

ETSI TR 103 944 V1.1.1 (2023-11)



**Smart Body Area Network (SmartBAN);
Technical Report on Smart Coordinator
for SmartBAN Networks**

(<https://standards.iteh.ai>)

Document Preview

[ETSI TR 103 944 V1.1.1 \(2023-11\)](https://standards.iteh.ai/catalog/standards/sist/e72181aa-2c6a-40e1-abd3-a9554c266f42/etsi-tr-103-944-v1-1-1-2023-11)

<https://standards.iteh.ai/catalog/standards/sist/e72181aa-2c6a-40e1-abd3-a9554c266f42/etsi-tr-103-944-v1-1-1-2023-11>

Reference

DTR/SmartBAN-0021

Keywords

air interface, wireless ad-hoc network

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:

<https://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our

Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2023.
All rights reserved.

Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	5
Executive summary	6
Introduction	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	7
3 Definition of terms, symbols, and abbreviations.....	7
3.1 Terms.....	7
3.2 Symbols.....	7
3.3 Abbreviations	7
4 Outlook of smart coordinator	8
4.1 Functionalities at a glance	8
4.2 Data traffic between the smart coordinator and the infrastructure	9
4.3 Service flows	10
4.4 Smart coordinator high-level description	10
4.4.0 General information smart coordinator high-level description	10
4.4.1 KPIs	11
4.4.2 New technologies.....	11
4.5 SmartBAN generic architecture	12
4.6 Reference model.....	14
4.7 Control management	15
4.8 Coexistence	15
5 Cyber-security and privacy protection	16
5.1 Introduction	16
5.2 Threat model	16
5.3 Security and trust model.....	17
5.3.0 General information security and trust model.....	17
5.3.1 SmartBAN ontology	18
5.4 Low-power radio interface	18
5.5 Cryptography in SmartBAN.....	19
5.6 Authenticated Key Exchange protocol with one Diffie Hellman key exchange combined with digital signature and proof of knowledge of discrete logarithm	19
5.7 Ratchet-based key refreshing	20
6 Smart coordinator data plane architecture	20
6.1 Smart coordinator data service	20
6.1.0 General information smart coordinator data service.....	20
6.1.1 Higher layers.....	20
6.1.1.0 General information higher layers.....	20
6.1.1.1 Infrastructure Security Access Entity & L3	20
6.1.1.2 L3 Protocol discriminator	20
6.1.1.3 Bridge convergence function	20
6.1.1.4 Infrastructure Controlled & Uncontrolled access filtering	21
6.1.1.5 TX MSDU rate limiting.	21
6.1.1.6 TX Aggregation A-MSDU.....	21
6.1.1.7 Sequence number assignment	21
6.1.1.8 TX Fragmentation	21
6.1.1.9 MPDU number assignment	21
6.1.1.10 MPDU Payload Encryption.....	21
6.1.1.11 Append MPDU Header & CRC.....	21

6.1.1.12	TX Aggregation A-MPDU.....	21
Annex A (informative):	Change history	23
Annex B (informative):	Bibliography.....	24
History		25

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ETSI TR 103 944 V1.1.1 \(2023-11\)](#)

<https://standards.iteh.ai/catalog/standards/sist/e72181aa-2c6a-40e1-abd3-a9554c266f42/etsi-tr-103-944-v1-1-1-2023-11>

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Smart Body Area Network (SmartBAN).

The contents of the present document are subject to continuing work within the SmartBAN TB and may change following formal TB approval. Should the TB change the contents of the present document, it will be re-released by the TB with an identifying change of release date and an increase in version number as follows:

Version x. y. z

where:

- x the first digit:
 - 0 early working draft;
 - 1 presented to the TB for information;
 - 2 presented to the TB for approval;
 - 3 or greater shows the TB-approved document under change control.
- y the second digit is incremented for technical changes, corrections, or updates.
- z the third digit is incremented for editorial changes.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Executive summary

The present document lays out an outlook of the smart coordinator, potential service flows to infrastructure, generic architecture, coexistence, cyber-security, and privacy protection.

Introduction

The present document provides information on the functionalities considered necessary and under consideration to implement the next generation of SmartBAN functionality.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ETSI TR 103 944 V1.1.1 \(2023-11\)](https://standards.iteh.ai/catalog/standards/sist/e72181aa-2c6a-40e1-abd3-a9554c266f42/etsi-tr-103-944-v1-1-1-2023-11)

<https://standards.iteh.ai/catalog/standards/sist/e72181aa-2c6a-40e1-abd3-a9554c266f42/etsi-tr-103-944-v1-1-1-2023-11>

1 Scope

The present document is limited to providing information about the smart coordinator operating at the link layer.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TS 103 325 (V1.1.1): "Smart Body Area Network (SmartBAN); Low Complexity Medium Access Control (MAC) for SmartBAN".
- [i.2] ETSI TS 103 326 (V1.2.1): "Smart Body Area Network (SmartBAN); Enhanced Ultra-Low Power Physical Layer".
- [i.3] ETSI TS 103 806 (V0.0.4): "Smart Body Area Network (SmartBAN); Hub to Hub Communication for SmartBAN Medium Access Control (MAC)".

