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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

E-health multimedia systems, services and applications – Interoperability compliance testing of personal health systems (HRN, PAN, LAN, TAN and WAN)

Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10C: Transcoding for Bluetooth Low Energy: Personal Health Gateway – Heart-rate

Recommendation ITU-T H.850.3

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Recommendation ITU-T H.850.3

Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10C: Transcoding for Bluetooth Low Energy: Personal Health Gateway – Heart-rate

Summary

Recommendation ITU-T H.850.3 provides a test suite structure (TSS) and the test purposes (TP) for the transcoding of heart rate data by personal health gateways in the Personal Health Devices (PHD) interface of application-level data between the Bluetooth Low Energy Bluetooth Generic Attribute Profile (GATT) format and the IEEE 11073-20601 data format, of which Recommendation ITU-T H.810 (2016) is the base Recommendation. The objective of this test specification is to provide a high probability of interoperability at this interface.

Recommendation ITU-T H.850.3 is a transposition of clause 3.5 of Continua Test Tool DG2016, Test Suite Structure & Test Purposes, Personal Health Devices Interface; Part 10: PHD Transcoding Whitepaper. Personal Health Gateway (Version 1.7, 2017-07-18), that was developed by the Personal Connected Health Alliance. A number of versions of this specification existed before transposition.

This Recommendation includes an electronic attachment with the protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.850.3	2017-04-29	16	11.1002/1000/13356
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Keywords

Bluetooth generic attribute profile, Bluetooth low energy (BLE), continua design guidelines, conformance testing, data format transcoding, e-health, heart rate, IEEE 11073-20601, ITU-T H.810, personal area network, personal connected health devices, personal health devices interface, personal health gateway, touch area network.

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* 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

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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.

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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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Electronic attachment: This Recommendation includes an electronic attachment with the protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

Introduction

This Recommendation is a transposition of clause 3.5 of Continua Test Tool DG2016, Test Suite Structure & Test Purposes, Personal Health Devices Interface; Part 10: PHD Transcoding Whitepaper. Personal Health Gateway (Version 1.7, 2017-07-18), that was developed by the Personal Connected Health Alliance. The table below shows the revision history of this test specification; it may contain versions that existed before transposition.

Version	Date	Revision history
1.0	2012-10-05	Initial release for Test Tool DG2011 based on the requirements in [b-CDG 2011].
1.1	2013-05-24	Initial release for Test Tool DG2012. It uses "TSS&TP_DG2011_LP-PAN_PART_10_v1.0.doc" as a baseline and adds new features included in [b-CDG 2012] (BPM and HR profiles).
1.2	2014-01-24	Initial release for Test Tool DG2013. It uses "TSS&TP_DG2012_LP-PAN_PART_10_v1.1.doc" as a baseline and adds new features included in [b-ITU-T H.810 (2013)]/[b-CDG 2013]: • Adds glucose meter BLE • Adds BLE SSP support • Adds NFC new transport • Adds INR device specialization
1.3	2014-04-24	TM Lite & Doc Enhancements (Test Tool v4.0 Maintenance Release 1). It uses "TSS&TP_DG2013_LP-PAN_PART_10_ v1.2.doc" as a baseline and adds new features included in Documentation Enhancements: • "Other PICS" row has been added
1.4	2015-07-01	Initial release for Test Tool DG2015. It uses "TSS&TP_DG2013_LP-PAN_PART_10_v1.3.doc" as a baseline and adds new features included in [b-ITU-T H.810 (2015)]/[b-CDG 2015]: • Adds WS/BCA BLE device specialization • Adds SABTE IEEE device specialization
1.5	2016-01-26	First maintenance release for Test Tool DG2015. It uses "TSS&TP_DG2015_LP-PAN_PART_10_v1.4.doc" as a baseline and adds some updates according to the Maintenance 2015 activity.
1.6	2016-09-20	Initial release for Test Tool DG2016. It uses "TSS&TP_DG2016_LP-PAN_PART_10_v1.5.doc" as a baseline and adds new features included in [ITU-T H.810 (2016)]/[b-CDG 2016]: • Adds PLX BLE device specialization • Adds PLX CGM device specialization
1.7	2017-07-18	Second Maintenance Release for Test Tool DG2016. It uses "TSS&TP_DG2016_LP-PAN_PART_10_v1.6.doc" as a baseline and corrects minor typos.
1.8	2020-06-02	Updates related to the value of the Reg-Cert-Data-List according to [b-CDG 2017].

Recommendation ITU-T H.850.3

Conformance of ITU-T H.810 personal health devices: Personal Health Devices interface Part 10C: Transcoding for Bluetooth Low Energy: Personal Health Gateway – Heart-rate

1 Scope

The scope of this Recommendation[1] is to provide a test suite structure (TSS) and the test purposes (TP) for the Personal Health Devices interface based on the requirements defined in the Continua Design Guidelines (CDG) [ITU-T H.810 (2016)]. The objective of this test specification is to provide a high probability of interoperability at this interface.

The TSS and TP for the Personal Health Devices interface have been divided into the parts specified below. This Recommendation covers Part 10C.

– Part 1: Optimized exchange protocol. Personal Health Device
– Part 2: Optimized exchange protocol. Personal Health Gateway
– Part 3: Continua design guidelines. Personal Health Device
– Part 4: Continua design guidelines. Personal Health Gateway
– Part 5: Device specializations. Personal Health Devices interface. This document is divided into the following subparts:
  - Part 5A: Weighing scales
  - Part 5B: Glucose meter
  - Part 5C: Pulse oximeter
  - Part 5D: Blood pressure monitor
  - Part 5E: Thermometer
  - Part 5F: Cardiovascular fitness and activity monitor
  - Part 5G: Strength fitness equipment
  - Part 5H: Independent living activity hub
  - Part 5I: Adherence monitor
  - Part 5J: Insulin pump
  - Part 5K: Peak expiratory flow monitor
  - Part 5L: Body composition analyser
  - Part 5M: Basic electrocardiograph
  - Part 5N: International normalized ratio monitor
  - Part 5O: Sleep apnoea breathing therapy equipment (SABTE)
  - Part 5P: Continuous glucose monitor (CGM)
– Part 6: Device specializations. Personal Health Gateway

[1] This Recommendation includes an electronic attachment with the protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

– Part 7: Continua Design Guidelines. BLE Personal Health Device
– Part 8: Continua Design Guidelines. BLE Personal Health Gateway
– Part 9: Personal Health Devices Transcoding Whitepaper. Personal Health Devices
– Part 10: Personal Health Devices Transcoding Whitepaper. Personal Health Gateway. In addition to the main part, the document is subdivided into the following subparts:
  - Part 10A: Whitepaper Thermometer requirements
  - Part 10B: Whitepaper Blood pressure requirements
  - **Part 10C: Whitepaper Heart rate requirements**
  - Part 10D: Whitepaper Glucose meter requirements
  - Part 10E: Whitepaper Weighing scales requirements
  - Part 10F: Whitepaper Pulse oximeter requirements
  - Part 10G: Whitepaper Continuous glucose monitoring requirements

2 References

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

[ITU-T H.810 (2016)] Recommendation ITU-T H.810 (2016), *Interoperability design guidelines for personal health systems*.

