
**Information technology —
Telecommunications and information
exchange between systems — Local
and metropolitan area networks —
Specific requirements —**

**Part 15-4:
Wireless medium access control
(MAC) and physical layer (PHY)
specifications for low-rate wireless
personal area networks (WPANs)**

*Technologies de l'information — Télécommunications et échange
d'information entre systèmes — Réseaux locaux et métropolitains —
Exigences spécifiques —*

*Partie 15-4: Spécifications du contrôle d'accès du milieu sans fil
(MAC) et de la couche physique (PHY) pour les réseaux personnels
sans fil de faible débit (WPAN)*





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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA

stds.ipr@ieee.org
www.ieee.org

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A list of all parts in the ISO/IEC/IEEE 8802 series can be found on the ISO website.

IEEE Std 802.15.4™-2015

(Revision of
IEEE Std 802.15.4-2011)

IEEE Standard for Low-Rate Wireless Networks

Sponsor

**LAN/MAN Standards Committee
of the
IEEE Computer Society**

Approved 5 December 2015

IEEE-SA Standards Board

Abstract: The protocol and compatible interconnection for data communication devices using low-data-rate, low-power, and low-complexity short-range radio frequency (RF) transmissions in a wireless personal area network (WPAN) are defined in this standard. A variety of physical layers (PHYs) have been defined that cover a wide variety of frequency bands.

Keywords: ad hoc network, IEEE 802.15.4™, low data rate, low power, LR-WPAN, mobility, PAN, personal area network, radio frequency, RF, short range, wireless, wireless personal area network, WPAN

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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Chandrashekhar P. S. Bhat	Iwao Hosako	Hiroyo Ogawa
Kiran Bynam	Yeong Min Jang	Taejoon Park
Edgar Callaway	Seong-Soon Joo	Glenn Parsons
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Radhakrishna Canchi	Shuzo Kato	Albert Petrick
Kapseok Chang	Toyoyuki Kato	Clinton C. Powell
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Clint Chaplin	Jaehwan Kim	Ivan Reede
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Paul Chilton	Shoichi Kitazawa	Ruben E. Salazar Cardozo
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Hendricus de Ruijter	Ryuji Kohno	Norihiko Sekine
Guido Dolmans	Fumihide Kojima	Kunal Shah
Igor Dotlic	Thomas Kuerner	Stephen Shellhammer
Stefan Drude	Byung-Jae Kwak	Shusaku Shimada
Dietmar Eggert	Jae Seung Lee	Gary Stuebing
Shahriar Emami	Myung Lee	Don Sturek
Andrew Estrada	Sangjae Lee	Mineo Takai
David Evans	Huan-Bang Li	Kou Togashi
George Flammer	Liang Li	Billy Verso
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Matthew Gillmore	Michael Lynch	Brian Weis
Tim Godfrey	Itaru Maekawa	Makoto Yaita
Elad Gottlib	Hiroyuki Matsumura	Peter Yee
Jussi Haapola	Michael McLaughlin	Yu Zeng
Rainer Hach	Michael McInnis	Chunhui (Allan) Zhu
	Kenichi Mori	

Major contributions in the revision process were received from the following individuals:

Philip Beecher	Jeritt Kent	Benjamin A. Rolfe
Monique Brown	Patrick W. Kinney	Ruben E. Salazar Cardozo
Edgar Callaway	Tero Kivinen	Cristina Seibert
Soo-Young Chang	Amarjeet Kumar	Kunal Shal
James P. K. Gilb	Michael McInnis	Shusakh Shimada
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Rick Alfvén	Noriyuki Ikeuchi	Yoshihiro Ohba
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Stan Bottoms
Mark V. Bowles
Chuck Brabenac
Soo-Young Chang
Francois Po-Shin Chin
Aik Chindapol

Craig Conkling
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Kai Dombrowski
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Mathew Welborn
Richard Wilson
Stephen Wood
Edward G. Woodrow
Hirohisa Yamaguchi
Amos Young
Song-Lin Young
Nakache Yves-paul
Jim Zyren

Major contributions were received from the following individuals:

Tony Adamson
David Archer
David Avery
Venkat Bahl
Daniel Bailey
Edu Batliwala
Pratik Bose
Boaz Carmeli
Farron Dacus
Martin Digon
Ian C. Gifford

