that implements at least one Personal Health Device (PHD)-IF service component. Real word examples of PHD-IF service components include pulse oximeters, blood pressure monitor, thermometer or weighing-scales capabilities classes, where the physical transport media could be BLE, ZigBee, Bluetooth, USB and NFC.

– **Personal Health Gateway (PHG):** This is a reference capability class that implements at least one PHD-IF client component or services-IF client component. An example of a PHD-IF client component is an app (e.g. running on smart phone) that collects observations (e.g. vital signs measurements) from PHD-IF service components.

– **Health and Fitness Service (HFS):** This is a reference capability class that implements at least one services-IF service component or HIS-IF client component. An example of a services-IF service component is a remote server that collects observations (e.g. vital signs measurements from PHD devices or questionnaire responses) from a services-IF client component.

– **Healthcare Information System (HIS):** This is a reference capability class that implements at least one HIS-IF service component. An example of a HIS-IF service component is a General Physician EMR that is able to receive personal health monitoring (PHM) documents from a HIS-IF client component.

Figure 6-8 shows the definitions and graphical notation of reference capability classes.

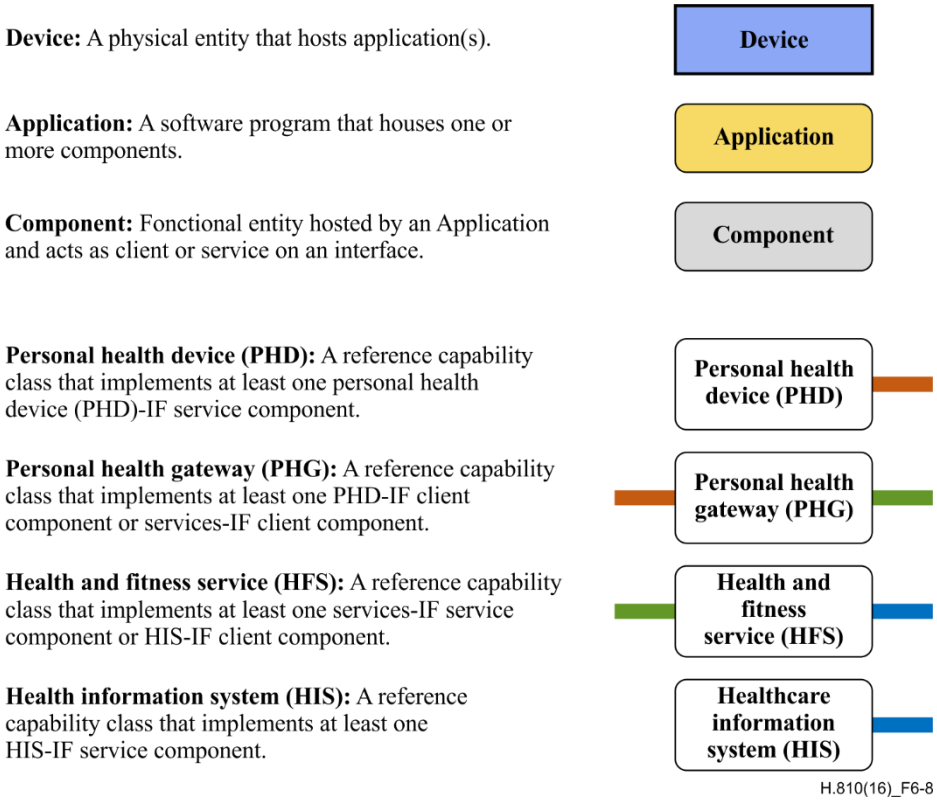

Figure 6-8 – Definitions and graphical notation

The distinction between the different interfaces is based on architectural dimensions (e.g., who-stakeholders, where-geography and what-functions and features). The highest level (the basis for the reference device classes) has the following dimensions:

– Personal health devices interface. This is the interface used by personal health devices (e.g., blood pressure meter, pulse oximeter, thermometer) in order to report observations (measurements) taken by these devices to a personal health gateway (e.g., a health and fitness app on a smartphone or tablet or dedicated hub) usually in the home but not necessarily. The key stakeholder here is the user (e.g., a user suffering from a chronic condition such as COPD or diabetes).

– Services interface. This is the interface used by a personal health gateway (e.g., a health and fitness app on a smartphone or tablet or dedicated hub) in order to forward collected observations (or measurements) from personal health devices to a remote health and fitness service provider. An example of the remote health and fitness service is a telehealth service provided by a home health agency (HHA). The health and fitness service could be hosted in the cloud. Some of the key stakeholders could be a skilled nurse or a remote coach for diet or fitness.

– Healthcare information system interface. This is the interface used by a health and fitness service in order to report and share patient data with a healthcare information system (HIS). Examples of HISs are EMR, PHRs, EHRs, laboratory information systems (LISs), etc. One of the key stakeholders for HIS is the care providers such as General Physicians.

The topology constraints for the Continua ecosystem are defined using the reference capability classes described above. These reference capability classes provide an abstract model for real-world devices and are the basis for further specialization. A personal health device could be further specialized on the type of transport media being used such as NFC, Bluetooth, ZigBee and USB.

The Continua reference topology imposes a number of constraints on how reference capability classes are physically connected. Figure 6-9 shows the Continua reference topology.

