



BSI Standards Publication

Wearable electronic devices and technologies

Part 801-2: Smart body area network (SmartBAN) — Low complexity medium access control (MAC) for SmartBAN

National foreword

This British Standard is the UK implementation of EN IEC 63203-801-2:2022. It is identical to IEC 63203-801-2:2022.

The UK participation in its preparation was entrusted to Technical Committee AMT/9, Printed Electronics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 13519 0

ICS 35.100.01; 35.110; 35.240.80; 35.240.99

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2023.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English Version

**Wearable electronic devices and technologies - Part 801-2:
Smart body area network (SmartBAN) - Low complexity medium
access control (MAC) for SmartBAN
(IEC 63203-801-2:2022)**

Technologies et dispositifs électroniques prêts-à-porter -
Partie 801-2: Smart body area network (SmartBAN) -
Contrôle d'accès au support (MAC) à faible complexité pour
SmartBAN
(IEC 63203-801-2:2022)

Tragbare elektronische Geräte und Technologien -Teil 801-
2: Smartes am Körper getragenes Netzwerk (SmartBAN) -
Medium Access Control (MAC) mit geringer Komplexität für
SmartBAN
(IEC 63203-801-2:2022)

This European Standard was approved by CENELEC on 2022-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 124/198/FDIS, future edition 1 of IEC 63203-801-2, prepared by IEC/TC 124 "Wearable electronic devices and technologies" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63203-801-2:2022.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-09-09
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2025-12-09

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 63203-801-2:2022 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 63203-801-1	2022	Wearable electronic devices and technologies - Part 801-1: Smart body area network (SmartBAN) - Enhanced ultra-low power physical layer	EN IEC 63203-801-1	2022

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Abbreviated terms	8
5 General MAC framework.....	9
5.1 Different device types	9
5.2 Frequency spectrum	10
5.3 Channel format	10
5.3.1 Control channel format	10
5.3.2 Data channel format	10
5.4 User priorities	13
5.5 Node ID	14
5.6 IU	14
6 Frame formats	15
6.1 MAC general frame format	15
6.1.1 General description	15
6.1.2 MAC header	15
6.1.3 MAC frame body.....	18
6.1.4 Frame parity	18
6.2 Management frames	18
6.2.1 C-Beacon	18
6.2.2 D-Beacon	20
6.2.3 C-Req.....	23
6.2.4 C-Ass	25
6.2.5 S-Ras	26
6.2.6 D-Req.....	27
6.2.7 D-Res	27
6.3 C-Frame	27
6.4 D-Frame	27
7 MAC functions	28
7.1 General.....	28
7.2 SmartBAN creation and connection initialization	28
7.2.1 SmartBAN creation	28
7.2.2 Connection initialization.....	28
7.3 Channel access	29
7.3.1 Scheduled channel access	29
7.3.2 Slotted aloha channel access	30
7.3.3 Multi-use channel access.....	31
7.4 Supplementary downlink data transmission.....	33
7.5 Slot reassignment	34
7.6 Data channel migration	35
8 MAC parameters.....	36
Annex A (informative) Multi-use channel access	37
Bibliography.....	38

Figure 1 – SmartBAN topology.....	9
Figure 2 – Structure of Control Channel.....	10
Figure 3 – Access periods in Data Channel.....	11
Figure 4 – Scheduled access slot structure.....	12
Figure 5 – Control and management slot structure.....	12
Figure 6 – Multi-use access slot structure.....	12
Figure 7 – Structure of an IU.....	14
Figure 8 – MAC general frame format.....	15
Figure 9 – MAC header format.....	15
Figure 10 – Frame control format.....	16
Figure 11 – C-Beacon frame format.....	19
Figure 12 – D-Beacon frame format.....	21
Figure 13 – C-Req frame format.....	23
Figure 14 – C-Ass frame format.....	25
Figure 15 – D-Req frame structure (hub to node).....	27
Figure 16 – Connection procedure.....	29
Figure 17 – Scheduled channel access.....	29
Figure 18 – Downlink data transmission illustration.....	34
Figure 19 – Slot reassignment illustration.....	34
Figure 20 – Scheduled period slot reassignment procedure.....	35
Figure 21 – Example of Data Channel Migration (from #1 to #3).....	36
Figure A.1 – Flowchart of multi-use channel access.....	37
Table 1 – Values of T_{MUA}	13
Table 2 – List of user priorities.....	13
Table 3 – Contention probabilities for different user priorities.....	13
Table 4 – Node ID table.....	14
Table 5 – Element ID for different operations.....	14
Table 6 – Frame Type and Frame Subtype fields.....	16
Table 7 – Table of IDs.....	18
Table 8 – Slot Length field encoding.....	19
Table 9 – Bit values for the Duty Cycling field.....	20
Table 10 – Mapping of PHY Capability field.....	24
Table 11 – IM field for allocation request IU.....	24
Table 12 – IM field for allocation assignment IU.....	26
Table 13 – IM field for S-Ras IU.....	26
Table 14 – MAC parameters.....	36