Ed Hogervorst
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Richard Wilson
Wim Zwart

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Manoj Choudhary	Ismail Lakkis	Saeid Safavi
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Patrick Houghton	Hiroyo Ogawa	Arnaud Tonnerre
Robert Huang	Yasuyuki Okuma	Ichihiko Toyoda

Jerry Upton
Bart Van Poucke
Chris Weber
Matthew Welborn
Magnus Wiklund

Gerald Wineinger
Patrick Worfolk
Tracy Wright
Hirohisa Yamaguchi
Kamya Yekeh Yazdandoost

Su-Khiong Yong
Zhan Yu
Serdar Yurdakul
Mahmoud Zadeh
Bin Zhen

Major contributions in the revision process were received from the following individuals:

Jon Adams
Helmut P. Adamski
Jonathan Avey
Jon Beniston
Bernd Grohmann
José A. Gutierrez
Jesper Holm
ZhiJian Hu
Phil A. Jamieson
Yuen-Sam Kwok

Colin Lanzl
Myung Lee
Zhongding Lei
Liang Li
Yong Liu
Frederick Martin
Frank Poegel
Matthias Scheide
D. C. Seward

Huai-Rong Shao
Mark Shea
Stephen J. Shellhammer
Mark A. Tillinghast
Johannes Van Leeuwen
Richard Wilson
Ping Xiong
Bing Xu
ChenYang Yang
Chunhui Zhu

The following members of the IEEE P802.15 Working Group participated in the development of the second revision, IEEE Std 802.15.4-2011:

Robert F. Heile, Chair
Rick Alfvin, Co-Vice Chair
Patrick W. Kinney, Co-Vice Chair
James P. K. Gilb, Working Group Technical Editor
Patrick W. Kinney, Secretary

James P. K. Gilb, Task Group 4i Chair and Technical Editor

Emad Afifi
Gahng-Seop Ahn
Roberto Aiello
Arthur Astrin
Taehan Bae
Michael Bahr
John Barr
Anuj Batra
Tuncer Baykas
Philip E. Beecher
Ashutosh Bhatia
Ghulam Bhatti
Gary Birk
Mathew Boytim
Peter David Bradley
Nancy Bravin
David Britz
Monique B. Brown
Sverre Brubk
Brian Buchanan
John Buffington
Kiran Bynam
Brent Cain
Edgar H. Callaway
Chris Calvert

Ruben E. Salazar Cardozo
Douglas Castor
Jaesang Cha
Russell Chandler
Kuo-Hsin Chang
Soo-Young Chang
Clint Chaplin
Hind Chebbo
Chang-Soon Choi
Sangsung Choi
Ciaran Connell
David Cypher
Matthew Dahl
David Davenport
Mark Dawkins
Hendricus de Ruijter
Upkar Dhaliwal
Gang Ding
Paul Dixon
Guido Dolmans
Igor Dotlic
Michael Dow
Dietmar Eggert
David Evans
Charles Farlow

John Farserotu
Jeffrey Fischbeck
Mike Fischer
George Flammer
Ryosuke Fujiwara
Noriyasu Fukatsu
Kiyoshi Fukui
John Geiger
Gregory Gillooly
Tim Godfrey
Paul Gorday
Elad Gottlieb
Robert Hall
Shinsuke Hara
Hiroshi Harada
Timothy Harrington
Rodney Hemminger
Marco Hernandez
Garth Hillman
Jin-Meng Ho
Wei Hong
Srinath Hosur
David Howard
Jung-Hwan Hwang
Taeho Hwang