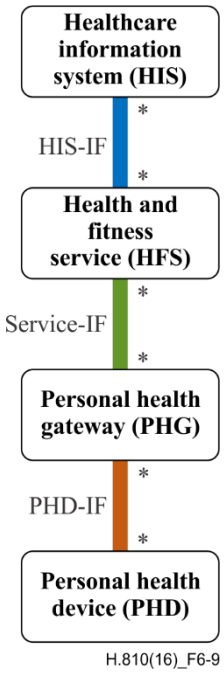

Figure 6-9 – Reference topology

This reference topology gives the following rules for the topology of the Continua ecosystem:

– Personal health device "can serve" 0 or more personal health gateways (PHGs) at a time.

– A personal health gateway "can use" 0 or more personal health devices (PHDs) at a time.

– Health and fitness services "can serve" 0 or more personal health gateways (PHGs) at a time.

– Health and fitness service "can use" 0 or more healthcare information systems (HIS) at a time.

– Healthcare information system "can serve" 0 or more health and fitness services (HFS) at a time.

6.1.4 Reference, certified and logo-ed capability classes

Reference capability classes form the (abstract) basis for the guidelines framework. Based on the reference capability classes, a large number of specializations are possible. These include certified capability classes and logo-ed capability classes.

It is desirable to define a number of certifiable guidelines. Certification only makes sense for entities that are part of the Continua E2E architecture (reference capability classes). However, there is a requirement for further specialization of these classes. An example is the certification of a PHD weighing-scales capability instead of just a personal health device. The architecture does not define the certified capability classes but does impose the constraint that the certified capability classes are a specialization (possibly indirect) of at least one reference capability class. Vendors can create a product that satisfies the associated guidelines for more than one certified capability class. These products (e.g., a personal health gateway that supports the collection of observations from a range

of PHD capabilities (e.g., pulse oximeter, weighing-scales) can receive multiple CDG-compliant certificates. Product literature should clearly denote the certified capability classes supported by that product.

The need or desire to add logos to physical devices or applications is recognized as it signifies interoperability. Adding logos only makes sense if a device or application implements a Continua capability class and it is certified (certified capability classes). Usually a certified capability class will match a logo-ed certified capability class, however this is not always the case. For example, authenticated persistent session certified device class will be an un-logo-ed certified device class as it is an infrastructure component and does not deliver full out of the box interoperability between the two certified devices.

For the rest of the certified capability classes in this version of the design guidelines, the logo-ed capability classes match the certified capability classes. In addition to the Continua logo for implementing a certified capability, a device or application may use a logo from other base standard bodies such as for example, Bluetooth, USB or ZigBee. A device or application shall list the capabilities for which it has obtained the certification.

6.1.5 Other views of the architecture

Continua has defined its own architectural concepts in order to describe the views of its members about the personal health ecosystem. The concepts have been defined taking into account different stakeholders such as users of the system, operators of the system and providers of the system. However different views of the Continua reference architecture and capabilities defined within this architecture are possible. Figure 6-10 below depicts key concepts pertaining to systems and their architectures as a context for understanding the practice of architecture description. For more background information on architecture descriptions consult [b-ISO/IEC IEEE 42010].

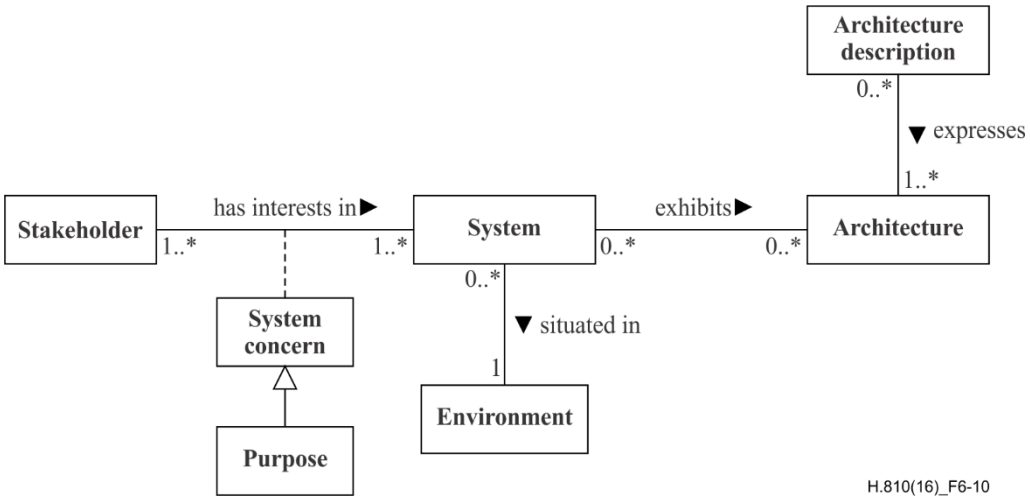

Figure 6-10 – Context of architecture description [b-ISO/IEC IEEE 42010]

Figure 6-11 describes the conceptual model for an architecture description. It is used to describe an architecture for a system of interest. For more background information on architecture descriptions consult [b-ISO/IEC IEEE 42010].