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

**Part 801-2: Smart body area network (SmartBAN) –
Low complexity medium access control (MAC) for SmartBAN**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 63203-801-2 has been prepared by IEC technical committee 124: Wearable electronic devices and technologies. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
124/198/FDIS	124/206/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 63203 series, published under the general title *Wearable electronic devices and technologies*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

TC 124 is developing International Standards (IS) for body area network (BAN) to define the wireless connectivity between the hub coordinator and the sensing nodes. The IEC 63203-801 series consists of the following sub-parts, under the general part title "Smart body area network (SmartBAN)":

IEC 63203-801-1: Enhanced ultra-low power physical layer

IEC 63203-801-2: Low complexity medium access control (MAC) for SmartBAN

The present document describes the medium access control (MAC) specifications including channel structure, MAC frame formats and MAC functions.

This document originates from the corresponding technical specification (ETSI TS 103 325) standardized in the European Telecommunication Standard Institute (ETSI) and captures the results the work of IEC TC 124 Working Group 4 on devices and systems. The current document reflects contributions and discussions by IEC TC 124 experts, mirror committees, liaison members and Joint Advisory Group (JAG) between IEC SyC. AAL, IEC TC 100 and IEC TC 124. This document contains material gathered from reports and group output from the IEC TC 124 meetings in May 2018 (Manchester), October 2018 (Busan), May 2019 (San Francisco), September 2019 (Shanghai), November 2020 (online) as well as information obtained during various web meetings.

Experts from the following national committees, liaison organizations have contributed: BE, CN, DE, FI, FR, GB, IN, JP, KR, MY, NL, US and ETSI TC SmartBAN.

This document is also positioned as a result of the activities of the JAG. At the IEC General Meeting in Busan in 2018, three committees related to wearable systems and technologies, SyC. AAL, IEC TC 100 and IEC TC 124 had a joint workshop and agreed to collaborate to develop relevant standards and to share roles. This collaboration agreement was advanced to a Joint Advisory Group (JAG) and the JAG was established managed by SyC. AAL in 2019.

The target audience for this document includes the following stakeholders who have an interest in the systems and services using wearable devices:

- consumer electronics (CE) and information communications technology (ICT) device manufacturers;
- system integrators who want to utilize wearable device and technologies;
- service operators who are interested in the AAL systems and services;
- stakeholders who want to understand the technologies and requirements for wireless connectivity between wearable sensor nodes and hub coordinators.

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 801-2: Smart body area network (SmartBAN) – Low complexity medium access control (MAC) for SmartBAN

1 Scope

This part of IEC 63203-801 specifies low complexity medium access control (MAC) for SmartBAN.

As the use of wearables and connected body sensor devices grows rapidly in the Internet of Things (IoT), wireless body area networks (BANs) facilitate the sharing of data in smart environments such as smart homes, smart life, etc. In specific areas of digital healthcare, wireless connectivity between the edge computing device or hub coordinator and the sensing nodes requires a standardized communication interface and protocols.