3 Definition of terms, symbols, and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

smart coordinator: device operating at the link layer that provides an interface to the MAC layer for operation over multiple hubs for coexistence, a bridge to infrastructure domains, and cryptographic material and primitives management

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACI	Adjacent Channel Interference
AEAD	Authenticated Encryption with Additional Data
AES	Advanced Encryption Standard
AI	Artificial Intelligence

AKE	Authenticated Key Exchange
A-MPDU	Aggregate MAC Protocol Data Unit
A-MSDU	Aggregate MAC Service Data Unit
AP	Access Point
AR/VR	Augmented Reality/Virtual Reality
BCI	Brain-Computer Interface
CPU	Central Process Unit
CRC	Cyclic Redundancy Check
DoS	Denial of Service
EC	Elliptic Curve
ECC	Elliptic Curve Cryptography
ECDHE	Elliptic Curve Diffie-Hellman Ephemeral
EdDSA	Edwards-curve Digital Signature Algorithm
HSM	Hardware Security Module
ID	Identity
IoT	Internet of Things
IP	Internet Protocol
ISM	Industrial Scientific and Medical (frequency band)
ISS	Internal Sublayer Service
KPI	Key Performance Indicator
L2	Layer 2
L3	Layer 3
MAC	Medium Access Control
MLDE	MAC Layer Data Entity
MLME	MAC Layer Management Entity
MPDU	MAC Protocol Data Unit
MSDU	MAC Service Data Unit
OSI	Open System Interconnection
PER	Packet Error Rate
PHY	PHYsical layer
PII	Personally Identifiable Information
PKI	Public Key Infrastructure
PLDE	PHY Layer Data Entity
PLME	PHY Layer Management Entity
QoS	Quality of Service
SAP	Service Access Point
SC	Smart Coordinator
SC2SC	Smart Coordinator to Smart Coordinator
SCLC	Smart Coordinator Link Control
SDR	Software Defined Radio
SHA-3	Secure Hash 3
TSN	Time Sensitive Networking
TX	Transmitter
ZTA	Zero Trust Architecture

4 Outlook of smart coordinator

4.1 Functionalities at a glance

Future healthcare and well-being systems will extend mobile services into new vertical application domains with specific requirements for communication services and well-being services. Such new domain applications come with demanding requirements, such as high availability, high reliability, low latency, and seamless integration into infrastructure.

The technology in smart wristbands, watches, rings, patches, headbands, earplugs, chest-straps, smart clothing, shoe insoles, and in-body sensors, are collectively called wearables. Such technology is measuring ever more aspects of daily people's lives. Smartwatches collect millions of data points per day. People see themselves in ways not possible before and are finding new ways to act on what they learn. The effect on healthcare and lifestyle can be profound.

The Covid-19 pandemic accelerated the process. Wearables entered the lives of more people and took on new roles. With gyms closed, exercise shifted outdoors, and people bought them for the first time, to keep track of how much they exercised.

A parallel trend was that many consumers began to see these devices as tracking specific areas of their health. People had to be checked at home for healthcare reasons. Hospitals and nursing homes started seeing more elderly patients with smartwatches to track their health and send alerts of any problems. Wearable technology is poised to be a seamless part of clinical care, diagnosis, and, in some cases treatment. Artificial Intelligence (AI)-based apps may process the collected data from people's wearables dispensing personalized advice on what to eat or when to go for a walk or exercise. Interactive apps backed up by clinical evidence are likely to prescribe treatment.

The wearables market will split into two categories: medical-grade devices approved by respective regulatory bodies for people with chronic conditions who need tracking with greater care, and devices with fewer features and accuracy for healthy people who want to keep an eye on their metrics and be able to spot a problem early. Leading manufacturers are expected to offer increasingly specific devices for many diverse groups: children, the elderly, people with chronic diseases, and healthy people.

Fulfilling that promise is the next step for SmartBAN. It is going beyond basic radio access. Building the best way to transfer the communication flows to the infrastructure or the edge for processing and evaluation and how to coexist with current technologies such as Bluetooth and Wi-Fi. Note that the edge could be part of the infrastructure or a device at home, a vehicle, or even on the body. The controlling device is named from now on, the smart coordinator.

Healthcare and well-being data will be transformed, with 24/7 monitoring of vital and other health indicators for healthy and sick groups through numerous wearable devices.

Health monitoring will also include in-body devices that communicate with the smart coordinator, which in turn can transport the data to the infrastructure and reach hospitals and healthcare providers.

The integration of the SmartBAN network with such infrastructure, i.e. Wi-Fi™ and 6G, will be fully context-aware, and such integration will become increasingly sophisticated at predicting people's needs.

Context awareness combined with new human-machine interfaces such as the Brain-Computer Interface (BCI) will make interaction with the physical and digital world much more intuitive and efficient. Dynamic digital twins in the digital world with increasing accuracy require synchronous updates of the physical world, and these will be an essential platform for augmenting human abilities.