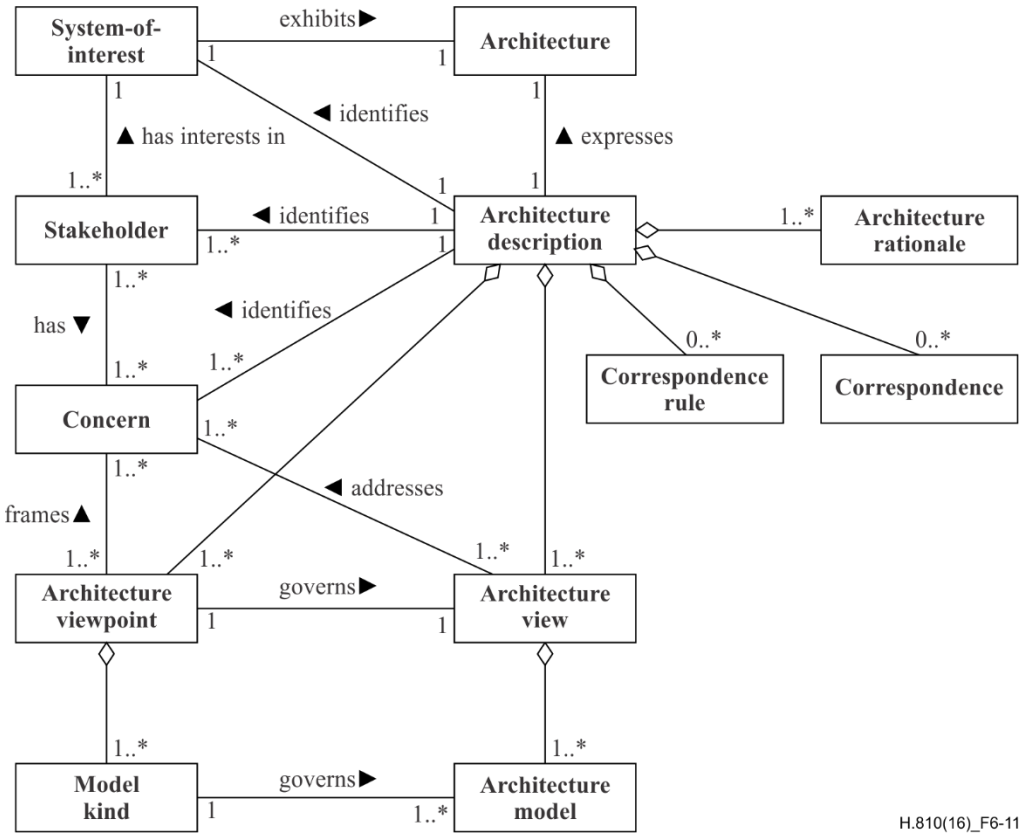

Figure 6-11 – Conceptual model of an architecture description

For example, Continua reference architecture and concepts can be easily translated and represented using concepts and views defined by Integrating Healthcare Enterprise (IHE). IHE has the following concepts:

– Integration profile: The integration profile solves specific integration problems and is a representation of a real-world capability that is supported by a set of actors that interact through transactions. It avoids having two different mechanisms to do the same thing.

– Actor: An actor is an information system or a component of an information system that produces, manages or acts on categories of information required by operational activities in the enterprise. Actors are assigned to profiles when they have a role to fill.

– Transaction: A transaction is an interaction between actors that communicate the required information through standard-based messages. A transaction should complete a specific task and should usually select a single standard for one single task.

In clauses 6.1.5.1 and 6.1.5.2 a "communicate PCHA data transaction" across a PHD-IF serves as a use case to show how to represent Continua PHD-IF capabilities using IHE concepts and terminologies.

6.1.5.1 Scope of the communicate PCHA data transaction

A "communicate PCHA data transaction" is used to transfer measurement data from personal health device (PHD) sensor data source actors to an appropriate consumer in a standardized manner. This transaction allows a single sensor data consumer actor to process data from any compliant sensor device (blood pressure cuffs, glucometers, coagulation meters, sleep apnea breathing therapy equipment, etc.)

This transaction is typically the only point at which a human is involved. Once the measurement data is received by the sensor data consumer, the process of delivering the data to its final destination in its final form at a content consumer is automated [IHE RPM Profile].

6.1.5.2 Actor roles

Figure 6-12 shows a diagram of the "communicate PCHA data transaction" use case.

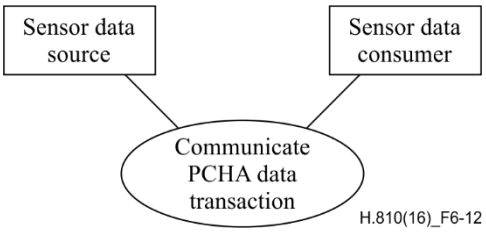

Figure 6-12 – Use case diagram

Table 6-1 – Actor roles

Actor:	Sensor data source
Role:	This actor is responsible for taking the measurement on the patient, packaging it into a standardized form and sending it to a consumer in a standardized manner.
Actor:	Sensor data consumer
Role:	This actor receives measurement data from one or more sensor data source actors (sensor devices)