[Bluetooth PHDT v1.4] Bluetooth SIG (2013), *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 (2014), *Personal Health Devices Transcoding White Paper, v1.5*. https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=272346

[Bluetooth PHDT v1.6] Bluetooth SIG (2015), *Personal Health Devices Transcoding White Paper, v1.6*. https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=310657

[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 [ISO/IEEE 11073-20601-2015A], where xx can be any number from 01 to 99, inclusive.

[ISO/IEEE 11073-20601-2015A] ISO/IEEE 11073-20601:2010, *Health informatics – Personal health device communication – Part 20601: Application profile – Optimized exchange protocol*, including ISO/IEEE 11073-20601:2010 Amd 1:2015.
https://www.iso.org/standard/54331.html with
https://www.iso.org/standard/63972.html

[ISO/IEEE 11073-20601-2016C] ISO/IEEE 11073-20601:2016, *Health informatics – Personal health device communication – Part 20601: Application profile – Optimized exchange protocol*, including ISO/IEEE 11073-20601:2016/Cor.1:2016.

https://www.iso.org/standard/66717.html with
https://www.iso.org/standard/71886.html

[IHE PCD TF 1] IHE PCD TF 1 (2012), *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 2] IHE PCD TF 2 (2012), *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 3] IHE PCD TF 3 (2012), *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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 agent [ISO/IEEE 11073-20601-2016C]: A node that collects and transmits personal health data to an associated manager.

3.1.2 manager [ISO/IEEE 11073-20601-2016C]: A node receiving data from one or more agent systems. Some examples of managers include a cellular phone, health appliance, set top box, or a computer system.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ATS Abstract Test Suite

CDG Continua Design Guidelines

CGM Continuous Glucose Monitor

DUT Device Under Test

GUI Graphical User Interface

INR International Normalized Ratio

IP Insulin Pump

IUT Implementation Under Test

LSB Least Significant Bit

MDS Medical Device System

MSB Most Significant Bit

NFC Near Field Communication

PAN Personal Area Network

PCD Patient Care Device

PCO Point of Control and Observation

PCT Protocol Conformance Testing

PHD Personal Health Device

PHDC Personal Healthcare Device Class

PHG Personal Health Gateway

PICS Protocol Implementation Conformance Statement

PIXIT Protocol Implementation extra Information for Testing

RACP Record Access Control Point

SABTE Sleep Apnoea Breathing Therapy Equipment

SCR Static Conformance Review

SDP Service Discovery Protocol

SOAP Simple Object Access Protocol

TCRL Test Case Reference List

TCWG Test and Certification Working Group

TP Test Purposes

TSS Test Suite Structure

USB Universal Serial Bus

WDM Windows Driver Model

5 Conventions

In this text, the uppercase letter L is used as the symbol for litre.

Several of the test purposes in Annex A refer to "WAN PCD-01 messages"; these messages are specified in the patient care device (PCD) technical framework defined in [IHE PCD TF 1], [IHE PCD TF 2] and [IHE PCD TF 3]. Similarly, the "IEEE 11073 Objects and Attributes" are defined in [ISO/IEEE 11073-104xx].

The key words "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "MAY", "MAY NOT" in this Recommendation are to be interpreted as in [b-ETSI SR 001 262].

– SHALL is equivalent to 'must' or 'it is required to'.

– SHALL NOT is equivalent to 'must not' or 'it is not allowed'.

– SHOULD is equivalent to 'it is recommended to'.

– SHOULD NOT is equivalent to 'it is not recommended to'.

– MAY is equivalent to 'is permitted'.

– MAY NOT is equivalent to 'it is not required that'.

NOTE – The above-mentioned key words are capitalized for illustrative purposes only and they do not appear capitalized within this Recommendation.

In this document, hexadecimal numbers are denoted either with the prefix "0x" or by "(hex)" after the number; "(dec)" after a number indicates it is expressed in decimal format.

Reference is made in the ITU-T H.800-series of Recommendations to different versions of the Continua Design Guidelines (CDG) by a specific designation. The list of terms that may be used in this Recommendation is provided in Table 1.

Table 1 – List of designations associated with the various versions of the CDG

CDG release	Transposed as	Version	Description	Designation
2016 plus errata	[ITU-T H.810 (2016)]	6.1	Release 2016 plus errata noting all ratified bugs [b-CDG 2016].	–
2016	–	6.0	Release 2016 of the CDG including maintenance updates of the CDG 2015 and additional guidelines that cover new functionalities.	Iris
2015 plus errata	[b-ITU-T H.810 (2015)]	5.1	Release 2015 plus errata noting all ratified bugs [b-CDG 2015]. The 2013 edition of ITU-T H.810 is split into eight parts in the ITU-T H.810-series.	–
2015	–	5.0	Release 2015 of the CDG including maintenance updates of the CDG 2013 and additional guidelines that cover new functionalities.	Genome
2013 plus errata	[b-ITU-T H.810 (2013)]	4.1	Release 2013 plus errata noting all ratified bugs [b-CDG 2013].	–
2013	–	4.0	Release 2013 of the CDG including maintenance updates of the CDG 2012 and additional guidelines that cover new functionalities.	Endorphin
2012 plus errata	–	3.1	Release 2012 plus errata noting all ratified bugs [b-CDG 2012].	–
2012	–	3.0	Release 2012 of the CDG including maintenance updates of the CDG 2011 and additional guidelines that cover new functionalities.	Catalyst
2011 plus errata	–	2.1	CDG 2011 integrated with identified errata.	–
2011	–	2.0	Release 2011 of the CDG including maintenance updates of the CDG 2010 and additional guidelines that cover new functionalities [b-CDG 2011].	Adrenaline
2010 plus errata	–	1.6	CDG 2010 integrated with identified errata.	–
2010	–	1.5	Release 2010 of the CDG with maintenance updates of the CDG Version 1 and additional guidelines that cover new functionalities [b-CDG 2010].	1.5
1.0	–	1.0	First released version of the CDG [b-CDG 1.0].	–

6 Test suite structure

The test purposes (TPs) for the Personal Health Devices interface have been divided into the groups and subgroups specified below. Annex A describes the TPs for subgroup 2.4.4 (shown in bold).

