



ISO/IEC 29145-1

Edition 1.0 2014-03

INTERNATIONAL STANDARD



**Information technology – Wireless beacon-enabled energy efficient mesh
network (WiBEEM) for wireless home network services –
Part 1: PHY layer**

get full document from standards.iteh.ai



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 ISO/IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about ISO/IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.



ISO/IEC 29145-1

Edition 1.0 2014-03

INTERNATIONAL STANDARD



**Information technology – Wireless beacon-enabled energy efficient mesh
network (WiBEEM) for wireless home network services –
Part 1: PHY layer**

get full document from standards.iteh.ai

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

P

ICS 35.200

ISBN 978-2-8322-1451-0

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative reference	8
3 Terms, definitions and abbreviations	8
3.1 Terms and definitions.....	8
3.2 Abbreviations	10
3.3 Conventions.....	11
4 Conformance	11
5 Overview of the WiBEEM technology	12
5.1 General description.....	12
5.2 Functions and descriptions of device types	13
5.3 Functional overview of WiBEEM.....	13
5.3.1 General	13
5.3.2 Superframe structure of WiBEEM	13
5.3.3 Data transfer model	14
6 PHY layer specifications	15
6.1 General.....	15
6.2 General requirements and definitions	16
6.2.1 General	16
6.2.2 Operating frequency range	16
6.2.3 Channel assignments and numbering	16
6.2.4 RF power measurement.....	16
6.2.5 Transmit power.....	17
6.2.6 Out-of-band spurious emission	17
6.2.7 Receiver sensitivity definitions.....	17
6.3 PHY service specifications	17
6.3.1 General	17
6.3.2 PHY data service	18
6.3.3 PHY management service.....	20
6.3.4 PHY enumerations description.....	27
6.4 PPDU format.....	28
6.4.1 Function	28
6.4.2 General packet format	28
6.5 PHY constants and PIB attributes	29
6.5.1 Function	29
6.5.2 PHY constants.....	30
6.5.3 PHY PIB attributes.....	30
6.6 2 450 MHz PHY specifications	30
6.6.1 Requirements	30
6.6.2 Data rate	30
6.6.3 Modulation and spreading.....	31
6.7 General radio specifications	34
6.7.1 Application of specifications.....	34

6.7.2	TX-to-RX turnaround time	34
6.7.3	RX-to-TX turnaround time	34
6.7.4	Error-vector magnitude (EVM) definition	34
6.7.5	Transmit centre frequency tolerance	35
6.7.6	Transmit power	35
6.7.7	Receiver maximum input level of desired signal	35
6.7.8	Receiver ED	35
6.7.9	LQI	35
6.7.10	CCA.....	36
Bibliography.....		37
Figure 1 – Superframe structure of WiBEEM.....		13
Figure 2 – Communication from an end device to a co-ordinator in a beacon and non-beacon mode		14
Figure 3 – Communication from a co-ordinator to an end device in a beacon and non-beacon mode		14
Figure 4 – Communications between co-ordinators in a beacon and non-beacon mode		15
Figure 5 – Communications between end devices		15
Figure 6 – PHY reference model		17
Figure 7 – Modulation and spreading functions		31
Figure 8 – Symbol-to-chip mapping.....		32
Figure 9 – O-QPSK chip offset.....		32
Figure 10 – Sample baseband chip sequences with pulse shaping.....		33
Figure 11 – Error vector calculation		34
Table 1 – Frequency bands and data rate		16
Table 2 – Receiver sensitivity definitions		17
Table 3 – PD-SAP primitives.....		18
Table 4 – PD_Data.request parameters		18
Table 5 – PD_DATA.confirm parameters.....		19
Table 6 – PD_DATA.indication parameters		20
Table 7 – PLME-SAP primitives		20
Table 8 – PLME-CCA confirm primitive		21
Table 9 – PLME_ED.confirm parameters		22
Table 10 – PLME_GET.request parameters		23
Table 11 – PLME_GET.confirm parameters		24
Table 12 – PLME-SET-TRX-STATE.request parameters		24
Table 13 – PLME-SET-TRX-STATE.confirm parameters		25
Table 14 – PLME_SET.request parameters		26
Table 15 – PLME_SET.confirm parameters.....		27
Table 16 – PHY enumerations description		28
Table 17 – Format of the PDU		28
Table 18 – Format of the SFD field		29
Table 19 – Frame length values		29