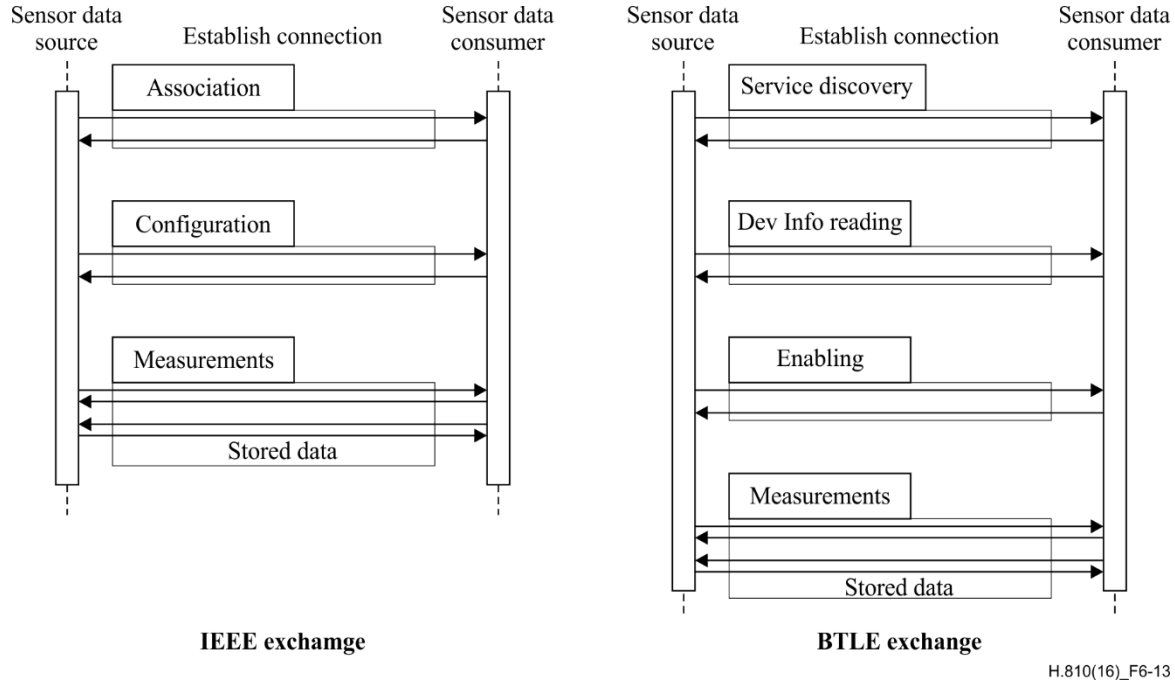

Figure 6-13 – PHD-IF communicate PCHA data transaction

Figure 6-13 illustrates the sequence of events that take place in the two different implementations of the PCHA transaction. In both cases there is a series of exchanges that allow the sensor data consumer to either receive or request measurement data from the sensor data source. It should be noted that the sensor data consumer only requests data from the sensor data source if the sensor data source indicates that it has permanently stored data.

6.1.6 Compatibility

6.1.6.1 Compatibility definitions

Extensibility

This is the ability to extend a system (design-time) with new capabilities and applications over time with minimal effort (sometimes confused with forward compatibility).

Backward compatibility

This is the ability of a system to interoperate (run-time) with other systems that were designed for earlier versions of that system. Figure 6-14 shows the backward compatibility and forward compatibility philosophy.

Forward compatibility (robustness, future-proofness):

This is the ability of a system to accept input (run-time) from other systems that were designed for later versions of that system. Figure 6-14 shows the backward compatibility and forward compatibility philosophy.