The present document describes the following medium access control (MAC) specifications:

- channel structure;
- MAC frame formats;
- MAC functions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 63203-801-1:2022, *Wearable electronic devices and technologies – Part 801-1: Smart body area network (SmartBAN) – Enhanced ultra-low power physical layer*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

beacon

frame transmitted by a hub to facilitate network management, such as the coordination of medium access and power management of the nodes in the SmartBAN, and to facilitate clock synchronization with the hub

3.2

beacon period

duration during which a beacon is transmitted

3.3

downlink

communication link for transfer of management and data traffic from a hub to a node

3.4

hub

entity that possesses a node's functionality and coordinates the medium access and power management of the nodes in the SmartBAN

3.5

inactive period

period in time following an active transmission sequence during which the equipment does not transmit or receive

3.6

node

any entity conforming to the SmartBAN medium access control and physical interface to the wireless medium

3.7

priority channel access

highest priority access during multi-use channel access

3.8

re-use channel access

priority access during multi-use channel access which enables re-use of scheduled but non-utilised slots

3.9

scheduled access

one or more scheduled recurring time intervals that a node and a hub obtain using scheduled access to initiate frame transactions

Note 1 to entry: A scheduled allocation is an uplink allocation or a downlink allocation suitable for servicing high or low duty cycle periodic or quasi-periodic traffic on a committed schedule.

3.10

uplink

communication link for transfer of management and data traffic from a node to a hub

4 Abbreviated terms

ACK	Acknowledgement
BAN	Body area network
C-Ass	Connection assignment
C-Beacon	Control channel beacon
C-Frame	Control frame
CRC	Cyclic redundancy check
C-Req	Connection request
D/SR	Downlink/slot reassignment
D-Beacon	Data channel beacon
D-Frame	Data frame
D-Req	Disconnection request
D-Res	Disconnection response

EUI-48™	Extended Unique Identifier-48 bits
FCS	Frame check sequence
FEC	Forward error correction
IFS	Inter-frame spacing
IM	Information module
ISM	Industrial, scientific and medical
IU	Information unit
MAC	Medium access control
NACK	Negative acknowledgement
NID	Node ID
PHY	Physical layer
REP	Repetition coding
Rx	Receive
S-Ras	Slot reassignment
Tx	Transmit
UL	Uplink

5 General MAC framework

5.1 Different device types

Clause 5 provides the basic MAC framework for the nodes and hubs.

Two different device types can participate in SmartBAN:

- 1) sensor device (node); and
- 2) coordinator device (hub).

A hub is a device that acts as a SmartBAN coordinator. A node is any device that acts as an information source or an information sink. One hub and at least one node constitute a SmartBAN.

A SmartBAN shall be organized into a star topology illustrated in Figure 1. It shall consist of at least one node communicating directly with the hub.

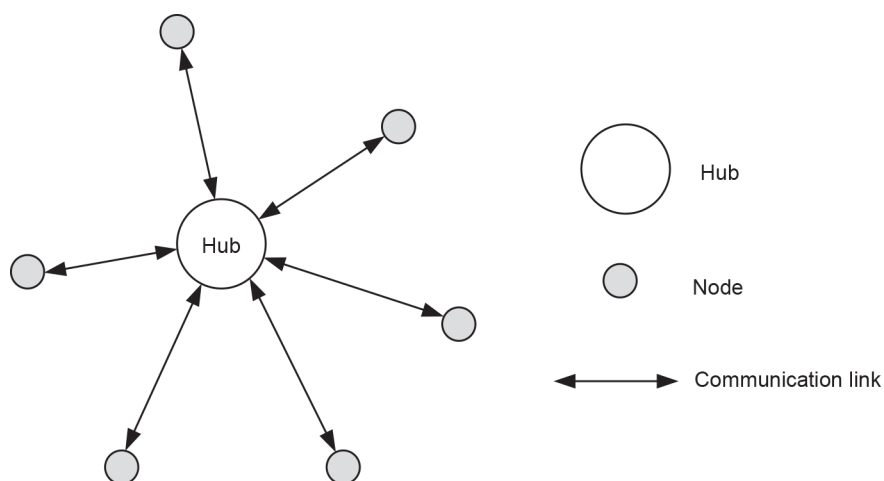


Figure 1 – SmartBAN topology

IEC