Table 20 – PHY constants.....	30
Table 21 – PHY PIB attributes	30
Table 22 – Minimum receiver jamming resistance requirements for 2 450 MHz PHY	33

Sample Document

get full document from standards.iteh.ai

INFORMATION TECHNOLOGY – WIRELESS BEACON-ENABLED ENERGY EFFICIENT MESH NETWORK (WIBEEM) FOR WIRELESS HOME NETWORK SERVICES –

Part 1: PHY layer

FOREWORD

- 1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards. Their preparation is entrusted to technical committees; any ISO and IEC member body interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with ISO and IEC also participate in this preparation.
- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.
- 3) The formal decisions or agreements of IEC and ISO 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 and ISO member bodies.
- 4) IEC, ISO and ISO/IEC publications have the form of recommendations for international use and are accepted by IEC and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 5) In order to promote international uniformity, IEC and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.
- 6) ISO and IEC provide no marking procedure to indicate their approval and cannot be rendered responsible for any equipment declared to be in conformity with an ISO/IEC publication.
- 7) All users should ensure that they have the latest edition of this publication.
- 8) No liability shall attach to IEC or ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC or ISO member bodies 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 of, use of, or reliance upon, this ISO/IEC publication or any other IEC, ISO or ISO/IEC publications.
- 9) 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.
- 10) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 29145-1 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 29145 series, under the general title *Information technology – Wireless beacon-enabled energy efficient mesh network (WiBEEM) for wireless home network services*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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.

Sample Document

get full document from standards.iteh.ai

INTRODUCTION

This International Standard specifies the WiBEEM (Wireless Beacon-enabled Energy Efficient Mesh network) protocol, which provides low-power-consuming mesh network functions by enabling the “beacon mode operation”. WiBEEM is based on the IEEE 802.15.4 standard with additional upper layer protocols and a specific usage of the MAC layer protocol. Through the novel use of beacons, WiBEEM technology achieves longer battery life, larger network support, quicker response, enhanced mobility and dynamic reconfiguration of the network topology compared with other protocols such as ZigBee.

In the beacon mode, beacon information propagates over the entire mesh network nodes during the BOP (Beacon-Only Period) of the superframe structure without any beacon conflicts by utilising a smart beacon scheduling technique in the BOP. It also provides location information about moving devices without spending extra time running a positioning and locating algorithm by using RSSI (Received Signal Strength Indication). These features allow the WiBEEM protocol to be widely used for wireless home network services in the ubiquitous network era.

One of the key features of the WiBEEM protocol is that it has a special time interval called BOP (Beacon-Only Period) in the superframe structure that allows more than two beacons to be transmitted. This unique time period is located at the beginning of the Superframe. Because the BOP does not use the CSMA/CA mechanism, the network will not work properly in the beacon mode unless an appropriate algorithm is applied. This algorithm needs to manage and control multiple beacons in a single superframe. The solution is the Beacon Scheduling method applied in the BOP to avoid collisions among beacons, providing synchronisation among all the nodes of the entire mesh network.

For the network layer, the NAA (Next Address Available) mechanism, which is a short address allocation algorithm, has been adopted to provide an efficient way of utilising the complete 16-bit address space. The NAA algorithm does not limit the maximum number of children nodes that a node of a mesh network can have. Since the number of children nodes is unlimited, the NAA mechanism allows the WiBEEM protocol to be used not only for home network services, but also for community services. WiBEEM can be used where high network expandability through efficient use of short address spaces, device mobility and end-to-end QoS are required.

This part of ISO/IEC 29145 specifies the Physical (PHY) layer for the WiBEEM protocol.