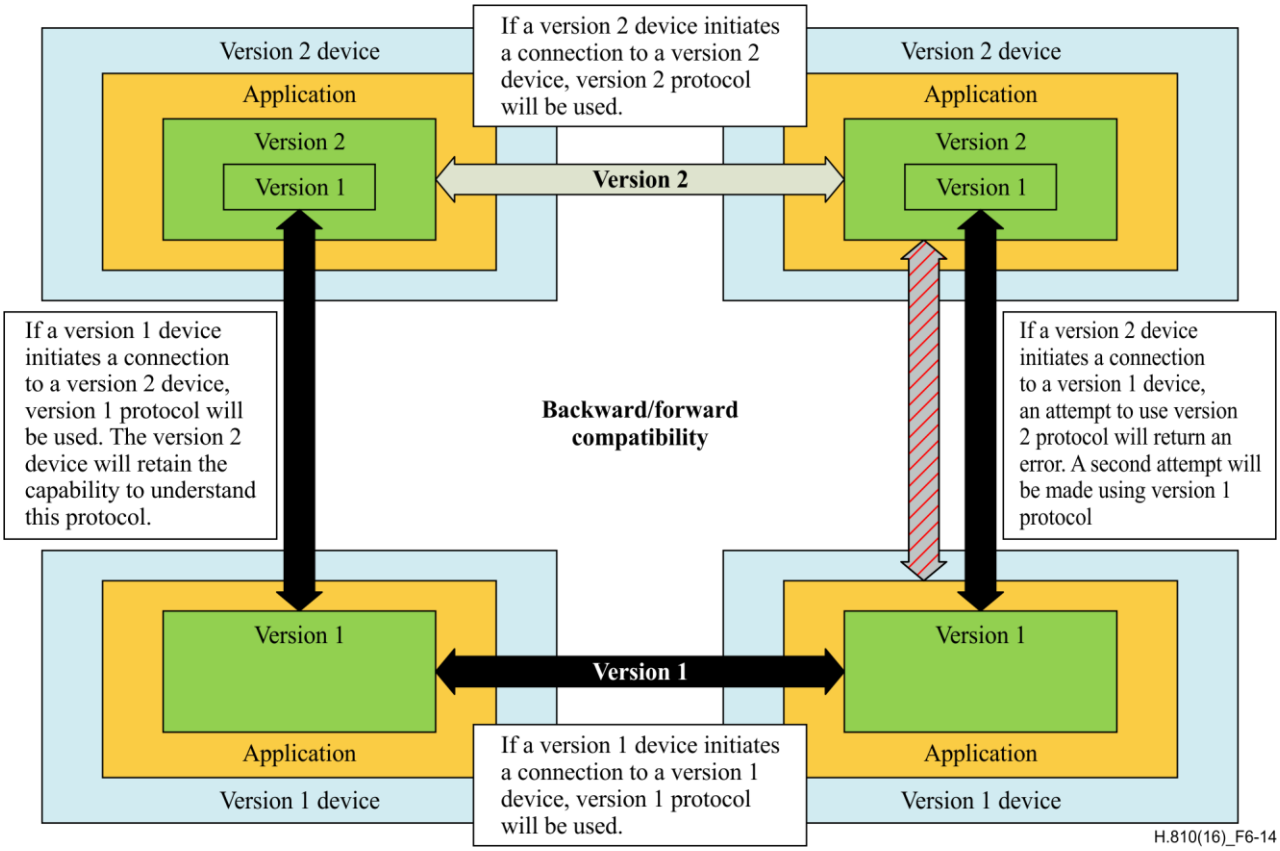

Figure 6-14 – Backward compatibility and forward compatibility philosophy

6.1.6.2 Compatibility philosophy

The Continua E2E architecture should have the flexibility to incorporate reasonable future changes. On the other hand, devices need to maintain interoperability (as much as possible) when guidelines evolve over time. Additionally, devices based on different versions also need to interoperate. This clause provides a logical analysis of the principles to be taken into account in the definition of N-IF specifications. These principles address the proper definition of an N-IF specification, as well as the constraints on the evolution of these specifications. The aim is that two devices based on different

versions of the guidelines are compatible and together they provide the functionality expected from the oldest version of the guidelines involved.

An N-IF specification consists of:

– interoperable protocol
– semantics of command and messages
– common data format and data specializations
– commands and exchange protocol
– consistent communication framework
– transport / network protocol
– network
– N-IF specifications will evolve over time. For extensibility and compatibility, multiple versions of an N-IF specification are considered. This provides guidance on how the N-IF specifications were allowed to evolve. To address the concerns with respect to extensibility and compatibility, the following are guidelines for the definition and evolution of N-IF specifications:
  – A component should have well-specified behaviour for all possible inputs. Only unknown portions of messages / commands are ignored. A component should not crash on any input (forward compatible). When part of a message is not understood a warning should be returned.
  – Messages / commands are extended in later versions. Semantics of the extended messages / commands should include the semantics of the original message (extensibility).
  – Semantics of messages / commands should not change in later versions (backward compatible).
  – Messages / commands are not removed in later versions (backward compatible).
  – The consistent communication framework is only replaced by a backward compatible framework in later versions (backward compatible).
  – The transport / network protocol are only replaced by a backward compatible protocol in later versions (backward compatible).
  – The network is only replaced by a backward compatible network in later versions (e.g., USB 1.0 by USB 2.0) (backward compatible).

NOTE – The guidelines listed above allow for vendor-specific extensions (first bullet). The last five bullets targeting backward compatibility are probably not realistic to maintain indefinitely. However, messages, commands, consistent communication framework, transport / network protocol and network are supported by components for at least two versions after they were marked as deprecated.

6.1.7 Quality of service strategy

6.1.7.1 General overview

The ability to transfer quality of service (QoS) information from component to component is an important requirement on the Continua architecture. This clause defines the CDG approach to enable the transfer of QoS information between components.

Quality of service (QoS) is a very broad area with numerous attributes. A representative list of QoS attributes includes:

1. reliability
2. latency

3. bandwidth
4. forward and reverse channel set up / tear down times
5. monetary cost
6. energy cost (often useful in wireless communications).

There are certainly others. All attributes are not equally applicable to all applications or to all transport technologies.

In the area of healthcare communications, reliability and latency are considered the most important attributes that need to be managed effectively and thus are addressed in the design guidelines. It is envisioned that other QoS attributes are addressed as the Continua ecosystem grows, expands and develops new uses.

6.1.7.2 Reliability and latency

At the extreme, there is a trade-off between the application reliability and latency attributes when deciding which of these two attributes is more important to a particular piece of data.

1. There are times when ***low*** latency is more important than reliability. It is acceptable to drop "some" data as a trade-off to getting the data quickly. For example, when sending real-time waveform data, it is more important to get the data sent quickly versus an absolute guarantee that all data has been delivered.
2. There are times when the ***best*** reliability is more important than timeliness. For instance, sometimes it is required that all data is transmitted correctly and it is acceptable to wait for data to be retransmitted (delayed) to achieve this correctness guarantee.

Table 6-2 maps the data transfers involved in CDG use cases across latency and reliability vectors. The boxes with icons denote the latency and reliability combinations that are, or could be utilized by CDG use cases. For more detail on the meaning and use of the reliability/latency pairs in these boxes, see clause 6.1.7.5. Best results would be achieved if all transport technologies could operate in the lower right corner of Table 6-2 (i.e., best reliability and low latency, such as a processor bus with an error correcting code (ECC). However, typical inter-device transport technologies cannot achieve this.