– Group 1: Personal Health Device (PHD)
  - Group 1.1: Transport (TR)
    - Subgroup 1.1.1: Design guidelines: Common (DGC)
    - Subgroup 1.1.2: USB design guidelines (UDG)
    - Subgroup 1.1.3: Bluetooth design guidelines (BDG)
    - Subgroup 1.1.4: Pulse oximeter design guidelines (PODG)
    - Subgroup 1.1.5: Cardiovascular design guidelines (CVDG)
    - Subgroup 1.1.6: Activity hub design guidelines (HUBDG)
    - Subgroup 1.1.7: ZigBee design guidelines (ZDG)
    - Subgroup 1.1.8: Glucose meter design guidelines (GLDG)
    - Subgroup 1.1.9: Bluetooth low energy design guidelines (BLEDG)
    - Subgroup 1.1.10: Basic electrocardiograph design guidelines (ECGDG)
    - Subgroup 1.1.11: NFC design guidelines (NDG)
  - Group 1.2: IEEE 20601 Optimized exchange protocol (OXP)
    - Subgroup 1.2.1: PHD domain information model (DIM)
    - Subgroup 1.2.2: PHD service model (SER)
    - Subgroup 1.2.3: PHD communication model (COM)
  - Group 1.3: Devices class specializations (CLASS)
    - Subgroup 1.3.1: Weighing scales (WEG)
    - Subgroup 1.3.2: Glucose meter (GL)
    - Subgroup 1.3.3: Pulse oximeter (PO)
    - Subgroup 1.3.4: Blood pressure monitor (BPM)
    - Subgroup 1.3.5: Thermometer (TH)
    - Subgroup 1.3.6: Cardiovascular (CV)
    - Subgroup 1.3.7: Strength (ST)
    - Subgroup 1.3.8: Activity hub (HUB)
    - Subgroup 1.3.9: Adherence monitor (AM)
    - Subgroup 1.3.10: Insulin pump (IP)
    - Subgroup 1.3.11: Peak flow (PF)
    - Subgroup 1.3.12: Body composition analyser (BCA)
    - Subgroup 1.3.13: Basic electrocardiograph (ECG)
    - Subgroup 1.3.14: International normalized ratio (INR)
    - Subgroup 1.3.15: Sleep apnoea breathing therapy equipment (SABTE)
    - Subgroup 1.3.16: Continuous glucose monitor (CGM)
  - Group 1.4: Personal health device transcoding whitepaper (PHDTW)
    - Subgroup 1.4.1: Whitepaper general requirements (GEN)
    - Subgroup 1.4.2: Whitepaper thermometer requirements (TH)
    - Subgroup 1.4.3: Whitepaper blood pressure requirements (BPM)
    - Subgroup 1.4.4: Whitepaper heart rate requirements (HR)
    - Subgroup 1.4.5: Whitepaper glucose meter requirements (GL)
    - Subgroup 1.4.6: Whitepaper weight scale requirements (WS)

- Subgroup 1.4.7: Whitepaper pulse oximeter requirements (PLX)
- Subgroup 1.4.8: Whitepaper continuous glucose monitoring requirements (CGM)

– Group 2: Personal Health Gateway (PHG)

- Group 2.1: Transport (TR)
  - Subgroup 2.1.1: Design guidelines: Common (DGC)
  - Subgroup 2.1.2: USB design guidelines (UDG)
  - Subgroup 2.1.3: Bluetooth design guidelines (BDG)
  - Subgroup 2.1.4: Cardiovascular design guidelines (CVDG)
  - Subgroup 2.1.5: Activity hub design guidelines (HUBDG)
  - Subgroup 2.1.6: ZigBee design guidelines (ZDG)
  - Subgroup 2.1.7: Bluetooth low energy design guidelines (BLEDG)
  - Subgroup 2.1.8: NFC design guidelines (NDG)
- Group 2.2: IEEE 20601 Optimized exchange protocol (OXP)
  - Subgroup 2.2.1: General (GEN)
  - Subgroup 2.2.2: PHD domain information model (DIM)
  - Subgroup 2.2.3: PHD service model (SER)
  - Subgroup 2.2.4: PHD communication model (COM)
- Group 2.3: Devices class specializations (CLASS)
  - Subgroup 2.3.1: Weighing scales (WEG)
  - Subgroup 2.3.2: Glucose meter (GL)
  - Subgroup 2.3.3: Pulse oximeter (PO)
  - Subgroup 2.3.4: Blood pressure monitor (BPM)
  - Subgroup 2.3.5: Thermometer (TH)
  - Subgroup 2.3.6: Cardiovascular (CV)
  - Subgroup 2.3.7: Strength (ST)
  - Subgroup 2.3.8: Activity hub (HUB)
  - Subgroup 2.3.9: Adherence monitor (AM)
  - Subgroup 2.3.10: Insulin pump (IP)
  - Subgroup 2.3.11: Peak flow (PF)
  - Subgroup 2.3.12: Body composition analyser (BCA)
  - Subgroup 2.3.13: Basic electrocardiograph (ECG)
  - Subgroup 2.3.14: International normalized ratio (INR)
  - Subgroup 2.3.15: Sleep apnoea breathing therapy equipment (SABTE)
  - Subgroup 2.3.16: Continuous glucose monitor (CGM)
- Group 2.4: Personal health device transcoding whitepaper (PHDTW)
  - Subgroup 2.4.1: Whitepaper general requirements (GEN)
  - Subgroup 2.4.2: Whitepaper thermometer requirements (TH)
  - Subgroup 2.4.3: Whitepaper blood pressure measurement requirements (BPM)
  - **Subgroup 2.4.4**: **Whitepaper heart rate requirements (HR)**
  - Subgroup 2.4.5: Whitepaper glucose meter requirements (GL)
  - Subgroup 2.4.6: Whitepaper weight scale requirements (WS)

- Subgroup 2.4.7: Whitepaper pulse oximeter requirements (PLX)
- Subgroup 2.4.8: Whitepaper continuous glucose monitoring requirements (CGM)

7 Electronic attachment

The protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A can be downloaded from http://handle.itu.int/11.1002/2000/12067.

In the electronic attachment, letters "C" and "I" in the column labelled "Mandatory" are used to distinguish between "PICS" and "PIXIT" respectively during testing. If the cell is empty, the corresponding PICS is "independent". If the field contains a "C", the corresponding PICS is dependent on other PICS, and the logical expression is detailed in the "SCR_Expression" field. The static conformance review (SCR) is used in the test tool to assert whether the PICS selection is consistent.

Annex A

Test purposes

(This annex forms an integral part of this Recommendation.)

A.1 TP definition conventions

The test purposes (TPs) are defined according to the following rules:

– **TP Id**: This is a unique identifier (TP/<TT>/<DUT>/<GR>/<SGR>/<XX> – <NNN>). It is specified according to the naming convention defined below:

- Each test purpose identifier is introduced by the prefix "TP".
- <TT>: This is the test tool that will be used in the test case.
  - PAN: Personal area network (Bluetooth or USB)
  - LAN: Local area network (ZigBee)
  - PAN-LAN: Personal area network (Bluetooth or USB) – Local area network (ZigBee)
  - LP-PAN: Low power personal area network (Bluetooth low energy)
  - TAN: Touch area network (NFC)
  - PLT: Personal area network (Bluetooth or USB) – Local area network (ZigBee) – Touch area network (NFC)
- <DUT>: This is the device under test.
  - PHD: Personal Health Device
  - PHG: Personal Health Gateway
- <GR>: This identifies a group of test cases.
- <SGR>: This identifies a subgroup of test cases.
- <XX>: This identifies the type of testing.
  - BV: Valid behaviour test
  - BI: Invalid behaviour test
- <NNN>: This is a sequential number that identifies a test purpose.

– **TP label**: This is the TP's title.

– **Coverage**: This contains the specification reference and clause to be checked by the TP.

- Spec: This indicates the earliest version of the specification from which the testable items to be checked by the TP were included.
- Testable item: This contains the testable items to be checked by the TP.

– **Test purpose**: This is a description of the requirements to be tested.

– **Applicability**: This contains the PICS items that define if the test case is applicable or not for a specific device. When a TP contains an "ALL" in this field it means that it applies to the device under test within that scope of the test (specialization, transport used, etc.).

– **Other PICS**: This contains additional PICS items (apart from the PICS specified in the Applicability row) which are used within the test case implementation and can modify the final verdict. When this row is empty, it means that only the PICS specified in the Applicability row are used within the test case implementation.