INFORMATION TECHNOLOGY – WIRELESS BEACON-ENABLED ENERGY EFFICIENT MESH NETWORK (WIBEEM) FOR WIRELESS HOME NETWORK SERVICES –

Part 1: PHY layer

1 Scope

This part of ISO/IEC 29145 specifies the physical (PHY) layer of WiBEEM (Wireless Beacon-enabled Energy Efficient Mesh network) protocol for wireless home network services that supports a low power-consuming wireless mesh network topology as well as device mobility and QoS.

2 Normative reference

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29145-2, *Information technology – Wireless beacon-enabled energy efficient mesh network (WiBEEM) for wireless home network services – Part 2: MAC layer*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1

access control list

table used by a device to determine which devices are authorised to perform a specific function

3.1.2

association

service used to establish the membership of a device in a wireless mesh network

3.1.3

authentication

service used to establish the identity of one device as a member of the set of devices authorised to communicate securely to other devices in the set

3.1.4

confidentiality

assurance that communicated data remain private to the parties for whom the data are intended

3.1.5

co-ordinator

wireless device configured to provide synchronisation services through the transmission of beacons

Note 1 to entry: If a co-ordinator is the principal controller of a wireless mesh network, it is called the WMC (WiBEEM Mesh Co-ordinator).

3.1.6

data integrity

assurance that the data have not been modified from their original form

3.1.7

device

entity containing an implementation of the WiBEEM applications, NWK, MAC and physical interface to the wireless medium

3.1.8

frame

data format of aggregated bits from a medium access control (MAC) layer entity transmitted in a specified sequence

3.1.9

packet

format of aggregated bits transmitted in a specified sequence across the physical medium

3.1.10

personal operating space

space of typically about 10 m around a person or object, no matter whether this person or object is stationary or in motion

3.1.11

portable device

device that may be moved from location to location, but uses network communications only while at a fixed location

3.1.12

protocol data unit

unit of data exchanged between two peer entities

3.1.13

pseudo-random number generation

process of generating a deterministic sequence of bits from a given seed that has the statistical properties of a random sequence of bits when the seed is not known

3.1.14

service data unit

information delivered as a unit through a service access point (SAP)

3.1.15

WiBEEM end device

WiBEEM device acting as the leaf device of a mesh network

3.1.16

WiBEEM mesh co-ordinator

WiBEEM device acting as the principal controller of a mesh network

Note 1 to entry: A WiBEEM mesh network has exactly one WiBEEM mesh co-ordinator.

3.1.17

WiBEEM routable co-ordinator

WiBEEM device acting as the router of a mesh network

3.1.18

wireless medium

medium used to implement the transfer of protocol data units (PDUs) between peer physical layer (PHY) entities of a low-rate wireless mesh network

3.2 Abbreviations

The following acronyms and abbreviations are used in this standard. They are commonly used in other industry publications.

AES	Advanced Encryption Standard
BO	Beacon Order
BOP	Beacon Only Period
BOPL	Beacon Only Period Length
BPSK	Binary Phase-Shift Keying
CAP	Contention Access Period
CBC-MAC	Cipher Block Chaining Message Authentication Code
CCA	Clear Channel Assessment
CSMA-CA	Carrier Sense Multiple Access With Collision Avoidance
DSP	Deep Sleep Period
ED	Energy Detection
EIRP	Effective Isotropic Radiated Power
EVM	Error-Vector Magnitude
ID	Identifier
IFS	Interframe Space or Spacing
LLC	Logical Link Control
LQ	Link Quality
LQI	Link Quality Indication
LPDU	LLC Protocol Data Unit
LR-WPAN	Low-Rate Wireless Personal Area Network
LSB	Least Significant Bit
MAC	Medium Access Control
MIB	MAC Information Base
MLME	MAC Layer Management Entity
MLME-SAP	MAC Layer Management Entity-Service Access Point
MPDU	MAC Protocol Data Unit
MSB	Most Significant Bit
MSC	Message Sequence Chart
MSDU	MAC Service Data Unit
NAA	Next Address Available
NB	Number Of Backoff (periods)
O-QPSK	Offset Quadrature Phase-Shift Keying
PD-SAP	PHY Data Service Access Point
PDU	Protocol Data Unit
PER	Packet Error Rate
PHR	PHY Header