Table 6-2 – Reliability and latency

Reliability.latency bin		**Relative reliability**		
		Good	**Better**	**Best**
Latency (overall E2E)	Very high			best.veryhigh
	High			best.high
	Medium	good.medium	better.medium	best.medium
	Low	good.low		

6.1.7.3 Reliability vector

The reliability terms ***good***, ***better*** and ***best*** from Table 6-2 are not absolute definitions, but rather 'relative' definitions based upon the transport technology of interest. In other words, ***best*** reliability $\geq$ ***better*** reliability $\geq$ ***good*** reliability with respect to the statistical likelihood of transmitting the data successfully. While there are no absolute definitions, notice that:

1. The ***good*** application reliability requirement corresponds to the "no guarantees" data path or the "lossy" data path options of any given transport technology (i.e., the least stringent reliability characteristics option).

2. The ***best*** application reliability requirement corresponds to a given transport technology's most reliable data transfer mechanism. This is typically an acknowledged transport data transfer service that is explicitly aware of the successfully transferred data.

The following is a casual definition (by way of example) for the use of these three healthcare application reliability modes. Consider a viewable waveform, a blood pressure measurement and a "life threatening" alarm.

1. For the viewable waveform, it is acceptable for 'some' data to be lost in transmission. The waveform information is continuously flowing and the loss of 'some' data in the waveform display does not cause any degradation in the clinician's ability to interpret the waveform. This maps to ***good*** reliability.
2. A "life threatening" alarm is an asynchronous and significant event. Every moment counts in response to this alarm. The highest reliability and the most robust data path are typically used for these events. This maps to ***best*** reliability.
3. For a blood pressure measurement, the measurement is an infrequent, but repeatable, event. If a single measurement was lost in transmission, while not desirable by any means, it would typically not have a dramatic impact on the person. This maps to ***better*** reliability.

Thus, from the overall application point of view, ***best*** reliability ≥ ***better*** reliability ≥ ***good*** reliability.

6.1.7.4 Latency vector

The terms very high, high, medium and low from Table 6-2 are also relative definitions based upon the transport technology of interest. In the context of personal healthcare, very high latency typically refers to a maximum of 100 seconds, high latency typically refers to a maximum of 10 seconds, medium latency typically refers to a maximum of 1 second and low latency typically refers to a maximum of 100 milliseconds. However, these latencies are transport-dependent and the actual values may change based on the transport.

6.1.7.5 Reliability.Latency pairs

The following text provides further details on the six bins identified in Table 6-2.

NOTE - In the current version of the design guidelines, only the good.medium and best.medium bins are utilized. Future versions of the design guidelines could use additional bins.

1. **good.low:** This bin provides 'good' reliability with low E2E transport latency. Some additional characteristics are:
   - '**good**' relative reliability needs
   - the sampled analogue data can easily be grouped together
   - overall E2E latency = ~100 ms (relative to transport).
2. **good.medium:** This bin provides 'good' reliability with medium E2E transport latency. Some additional characteristics are:
   - '**good**' relative reliability needs
   - the sampled analogue data can easily be grouped together
   - overall E2E latency = ~1 s (relative to transport).
3. **better.medium:** This bin provides 'better' reliability with medium E2E transport latency. Some additional characteristics are:
   - '**better**' relative reliability needs
   - a measured parameter (blood pressure, percentage of oxygen saturation in blood (SpO2, heart rate, etc.).

- overall E2E latency = ~1 s (relative to transport).

4. **best.medium:** This bin provides 'best' reliability with medium E2E transport latency. Some additional characteristics are:
   - '**best**' relative reliability needs
   - also known as get/set device parameters; also known as events and/or notifications; also known as request/response
   - control/status of both physiological and equipment functionality
   - overall E2E latency = ~1 s (relative to transport).
5. **best.high:** This bin provides 'best' reliability with high E2E transport latency. Some additional characteristics are:
   - '**best**' relative reliability needs
   - both physiological driven alarms and equipment issued alarms
   - overall E2E latency = ~10 s (relative to transport).
6. **best.veryhigh:** This bin provides 'best' reliability with very high E2E transport latency. Some additional characteristics are:
   - '**best**' relative reliability needs
   - print, transfer, or exchange of summaries, reports or histories
   - overall E2E latency = ~100 s (relative to transport).

6.1.8 E2E security

Security is essential in dealing with medical information that is very sensitive in nature. The design guidelines have been developed so that it supports the development of secure systems.

Security, for its own sake, may be excessive, making it unnecessarily expensive, or it may be insufficient, creating unacceptable risk. Furthermore, security requirements are not static and tend to become more stringent over time. Therefore, security must be considered holistically.

Table 6-3 lists the confidentiality, integrity and availability requirements considered in the design guidelines. Advanced security and privacy requirements, such as identity management (including authentication), non-repudiation of origin and consent management are included. Confidentiality signifies that data is accessible only to those who have the right to know. Integrity is the assurance that data has not been tampered with or modified in any way to undermine its authenticity. Availability denotes having timely access to information, hence access rights can be verified. Identity management enables the management of user identities across the Continua E2E architecture, hence associating health information with the right individuals. Authentication is part of identity management, whereby the identity credentials and associated rights of a user, service or entity are validated. Non-repudiation of origin is provided through the use of digital signatures and guarantees that the sender of information cannot later deny (or repudiate) having sent the information. Consent management enables patients to provide and manage their consent preferences, which serves as a basis for governing access to and usage of their individual identifiable health information.