– **Initial condition**: This indicates the state to which the DUT needs to be moved at the beginning of TC execution.

– **Test procedure**: This describes the steps to be followed in order to execute the test case.
– **Pass/Fail criteria**: This provides criteria to decide whether the DUT passes or fails the test case.

A.2 Subgroup 2.4.4 – Whitepaper Heart-rate requirements (HR)

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-000		
TP label		Whitepaper. Heart Rate MDS Object - System-Type Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Specific MDS 1; M		
Test purpose		Check that: PHG does not include MDS object, System-Type attribute in transcoder output.		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 3. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 4. Check in PHG transcoder output for the MDS object, System-Type attribute.		
Pass/Fail criteria		In step 4, the MDS object, System-Type attribute is not present.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes System-Type attribute is not present: ❑ Object: MDS object ❑ Attribute-id: MDC_ATTR_SYS_TYPE (2438) ❑ Attribute-type: TYPE ❑ Attribute-value: <NOT PRESENT> b) WAN PCD-01 message PCD-01 message does not include segments with a System-Type attribute value (67974^MDC_ATTR_SYS_TYPE^MDC).		

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-001		
TP label		Whitepaper. Heart Rate MDS Object - Dev-Configuration-Id Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Specific MDS 2; M		
Test purpose		Check that: PHG includes MDS object, Dev-Configuration-Id attribute in transcoder output. [AND] Dev-Configuration-Id value is set to any value in range of 0x4000 to 0x7FFF (Extended Configuration)		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable).		

	2. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 3. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 4. Check in PHG transcoder output for the MDS object, Dev-Configuration-Id attribute.
Pass/Fail criteria	In step 4, the MDS object, Dev-Configuration-Id attribute is present, its value is inside the range 0x4000 - 0x7FFF.
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Dev-Configuration-Id attribute is present: ❑ Object: MDS object ❑ Attribute-id: MDC_ATTR_DEV_CONFIG_ID (2628) ❑ Attribute-type: INT-U16 ❑ Attribute-value: Any value inside the range 16384 - 32767 (dec) or 0x4000 – 0x7FFF (hex) b) WAN PCD-01 message According to [b-ITU-T H.810 (2013)], the Dev-Configuration-Id shall not be transmitted in the PCD-01 message; therefore it is not possible to check this attribute.

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-002		
TP label		Whitepaper. Heart Rate MDS Object - System-Type-Spec-List Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	Common MDS 15; M	HR Specific MDS 3; M	
Test purpose		Check that: PHG includes MDS object, System-Type-Spec-List attribute in transcoder output. [AND] System-Type-Spec-List is set to (MDC_DEV_SPEC_PROFILE_ECG, Version 1), (MDC_DEV_SPEC_PROFILE_HF_CARDIO, Version 1), (MDC_DEV_SUB_SPEC_PROFILE_HR, Version 1)		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 3. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 4. Check in PHG transcoder output for the MDS object, System-Type-Spec-List attribute.		
Pass/Fail criteria		In step 4, the MDS object, System-Type-Spec-List attribute is present, its value is (MDC_DEV_SPEC_PROFILE_ECG, Version 1), (MDC_DEV_SPEC_PROFILE_HF_CARDIO, Version 1), (MDC_DEV_SUB_SPEC_PROFILE_HR, Version 1).		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes System-Type-Spec-List attribute is present: ❑ Object: MDS object ❑ Attribute-id: MDC_ATTR_SYS_TYPE_SPEC_LIST (2650)		

	❑ Attribute-type: SEQUENCE OF [{type (INT-U16), version (INT-U16)}] ❑ Attribute-value: • type: MDC_DEV_SPEC_PROFILE_ECG or 4102 (dec) or 10 06 (hex) • version: 1 (dec) or 00 01 (hex) • type: MDC_DEV_SPEC_PROFILE_HF_CARDIO or 4137 (dec) or 10 29 (hex) • version: 1 (dec) or 00 01 (hex) • type: MDC_DEV_SUB_SPEC_PROFILE_HR or 4237 (dec) or 10 8D (hex) • version: 1 (dec) or 00 01 (hex) b) WAN PCD-01 message PCD-01 message includes a segment like this with System-Type-Spec-List attribute value (check OBX-5): OBX|?|NM|68186^MDC_ATTR_SYS_TYPE_SPEC_LIST^MDC|1.0.0.a|528390^MDC_DEV_SPEC_PROFILE_ECG^MDC~528425^MDC_DEV_SPEC_PROFILE_HF_CARDIO^MDC~528525^MDC_DEV_SUB_SPEC_PROFILE_HR^MDC|||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-003		
TP label		Whitepaper. Heart Rate MDS Object - Reg-Cert-Data-List Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	Common MDS 14; M	Regulatory Conv 1; M	
Test purpose		Check that: PHG transcodes IEEE 11073-20601 Regulatory Certification Data List characteristic into MDS object, Reg-Cert-Data-List attribute		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. IEEE 11073-20601 Regulatory Certification Data List (0x2A2A) • Format: reg-cert-data-list (opaque structure) • Value: 00 02 00 14 02 01 00 0A 08 00 00 02 00 04 80 06 80 8D 02 02 00 02 80 00 (hex) i. Element: • auth-body-and-struc-type: - auth-body: 02 (hex) auth-body-continua(2) - auth-body-struc-type: 01 (hex). continua-version-struct(1) • auth-body-data: - major-IG-version: 08 (hex) - minor-IG-version: 00 (hex) - certified-devices: 80 06 80 8D (hex). BLE ECG and BLE Heart Rate ii. Element: • auth-body-and-struc-type: - auth-body: 02 (hex). auth-body-continua(2)		