The computing needed for these devices will not all live in the devices themselves because of their small form factor and battery power limitations. Rather, they may have to rely on locally available computing resources to complete tasks, beyond the edge. Hence, the smart coordinator will play a significant role in this endeavour.

There are problems to solve. Among others, the interface between the current specification of SmartBAN (ETSI TS 103 325 [i.1] and ETSI TS 103 326 [i.2]) and infrastructure at the link layer to minimize latency and guarantee a QoS across networks; concerns about privacy protection, data cyber-security protection, and coexistence with other wireless systems operating in the same frequency band.

The proposed smart coordinator aims to solve those issues and create one entire solution for health monitoring, prevention, and treatment.

4.2 Data traffic between the smart coordinator and the infrastructure

SmartBAN supplies the capability for remote monitoring and care. As told before, it drops the need to visit hospitals often and allows for efficient management of health monitoring for patients and physicians.

The use case suggests automated monitoring of human data. Consequently, such sensitive information should be managed securely with different authorization levels.

Regular monitoring of human data may trigger an alarm to the patient or user via an app, depending on the received information. In other cases, it may trigger authorization to access parts of the patient, like the upper body, digestive system, etc., or user information by other medical care providers.

4.3 Service flows

Most SmartBAN data needs to be transferred to support real-time traffic with a certain level of QoS. In case of emergencies, link availability and reliability are needed.

In this use case, the patient or user has wearables assumed to be connected wirelessly to infrastructure (cellular network, Wi-Fi™) via the smart coordinator. Diverse types of information are transferred to a medical centre (data measuring and policy authorization) via a service provider or network operator. The medical centre will decide the emergency contingency based on a policy to take later actions.

However, the connection may be to an app running at the edge as well. For example, based on health data monitoring, eating, sleeping habits, when it is the most proper time to exercise, and advice on how many calories in a meal to intake, among others.

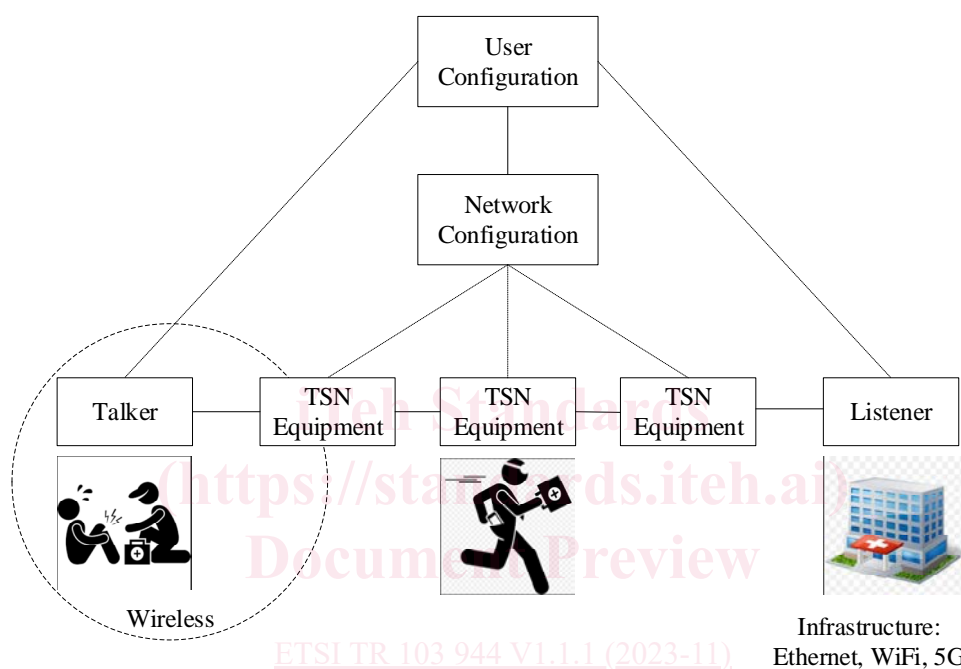


Figure 1: Service flows in SmartBAN emergency time-sensitive domain use case

In-body medical devices are implanted inside the body (if they are fixed), while some others are digestible (capsule endoscope). Such in-body devices have a small form factor, implying low power consumption and limited transmission power. Also, the information should be protected as it conveys [vital] human-body information.

SmartBAN implements power-efficient mobile access technology with battery and power-efficient connectivity. The smart coordinator will send such medical information to infrastructure while controlling reliability, QoS, cyber-security and privacy.

4.4 Smart coordinator high-level description

4.4.0 General information smart coordinator high-level description

SmartBAN complemented with the smart coordinator, enables the vertical for healthcare and well-being through mobile health monitoring and personalized delivery applications.

Such personal data, which may be medical data, is sensitive and private and requires a high degree of reliability and privacy in transporting and storing such data.

The smart coordinator will play a significant part in advancing this area of development.