Table 6-3 – An overview of security technologies used in the design guidelines

Standard bodies	Security standard	Security requirements	Interface
IETF	TLS v1.0 [IETF RFC 2246]	Confidentiality, integrity and authentication	HIS-IF
IHE, IETF	IHE XDM (S/MIME) [IHE ITI TF-1 XDM]	Confidentiality, integrity and authentication	HIS-IF
IHE, OASIS	[IHE ITI TF-1 XUA], [IHE TFS XUA++]	Entity authentication	HIS-IF
IHE, HL7	IHE ITI-44 : Patient Identity Feed HL7 V3, IHE ITI-45: PIXV3 Query transaction, IHE ITI-47: Patient Demographics Query HL7 V3 transaction [IHE ITF PIX PDQ]	Identity management	HIS-IF
HL7	IG for HL7 CDA R2 Consent Directive [HL7 CDA IG]	Consent management	Services-IF, HIS-IF
IHE, W3C, IETF	XML Encryption Specification [W3C XMLENC] IHE Document Encryption (DEN) Profile [IHE ITI DEN]	Consent enforcement	Services-IF
IHE, IETF	IHE Document Encryption (DEN) Profile [IHE ITI DEN]	Consent enforcement	HIS-IF
IHE, W3C	IHE Document Digital Signature (DSG) [IHE TFS DSG]	Non-repudiation of origin	HIS-IF
IHE	IHE ATNA [IETF RFC 3881]	Auditing	Services-IF, HIS-IF
OASIS, IETF	WS-I BSP (TLS v1.0) [OASIS WS-I BSP], TLS v1.1 [IETF RFC 4346]	Confidentiality, integrity and service authentication	Services-IF
IETF, OASIS	WS-I BSP (WS-Security + SAML 2.0) [OASIS WS-I BSP], OAuth 2.0 [IETF RFC 6749]	Entity authentication	HIS-IF
Bluetooth SIG, Inc., Zigbee Alliance	ZigBee security [ZigBee HCP], Bluetooth security [Bluetooth HDPv1.1]	Confidentiality, integrity and authentication	PHD-IF

6.1.9 Overview of standards used across PHD-IF

Table 6-4 provides an overview of standards used across PHD-IF, along with the purpose of using a specific standard.

Table 6-4 – An overview of standards used across PHD-IF

Standards body	Specific standard	Functionality / Purpose of using this standard	Which of the ISO/OSI 7 layers?
ISO/IEEE	11073-20601 11073-104xx	Application level services, protocol, data semantics and formats for PHD devices	Layer 5 to 7: Session .. Application
Bluetooth SIG	Core specification	Wireless transport connection (in 2 transport technologies – BR/EDR and LE)	Layer 1 to 4: Transport .. Network
	Health device profile (HDP)	Shim between Bluetooth and 11073	Layer 4: Transport
	Gatt profiles and services	Application level services, protocol, data semantics and formats for medical and sport and fitness devices	Layer 5 to 7: Session .. Application
	PHD transcoding white paper	Maps LE observations to 11073 observations	Layer 7 / Application
ZigBee	Zigbee specification	Wireless transport link	Layer 1 to 4: Transport .. Network
	Health care profile (HCP)	Shim between Zigbee and 11073	Layer 4: Transport
USB	USB 2.0	Wired transport connection	Layer 1 to 4: Transport .. Network
	USB device class definition for personal healthcare devices (PHDC)	Shim between USB and 11073	Layer 4: Transport
NFC Forum	NFC logical link control protocol (LLCP) technical specification, Version 1.1	Touch transport	Layer 1 to 4: Transport .. Network
	Personal health device communication (PHDC)	Shim between NFC and 11073	Layer 4: Transport

Bibliography

[b-ATOM Schema] The Atom Syndication Format schema. https://web.archive.org/web/20150307045002/http://www.kbcafe.com/rss/atom.xsd.xml (web archive version)

[b-Bluetooth Discovery] Bluetooth SIG (2008), *Bluetooth Discovery White Paper, Version 1.0*. https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=144841&_ga=1.22308216.2145017682.1452074883

[b-Bluetooth HDPIP] Bluetooth SIG, *Health Device Profile Implementation Guidance Whitepaper*, Version 1.0. https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=225927

[b-Bluetooth SSP UI] Bluetooth SIG (2007), *Bluetooth User Interface Flow Diagrams for Bluetooth Secure Simple Pairing Devices White Paper, Version 1.0*. https://www.bluetooth.org/Technical/Specifications/whitepapers.htm

[b-Bluetooth SSP UM] Bluetooth SIG (2007), *Bluetooth Secure Simple Pairing Usability Metric White Paper, Version 1.0*. https://www.bluetooth.org/Technical/Specifications/whitepapers.htm

[b-Bluetooth SSP UT] Bluetooth SIG (2007), *Bluetooth Secure Simple Pairing User Terminology White Paper, Version 1.0*. https://www.bluetooth.org/Technical/Specifications/whitepapers.htm