	- auth-body-struc-type: 02 (hex). continua-reg-struct(2) • auth-body-data: - regulation-bit-field: 80 00 (hex). Unregulated device 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD. 4. When the pairing has been completed (Connection state), force the PHG under test to read the IEEE 11073-20601 Regulatory Certification Data List characteristic. 5. The simulated PHD sends the measurement to the PHG under test. 6. Check in PHG transcoder output for the MDS object, Reg-Cert-Data-List attribute.
Pass/Fail criteria	In step 6, the MDS object, Reg-Cert-Data-List attribute is present and its value matches with the IEEE 11073-20601 Regulatory Certification Data List characteristic value.
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Reg-Cert-Data-List attribute is present: ❑ Object: MDS object ❑ Attribute-id: MDC_ATTR_REG_CERT_DATA_LIST (2635) ❑ Attribute-type: SEQUENCE OF [{auth-body-and-struc-type, auth-body-data}, {…}] ❑ Attribute-value: 00 02 00 14 02 01 00 0A 08 00 00 02 00 04 80 06 80 8D 02 02 00 02 80 00 i. Reg-Cert-Data Element: • auth-body-and-struc-type: - auth-body: 02 (hex) auth-body-continua(2) - auth-body-struc-type: 01 (hex). continua-version-struct(1) • auth-body-data: - major-IG-version: 08 (hex) - minor-IG-version: 00 (hex) - certified-devices: 80 06 80 8D (hex). BLE ECG and BLE Heart Rate ii. Reg-Cert-Data Element: • auth-body-and-struc-type: - auth-body: 02 (hex). auth-body-continua(2) - auth-body-struc-type: 02 (hex). continua-reg-struct(2) • auth-body-data: - regulation-bit-field: 80 00 (hex). Unregulated device b) WAN PCD-01 message PCD-01 message includes five segments like these with Reg-Cert-Data-List attribute value (check OBX-5 in four segments): OBX|?|CWE|68218^MDC_REG_CERT_DATA_AUTH_BODY^MDC| 1.0.0.a|2^auth-body-continua|||||R OBX|?|ST|532352^MDC_REG_CERT_DATA_CONTINUA_VERSION^MDC| 1.0.0.a.x|6.1||||||R OBX|?|NA|532353^MDC_REG_CERT_DATA_CONTINUA_CERT_DEV_LIST ^MDC|1.0.0.a.y|32774~32909||||||R OBX|?|CWE|68218^MDC_REG_CERT_DATA_AUTH_BODY^MDC| 1.0.0.b|2^auth-body-continua||||||R OBX|?|CWE|532354^MDC_REG_CERT_DATA_CONTINUA_REG_STATUS ^MDC|1.0.0.b.z|1^unregulated-device(0)||||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-004		
TP label		Whitepaper. Heart Rate MDS Object - Tick Resolution Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Specific MDS 5; M		
Test purpose		Check that: PHG includes MDS object, Tick Resolution attribute in transcoder output.		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are present, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: Not relevant 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the MDS object, Tick Resolution attribute.		
Pass/Fail criteria		In step 5, the MDS object, Tick Resolution attribute is present and its value is 1024 ticks per second.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Tick Resolution attribute is present: ❑ Object: MDS object ❑ Attribute-id: MDC_ATTR_TICK_RES (2693) ❑ Attribute-type: FLOAT ❑ Attribute-value: 00 00 04 00 (hex) or FF 00 28 00 (hex) or FE 01 90 00 (hex) or FD 0F A0 00 (hex) or FC 9C 40 00 (hex) or 1024 (dec) b) WAN PCD-01 message		

	OBX|?|NM|68229^MDC_ATTR_TICK_RES^MDC|1.0.0.a|1024| 265842^MDC_DIM_PER_SEC^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-005		
TP label		Whitepaper. Heart Rate Measurement Object - Handle Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Numeric 1; O		
Test purpose		Check that: PHG does not include Heart rate Measurement object, Handle Attribute in transcoder output [OR] If PHG includes Heart Rate Measurement object, Handle attribute in transcoder output, then its value shall be different than 0		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart rate measurement value in uint8 format field is included, RR-Interval and Energy Expended fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the Heart rate measurement object, Handle attribute.		
Pass/Fail criteria		In step 5, the Body temperature object, Handle attribute is not present; however, if it is present then its value is different to 0.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Handle attribute is not present, or if it is present then: ❑ Object: Heart rate measurement object		

	❑ Attribute-id: MDC_ATTR_ID_HANDLE (2337) ❑ Attribute-type: INT-U16 ❑ Attribute-value: Any value other than 0 b) WAN PCD-01 message PCD-01 message does not include segments with a Handle attribute value.

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-006		
TP label		Whitepaper. Heart Rate Measurement Object - Type Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Numeric 2; M		
Test purpose		Check that: PHG includes Heart Rate Measurement object, Type attribute in transcoder output. [AND] Type is set to {MDC_PART_SCADA, MDC_ECG_HEART_RATE_INSTANT}		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart rate measurement value in uint8 format field is included, RR-Interval and Energy Expended fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the Heart rate measurement object, Type attribute.		
Pass/Fail criteria		In step 5, the Heart rate measurement object, Type attribute is present and its value is {MDC_PART_SCADA, MDC_ECG_HEART_RATE_INSTANT}.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes		

	Type attribute is present: ❑ Object: Heart rate measurement object ❑ Attribute-id: MDC_ATTR_ID_TYPE (2351) ❑ Attribute-type: SEQUENCE {partition (INT-U16), code (INT-U16)} ❑ Attribute-value: • partition: MDC_PART_SCADA or 2 (dec) or 00 02 (hex) • code: MDC_ECG_HEART_RATE_INSTANT or 21982 (dec) or 55 DE (hex) b) WAN PCD-01 message PCD-01 message includes a segment like this with a Type attribute value (check OBX-3): OBX|?|NM|8410590^MDC_ECG_HEART_RATE_INSTANT^MDC|1.0.0.a|90|264864^MDC_DIM_BEAT_PER_MIN^MDC ||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-007		
TP label		Whitepaper. Heart Rate Measurement Object - Metric-Spec-Small Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Numeric 3; M		
Test purpose		Check that: PHG includes Heart Rate Measurement object, Metric-Spec-Small attribute in transcoder output. [AND] Metric-Spec-Small is set to {0x4040} (mss-avail-stored-data, mss-acc-agent-initiated).		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart rate measurement value in uint8 format field is included, RR-Interval and Energy Expended fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state).		

	4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the Heart rate measurement object, Metric-Spec-Small attribute.
Pass/Fail criteria	In step 5, the Heart rate measurement object, Metric-Spec-Small attribute is present and its value is {0x4040} (mss-avail-stored-data, mss-acc-agent-initiated).
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Metric-Spec-Small attribute is present: ❑ Object: Heart rate measurement object ❑ Attribute-id: MDC_ATTR_METRIC_SPEC_SMALL (2630) ❑ Attribute-type: BITS-16 ❑ Attribute-value: 40 40 (hex) or BITS mss-avail-stored-data(1), mss-acc-agent-initiated(9) set to TRUE and remaining BITS set to FALSE b) WAN PCD-01 message PCD-01 message does not include segments with a Metric-Spec-Small attribute value.

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-008		
TP label		Whitepaper. Heart Rate Measurement Object - Unit-Code Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Numeric 4; M		
Test purpose		Check that: PHG includes Heart Rate Measurement object, Unit-Code attribute in transcoder output. [AND] Heart Rate Measurement object, Unit-Code attribute is set to MDC_DIM_BEAT_PER_MIN		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart rate measurement value in uint8 format field is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: 90		

	iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 5. Check in PHG transcoder output for the Heart rate measurement object, Unit-Code attribute. 6. The simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0001 (MSB → LSB). Heart rate measurement value in uint16 format field is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • This field is not included iii. Field: Heart Rate Measurement Value (uint16) • Format: uint16 • Value: 110 iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 7. Check in PHG transcoder output for the Heart rate measurement object, Unit-Code attribute.
Pass/Fail criteria	In step 5, the Heart rate measurement object, Unit-Code attribute is present and its value is MDC_DIM_BEAT_PER_MIN. In step 7, the Heart rate measurement object, Unit-Code attribute is present and its value is MDC_DIM_BEAT_PER_MIN.
Notes	In step 5, possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Unit-Code attribute is present: ❑ Object: Heart rate measurement object ❑ Attribute-id: MDC_ATTR_UNIT_CODE (2454) ❑ Attribute-type: INT-U16 ❑ Attribute-value: MDC_DIM_BEAT_PER_MIN or 2720 (dec) or 0A A0 (hex) b) WAN PCD-01 message PCD-01 message includes a segment like this with Unit-Code attribute value (check OBX-6): OBX|?|NM|8410590^MDC_ECG_HEART_RATE_INSTANT^MDC|1.0.0.a|90|264864^MDC_DIM_BEAT_PER_MIN^MDC||||R In step 7, possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Unit-Code attribute is present: ❑ Object: Heart rate measurement object

	❑ Attribute-id: MDC_ATTR_UNIT_CODE (2454) ❑ Attribute-type: INT-U16 ❑ Attribute-value: MDC_DIM_BEAT_PER_MIN or 2720 (dec) or 0A A0 (hex) b) WAN PCD-01 message PCD-01 message includes a segment like this with Unit-Code attribute value (check OBX-6): OBX|?|NM|8410590^MDC_ECG_HEART_RATE_INSTANT^MDC|1.0.0.a|10|264864^MDC_DIM_BEAT_PER_MIN^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-009		
TP label		Whitepaper. Heart Rate Measurement Object - Simple-Nu-Observed-Value Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	HR Numeric 6; M		
Test purpose		Check that: PHG transcodes Heart Rate Measurement Value field of Heart Rate Measurement characteristic into Heart Rate Measurement Object - Simple-Nu-Observed-Value attribute		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart Rate Measurement Value in uint8 format field is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: 90 iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 5. Check in PHG transcoder output for the Heart rate measurement object, Simple-Nu-Observed-Value attribute. 6. The simulated PHD sends the measurement to the PHG under test with the following value:		

	i. Field: Flags • Format: 8 bit • Value: 0000 0001 (MSB → LSB). Heart rate measurement value in uint16 format field is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • This field is not included iii. Field: Heart Rate Measurement Value (uint16) • Format: uint16 • Value: 110 iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 7. Check in PHG transcoder output for the Heart rate measurement object, Simple-Nu-Observed-Value attribute.
Pass/Fail criteria	In step 5, the Heart rate measurement object, Simple-Nu-Observed-Value attribute is present and its value matches with the Heart Rate Measurement Value (INT-U8) field of the Heart rate measurement characteristic (90). In step 7, the Heart rate measurement object, Simple-Nu-Observed-Value attribute is present and its value matches with the Heart Rate Measurement Value (INT-U16) field of the Heart rate measurement characteristic (110).
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Simple-Nu-Observed-Value attribute is present: ❑ Object: Heart rate measurement object ❑ Attribute-id: MDC_ATTR_NU_VAL_OBS_SIMP (2646) ❑ Attribute-type: FLOAT ❑ Attribute-value: 00 00 00 5A (hex) or 90 (dec) [Note that exponent value for this FLOAT value must be 0] b) WAN PCD-01 message PCD-01 message includes a segment like this with a Simple-Nu-Observed-Value attribute value (check OBX-5): OBX|?|NM|8410590^MDC_ECG_HEART_RATE_INSTANT^MDC|1.0.0.a|90| 264864^ MDC_DIM_BEAT_PER_MIN ^MDC||||R In step 7, possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Simple-Nu-Observed-Value attribute is present: ❑ Object: Heart rate measurement object ❑ Attribute-id: MDC_ATTR_NU_VAL_OBS_SIMP (2646) ❑ Attribute-type: FLOAT ❑ Attribute-value: 00 00 00 6E (hex) or 110 (dec) [Note that exponent value for this FLOAT value must be 0] b) WAN PCD-01 message PCD-01 message includes a segment like this with a Simple-Nu-Observed-Value attribute value (check OBX-5): OBX|?|NM|8410590^MDC_ECG_HEART_RATE_INSTANT^MDC|1.0.0.a|10| 264864^ MDC_DIM_BEAT_PER_MIN ^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-010		
TP label		Whitepaper. RR-Interval Object - Handle Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 1; O		
Test purpose		Check that: PHG does not include RR-Interval object, Handle Attribute in transcoder output [OR] If PHG includes RR-Interval object, Handle attribute in transcoder output, then its value shall be different than 0		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are included, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: Not relevant 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the RR-Interval object, Handle attribute.		
Pass/Fail criteria		In step 5, the RR-Interval object, Handle attribute is not present; however, if it is present then its value is different to 0.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Handle attribute is not present, or if it is present then: ❑ Object: RR-Interval object ❑ Attribute-id: MDC_ATTR_ID_HANDLE (2337)		

	❑ Attribute-type: INT-U16 ❑ Attribute-value: Any value other than 0 b) WAN PCD-01 message PCD-01 message does not include segments with a Handle attribute value.

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-011		
TP label		Whitepaper. RR-Interval Object - Type Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 2; M		
Test purpose		Check that: PHG includes RR-Interval object, Type attribute in transcoder output. [AND] Type is set to {MDC_PART_SCADA, MDC_ECG_TIME_PD_RR_GL}		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are included, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint8) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: Not relevant 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the RR-Interval object, Type attribute.		
Pass/Fail criteria		In step 5, the RR-Interval object, Type attribute is present and its value is {MDC_PART_SCADA, MDC_ECG_TIME_PD_RR_GL}.		
Notes		Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes		

	Type attribute is present: ❑ Object: RR-Interval object ❑ Attribute-id: MDC_ATTR_ID_TYPE (2351) ❑ Attribute-type: SEQUENCE {partition (INT-U16), code (INT-U16)} ❑ Attribute-value: • partition: MDC_PART_SCADA or 2 (dec) or 00 02 (hex) • code: MDC_ECG_TIME_PD_RR_GL or 16168 (dec) or 3F 28 (hex) b) WAN PCD-01 message PCD-01 message includes two segments like these with a Type attribute value (check OBX-3): OBX|?|NM|147240^MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.a| 600268992^MDC_DIM_TICK^MDC |||||R OBX|?|NM|147240^MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.b| 900268992^MDC_DIM_TICK^MDC |||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-012		
TP label		Whitepaper. RR-Interval Object - Metric-Spec-Small Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 3; M		
Test purpose		Check that: PHG includes RR-Interval object, Metric-Spec-Small attribute in transcoder output. [AND] Metric-Spec-Small is set to {0x5440} (mss-avail-stored-data, mss-acc-agent-initiated, mss-msmt-btb-metric, mss-msmt-aperiodic).		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are included, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval		

	• Format: List of uint16 • Value: Not relevant 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test. 5. Check in PHG transcoder output for the RR-Interval object, Metric-Spec-Small attribute.
Pass/Fail criteria	In step 5, the RR-Interval object, Metric-Spec-Small attribute is present and its value is {0x5440} (mss-avail-stored-data, mss-acc-agent-initiated, mss-msmt-btb-metric, mss-msmt-aperiodic).
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Metric-Spec-Small attribute is present: ❑ Object: RR-Interval object ❑ Attribute-id: MDC_ATTR_METRIC_SPEC_SMALL (2630) ❑ Attribute-type: BITS-16 ❑ Attribute-value: 54 40 (hex) or BITS mss-avail-stored-data(1), mss-msmt-aperiodic (3), mss-msmt-btb-metric (5), mss-acc-agent-initiated(9) set to TRUE and remaining BITS set to FALSE b) WAN PCD-01 message PCD-01 message does not include segments with a Metric-Spec-Small attribute value.