[b-CHA CMG] Personal Connected Health Alliance (2012-10), *Implementation Guidelines for Cellular Modems Embedded into Medical Devices 1.0*. http://www.continuaalliance.org/sites/default/files/Implementation_Guidelines_for_Cellular_Modems_Embedded_into_Medical_Devices.pdf

[b-CHA UI] Personal Connected Health Alliance (2007-12), *Recommendations for Proper User Identification in Continua Version 1—PAN and xHR Interfaces, Version 1.0*. https://cw.continuaalliance.org/document/dl/download/3734

[b-CHA USB-PHDC] Personal Connected Health Alliance (2012-03), *Recommendations for Continua USB PHDC Device Driver Interoperability*. http://www.continuaalliance.org/sites/default/files/WP_ContinuaUSB-PHDC_Interop.pdf

[b-DIRECT] US Department of Health and Human Services Health Information Technology DIRECT Project <http://www.healthit.gov/policy-researchers-implementers/direct-project>

[b-GSM/UMTS] ETSI TS 123 040 V11.3.0 (2012-10), *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Technical realization of the Short Message Service (SMS)* (Equivalent to 3GPP TS 23.040 version 11.3.0 Release 11) <http://www.etsi.org/deliver/etsi_ts/123000_123099/123040/11.03.00_60/ts_123040v110300p.pdf>

[b-FIPS PUB 180-2] NIST FIPS PUB 180-2 (2002-08), *Secure Hash Signature Standard (SHS)*.
http://csrc.nist.gov/publications/PubsFIPS.html#fips180-4

[b-HL7 CDA IHE HSC] HL7 (2011), *HL7 Implementation Guide for CDA Release 2: IHE Health Story Consolidation, DSTU Release 1.1 (US Realm)*
http://www.hl7.org/implement/standards/product_brief.cfm?product_id=258

[b-HL7 V3IG MSSP] HL7 Version 3 Implementation Guide: Medication Statement Service Profile Using hData, Release 1
http://www.hl7.org/implement/standards/product_brief.cfm?product_id=299

[b-IEEE 802.15.4] IEEE Std 802.15.4 (2011), *IEEE Standard for Local and metropolitan area networks, Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)*.
http://dx.doi.org/10.1109/IEEESTD.2011.6012487

[b-IETF RFC 2119] IETF RFC 2119 (1997), *Key words for use in RFCs to Indicate Requirement Levels*.
http://tools.ietf.org/html/rfc2119

[b-IETF RFC 2437] IETF RFC 2437 (1998), *PKCS #1: RSA Cryptography Specifications Version 2.0*.
http://tools.ietf.org/html/rfc2437

[b-IETF RFC 3370] IETF RFC 3370 (2002), *Cryptographic Message Syntax (CMS) Algorithms*.
https://datatracker.ietf.org/doc/rfc3370/

[b-IETF RFC 5321] IETF RFC 5321 (2008), *Simple Mail Transfer Protocol (SMTP) Protocol.*
https://datatracker.ietf.org/doc/rfc5321/

[b-IHE ITI TF-1 PDQ] IHE TF-1 PDQ (2009), *IHE Patient Demographic Query (PDQ) profile*.
http://wiki.ihe.net/index.php?title=Patient_Demographics_Query

[b-IHE ITI TF 2 R4] IHE ITI TF 2 R4 (2007), *IT Infrastructure Technical Framework Volume 2 (ITI TF-2) Transactions Revision 4.0*, Final Text.
http://www.ihe.net/Technical_Framework/upload/IHE_ITI_TF_4.0_Vol2_FT_2007-08-22.pdf

[b-IHE PCC TF 2] IHE PCC TF-2/Bindings, *IHE Patient Care Coordination Bindings*.
http://wiki.ihe.net/index.php?title=PCC_TF-2/Bindings

[b-ISO 27000] ISO 27000 (2012), *Information technology – Security techniques – Information security management systems – Overview and vocabulary*.
http://www.iso.org/iso/catalogue_detail?csnumber=56891

[b-ISO/IEEE 11073-10101] ISO/IEEE 11073-10101: 2004, *Health informatics – Point-of-care medical device communication – Part 10101: Nomenclature*.
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=37890

[b-ISO/IEEE 11073-30200] ISO/IEEE 11073-30200: 2004, *Health informatics – Pont-of-care medical device communication – Part 30200: Transport profile – Cable connected*.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=33669

[b-ISO/IEC IEEE 42010] ISO/IEC/IEEE 42010:2011, Systems and software engineering - Architecture description. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=50508

[b-ONC-DIRECT-AS] ONC DIRECT Project (2012-07), *Applicability Statement for Secure Health Transport Version 1.1.I* http://wiki.directproject.org/Applicability+Statement+for+Secure+Health+Transport/

[b-ONC-DIRECT-X] ONC-DIRECT Project (2011-03), *XDR and XDM for Direct Messaging*. http://wiki.directproject.org/XDR+and+XDM+for+Direct+Messaging

[b-SNOMED CT] International Health Terminology Standards Development Organization, *SNOMED CT (Systematized Nomenclature of Medicine - Clinical Terms)*. http://www.ihtsdo.org/

[b-UCUM] *The Unified Code for Units of Measure*, Gunther Schadow, Clement J. McDonald, 1998-2008. http://unitsofmeasure.org/trac/

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