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-013		
TP label		Whitepaper. RR-Interval Object - Unit-Code Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 5; M		
Test purpose		Check that: PHG includes RR-Interval object, Unit-Code attribute in transcoder output. [AND] RR-Interval object, Unit-Code attribute is set to MDC_DIM_TICK		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart rate profile (device specialization); it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit		

	• Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are included, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: Not relevant 5. Check in PHG transcoder output for the RR-Interval object, Unit-Code attribute.
Pass/Fail criteria	In step 5, the RR-Interval object, Unit-Code attribute is present and its value is MDC_DIM_TICK.
Notes	In step 5, possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Unit-Code attribute is present: ❑ Object: RR Interval object ❑ Attribute-id: MDC_ATTR_UNIT_CODE (2454) ❑ Attribute-type: INT-U16 ❑ Attribute-value: MDC_DIM_TICK or 6848 (dec) or 1A C0 (hex) b) WAN PCD-01 message PCD-01 message includes two segments like these with Unit-Code attribute value (check OBX-6): OBX|?|NM|147240^ MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.a|600| 268992^MDC_DIM_TICK ^MDC||||R OBX|?|NM|147240^ MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.b|900| 268992^MDC_DIM_TICK ^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-014		
TP label		Whitepaper. RR-Interval Object -Simple-Nu-Observed-Value Attribute		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 6; M		
Test purpose		Check that: PHG transcodes the variable-size RR-Interval field of Heart Rate Measurement characteristic into RR-Interval Object - Simple-Nu-Observed-Value attribute		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a profile (device specialization) supported by the PHG under test; it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is:		

	a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are included, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: {600, 900} 5. Check in PHG transcoder output for the RR-Interval object, Compound-Simple-Nu-Observed-Value attribute.
Pass/Fail criteria	In step 5, the RR-Interval object, Simple-Nu-Observed-Value attribute is present and its value matches with RR-Interval field of Heart rate measurement {600, 900}.
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Simple-Nu-Observed-Value attribute is present two times: ❑ Object: RR-Interval object ❑ Attribute-id: MDC_ATTR_NU_ VAL_OBS_SIMP (2646) ❑ Attribute-type: FLOAT ❑ Attribute-value: • First occurrence: 00 00 02 58 (hex) or FF 00 17 70 (hex) or FE 00 EA 60 (hex) or FD 09 27 C0 (hex) or FC 5B 8D 80 (hex) or 600 (dec) • Second occurrence: 00 00 03 84 (hex) or FF 00 23 28 (hex) or FE 01 5F 90 (hex) or FD 0D BB A0 (hex) or FC 89 54 40 (hex) or 900 (dec) b) WAN PCD-01 message PCD-01 message includes a segment like this with a Simple-Nu-Observed-Value attribute value (check OBX-5): OBX|?|NM|147240^MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.a|600| 268992^MDC_DIM_TICK ^MDC||||R OBX|?|NM|147240^MDC_ECG_TIME_PD_RR_GL^MDC|1.0.0.b|900| 268992^MDC_DIM_TICK ^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-015
TP label		Whitepaper. Heart Rate measurement value
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]

	Testable items	HR Numeric 6; M		
Test purpose		Check that: PHG processes correctly the Rate Measurement Value field of Heart Rate Measurement characteristic		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_004		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a profile (device specialization) supported by the PHG under test; it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 0000 (MSB → LSB). Heart rate measurement value in uint8 format field is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: 90 iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • This field is not included 5. Check that the PHG accepts the measurement and decodes its value properly (pulse rate measurement). 6. The simulated PHD sends the measurement to the PHG under test with the following value: i. Field: Flags • Format: 8 bit • Value: 0000 0001 (MSB → LSB). Heart rate measurement value in uint16 format is included, Energy Expended and RR-Interval fields are not included ii. Field: Heart Rate Measurement Value (uint8) • This field is not included iii. Field: Heart Rate Measurement Value (uint16) • Format: uint16 • Value: 110 iv. Field: Energy Expended • This field is not included		

	v. Field: RR-Interval • This field is not included 7. Check that the PHG accepts the measurement and decodes its value properly (pulse rate measurement).
Pass/Fail criteria	In step 5, the PHG under test shows the following measurement Heart Rate = 90 beats per minute (bpm). In step 7, the PHG under test shows the following measurement Heart Rate = 110 beats per minute (bpm).
Notes	

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-016		
TP label		Whitepaper. RR-Interval measurement value		
Coverage	**Spec**	[b-Bluetooth PHDT v1.3]		
	Testable items	RR Numeric 6; M		
Test purpose		Check that: PHG processes correctly the RR-Interval field of Heart Rate Measurement characteristic		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_004 AND C_MAN_BLE_006		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a profile (device specialization) supported by the PHG under test; it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BLE characteristics. The characteristic of interest for this test case is: a. Heart rate measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state). It discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the measurement to the PHG under test with the following value: a. Heart rate measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0001 0000 (MSB → LSB). Heart rate measurement value in uint8 format and RR-Interval fields are present, Energy Expended field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • This field is not included v. Field: RR-Interval • Format: List of uint16 • Value: {600, 900} 5. Check that the PHG accepts the measurement and decodes its value properly (RR-Interval measurement value).		

Pass/Fail criteria	In step 5, the PHG under test shows the following measurements: • Measurement #1: RR-Interval = 586 ms or 600 ticks (1 tick = 1/1024 s) • Measurement #2: RR-Interval = 879 ms or 900 ticks (1 tick = 1/1024 s)
Notes	

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-017		
TP label		Whitepaper. Energy Expended Object - Handle Attribute		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 1; O		
Test purpose		Check that: PHG does not include Energy Expended object, Handle Attribute in transcoder output [OR] If PHG includes Energy Expended object, Handle attribute in transcoder output, then its value shall be different than 0		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_030		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart Rate Profile (device specialization), it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are included, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • Format: uint16 • Value: 123 v. Field: RR-Interval • This field is not included. 3. The PHG under test initiates a discovery process (Scanning state), it discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state) the simulated PHD sends the Measurement to the PHG under test. 5. Check in PHG transcoder output the Energy Expended object, Handle attribute		
Pass/Fail criteria		In Step 5, the Energy Expended object, Handle attribute is not present or, if it is present then its value is different than 0.		

Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Handle attribute is not present, or if it is present then: ❑ Object: Energy Expended Object ❑ Attribute-id: MDC_ATTR_ID_HANDLE (2337) ❑ Attribute-type: INT-U16 ❑ Attribute-value: Any value different than 0 b) WAN PCD-01 message PCD-01 message does not include segments with Handle attribute value

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-018		
TP label		Whitepaper. Energy Expended Object - Type Attribute		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 2; M		
Test purpose		Check that: PHG includes Energy Expended object, Type attribute in transcoder output. [AND] Type is set to {MDC_PART_PHD_HF, MDC_HF_ENERGY}		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_030		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart Rate Profile (device specialization), it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are included, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint8) • This field is not included iv. Field: Energy Expended • Format: uint16 • Value: 123 v. Field: RR-Interval • This field is not included. 3. The PHG under test initiates a discovery process (Scanning state), it discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state).		

	4. When the pairing has been completed (Connection state) the simulated PHD sends the Measurement to the PHG under test. 5. Check in PHG transcoder output the Energy Expended object, Type attribute
Pass/Fail criteria	In Step 5, the Energy Expended object, Type attribute is present and its value is {MDC_PART_PHD_HF, MDC_HF_ENERGY}
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Type attribute is present: ❑ Object: Energy Expended Object ❑ Attribute-id: MDC_ATTR_ID_TYPE (2351) ❑ Attribute-type: SEQUENCE {partition (INT-U16), code (INT-U16)} ❑ Attribute-value: • partition: MDC_PART_PHD_HF or 129 (dec) or 00 81 (hex) • code: MDC_HF_ENERGY or 119 (dec) or 00 77 (hex) b) WAN PCD-01 message PCD-01 message includes two segments like these with Type attribute value (check OBX-3): OBX|?|NM|8454263^MDC_HF_ENERGY^MDC|1.0.0.a|

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-019		
TP label		Whitepaper. Energy Expended Object - Metric-Spec-Small Attribute		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 3; M		
Test purpose		Check that: PHG includes Energy Expended object, Metric-Spec-Small attribute in transcoder output. [AND] Metric-Spec-Small is set to {0xF040} (mss-avail-intermittent, mss-avail-stored-data, mss-upd-aperiodic, mss-msmt-aperiodic, mss-acc-agent-initiated).		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_030		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart Rate Profile (device specialization), it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are included, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant		

	iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • Format: uint16 • Value: 123 v. Field: RR-Interval • This field is not included 3. The PHG under test initiates a discovery process (Scanning state), it discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state), the simulated PHD sends the Measurement to the PHG under test. 5. Check in PHG transcoder output the Energy Expended object, Metric-Spec-Small attribute
Pass/Fail criteria	In Step 5, the Energy Expended object, Metric-Spec-Small attribute is present and its value is {0xF040} (mss-avail-intermittent, mss-avail-stored-data, mss-upd-aperiodic, mss-msmt-aperiodic, mss-acc-agent-initiated).
Notes	Possible values in typical points of observation after transcoder output are: a. IEEE 11073 Objects and Attributes Metric-Spec-Small attribute is present: ❑ Object: Energy Expended Object ❑ Attribute-id: MDC_ATTR_METRIC_SPEC_SMALL (2630) ❑ Attribute-type: BITS-16 ❑ Attribute-value: F0 40 (hex) or BITS mss-avail-intermittent (0), mss-avail-stored-data(1), mss-upd-aperiodic (2), mss-msmt-aperiodic (3), mss-acc-agent-initiated(9) set to TRUE and remaining BITS set to FALSE b. WAN PCD-01 message PCD-01 message does not include segments with Metric-Spec-Small attribute value

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-020		
TP label		Whitepaper. Energy Expended Object - Unit-Code Attribute		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 4; M		
Test purpose		Check that: PHG includes Energy Expended object, Unit-Code attribute in transcoder output. [AND] Energy Expended object, Unit-Code attribute is set to MDC_DIM_JOULES		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_030		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		
Test procedure		1. The simulated PHD is configured with a Heart Rate Profile (device specialization), it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state), it discovers the		

	simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state) the simulated PHD sends the Measurement to the PHG under test with the following value: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are included, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • Format: uint16 • Value: 123 v. Field: RR-Interval • This field is not included 5. Check in PHG transcoder output the Energy Expended object, Unit-Code attribute
Pass/Fail criteria	In Step 5, the Energy Expended object, Unit-Code attribute is present and its value is MDC_DIM_JOULES
Notes	In Step 5, possible values in typical points of observation after transcoder output are: a. IEEE 11073 Objects and Attributes Unit-Code attribute is present: ❑ Object: Energy Expended Object ❑ Attribute-id: MDC_ATTR_UNIT_CODE (2454) ❑ Attribute-type: INT-U16 ❑ Attribute-value: MDC_DIM_JOULES or 6848 (dec) or 1A C0 (hex) b. WAN PCD-01 message PCD-01 message includes two segments like these with Unit-Code attribute value (check OBX-6): OBX|?|NM|8454263^MDC_HF_ENERGY^MDC|1.0.0.a|123000|266112^MDC_DIM_JOULES^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-021		
TP label		Whitepaper. Energy Expended Object -Simple-Nu-Observed-Value Attribute		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 5; M		
Test purpose		Check that: PHG transcodes the Energy Expended field of Heart Rate Measurement characteristic into Energy Expended Object - Simple-Nu-Observed-Value attribute		
Applicability		C_MAN_BLE_000 AND C_MAN_BLE_002 AND C_MAN_BLE_004 AND C_MAN_BLE_030		
Other PICS				
Initial condition		The PHG under test and the simulated PHD are in the Standby state.		

Test procedure	1. The simulated PHD is configured with a Profile (device specialization) supported by the PHG under test, it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state), it discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state) the simulated PHD sends the Measurement to the PHG under test with the following value: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are included, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • Format: • Value: v. Field: RR-Interval • This field is not included 5. Check in PHG transcoder output the Energy Expended object, Simple-Nu-Observed-Value attribute
Pass/Fail criteria	In Step 5, the Energy Expended object, Simple-Nu-Observed-Value attribute is present and its value matches with Energy Expended field of Heart Rate Measurement {}
Notes	Possible values in typical points of observation after transcoder output are: a) IEEE 11073 Objects and Attributes Simple-Nu-Observed-Value attribute is present two times: ❑ Object: Energy Expended Object ❑ Attribute-id: MDC_ATTR_NU_ VAL_OBS_SIMP (2646) ❑ Attribute-type: FLOAT ❑ Attribute-value: 03 00 00 7B (hex) or 123000 (dec). b) WAN PCD-01 message PCD-01 message includes a segment like this with Simple-Nu-Observed-Value attribute value (check OBX-5): OBX|?|NM|8454263^MDC_HF_ENERGY^MDC|1.0.0.a|123000| 266112^MDC_DIM_JOULES^MDC||||R

TP Id		TP/LP-PAN/PHG/PHDTW/HR/BV-022		
TP label		Whitepaper. Energy Expended measurement value		
Coverage	**Spec**	[Bluetooth PHDT v1.5]		
	Testable items	Energy Numeric 5; M		

Test purpose	Check that: PHG processes correctly the Energy Expended field of Heart Rate Measurement characteristic
Applicability	C_MAN_BLE_000 AND C_MAN_BLE_004 AND C_MAN_BLE_030
Other PICS	
Initial condition	The PHG under test and the simulated PHD are in the Standby state.
Test procedure	1. The simulated PHD is configured with a Profile (device specialization) supported by the PHG under test, it has a measurement ready to be sent and it is in the Advertising state (it is discoverable). 2. The simulated PHD implements several BTLE characteristics. The characteristic of interest for this Test Case is: a. Heart Rate Measurement (0x2A37) 3. The PHG under test initiates a discovery process (Scanning state), it discovers the simulated PHD and it starts a pairing process with the simulated PHD (Initiating state). 4. When the pairing has been completed (Connection state) the simulated PHD sends the Measurement to the PHG under test with the following value: a. Heart Rate Measurement (0x2A37) i. Field: Flags • Format: 8 bit • Value: 0000 1000 (MSB → LSB). Heart Rate Measurement Value in uint8 format and Energy Expended fields are present, RR-Interval field is not included ii. Field: Heart Rate Measurement Value (uint8) • Format: uint8 • Value: Not relevant iii. Field: Heart Rate Measurement Value (uint16) • This field is not included iv. Field: Energy Expended • Format: uint16 • Value: 123 v. Field: RR-Interval • This field is not included 5. Check that the PHG accepts the measurement and decodes its value properly (Energy Expended measurement value).
Pass/Fail criteria	In Step 5, the PHG under test shows the following measurements: 123000 J or 123 kJ.
Notes	

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