Ichirou Ida	Robert Moskowitz	Steve Shearer
Tetsushi Ikegami	Hamilton Moy	Stephen Shellhammer
Akio Iso	Peter Murray	Shusaku Shimada
Yeong Min Jang	Theodore Myers	Chang Sub Shin
Adrian Jennings	Chiu Ngo	Cheol Ho Shin
Wuncheol Jeong	Paul Nikolich	Michael Sim
Steven Jillings	Hirohito Nishiyama	Jonathan Simon
Noh-Gyoung Kang	David Olson	Jaeseung Son
Tae-Gyu Kang	Okundu Omeni	Paul Stadnik
Shuzo Kato	Ryoji Ono	René Struik
Tatsuya Kato	Laurent Ouvry	Chin-Sean Sum
Jeritt Kent	James Pace	Hui-Hsia Sung
Prithpal Khakuria	Hyung-Il Park	Gu Sungi
Dae Ho Kim	Jahng Park	Kenichi Takizawa
Dong-Sun Kim	Seung-Hoon Park	Hirokazu Tanaka
Dukhyun Kim	Taejoon Park	Larry Taylor
Jaehwan Kim	Ranjeet Patro	Mark Thompson
Jeffrey King	Al Petrick	James Tomcik
Ryuji Kohno	Dalibor Pokrajac	Ichihiko Toyoda
Fumihide Kojima	Daniel Popa	David Tracey
Bruce Kraemer	Stephen Pope	Khanh Tran
Raymond Krasinski	Clinton C. Powell	Jerry Upton
Masahiro Kuroda	Richard Powell	Jana van Greunen
John Lampe	Chang-Woo Pyo	Hartman van Wyk
Zhou Lan	Mohammad Rahman	Michel Veillette
Khanh Le	Sridhar Rajagopal	Billy Verso
Cheolhyo Lee	Jayaram Ramasastry	Bhupender Virk
Hyungsoo Lee	Marc Reed	Joachim Walewski
Myung Lee	Ivan Reede	Junyi Wang
Daniel Lewis	Richard Roberts	Quan Wang
Huan-Bang Li	Craig Rodine	Xiang Wang
Liang Li	June Chul Roh	Andy Ward
Sang-Kyu Lim	Benjamin A. Rolfe	Scott Weikel
Jeremy Link	Seung-Moon Ryu	Nicholas West
Mike Lynch	Didier Sagan	Mark Wilbur
Robert Mason	Kentaro Sakamoto	Ludwig Winkel
Tomokuni Matsumura	Will San Filippo	Eun Tae Won
Jeff McCullough	H. Sanderford	Alan Chi Wai Wong
Michael McGillan	Kamran Sayrafian	Tao Xing
Michael D. McInnis	Timothy Schmidl	Wen-Bin Yang
Michael McLaughlin	Michael Schmidt	Yang Yang
Charles Millet	Jean Schwoerer	Kazuyuki Yasukawa
Siamak Mirnezami	Cristina Seibert	Kamya Yazdandoost
Rishi Mohindra	Neal Seidl	Kaoru Yokoo
Emmanuel Monnerie	Kunal Shah	Mu Zhao
Rajendra Moorti		Bin Zhen

Major contributions in the revision process were received from the following individuals:

Philip E. Beecher	Clint Chaplin	Clinton C. Powell
Vern Brethour	James P. K. Gilb	Benjamin A. Rolfe
Monique B. Brown	Patrick W. Kinney	Timothy Schmidl
Edgar H. Callaway	Michael D. McInnis	René Struik
Kuor-Hsin Chang		Billy Verso

Introduction

This introduction is not part of IEEE Std 802.15.4™-2015, IEEE Standard for Low-Rate Wireless Networks.

This is the third revision of IEEE Std 802.15.4. From the beginning, the goal of the IEEE P802.15 Working Group was to produce a standard that enabled very low-cost, low-power communications. The initial standard, IEEE Std 802.15.4-2003, defined two optional physical layers (PHYs), operating in different frequency bands with a simple and effective medium access control (MAC).

In 2006, the standard was revised and added two more PHY options. The MAC remained backward compatible, but the revision added MAC frames with an increased version number and a variety of MAC enhancements, including the following:

- Support for a shared time base with a data time stamping mechanism
- Support for beacon scheduling
- Synchronization of broadcast messages in beacon-enabled personal area networks (PANs)
- Improved MAC layer security

In 2011, the standard was revised to include the three amendments approved subsequent to the 2006 revision. This effort added four more PHY options along with the MAC capability to support ranging. Additionally, the organization of the standard was changed so that each PHY would have a separate clause, and the MAC clause was split into functional description, interface specification, and security specification.

The current revision of the standard was created to roll in the amendments approved subsequent to the 2011 revision: six PHY amendments and one MAC amendment, with corrigenda and clarifications. The features added by the amendments include the following:

- Enhanced frame formats maintaining backward compatibility
- Information Elements (IEs)
- Channel agility
- Extended superframe options
- Low-energy mechanisms
- An enhanced acknowledgment frame that can carry data and can be secured
- Prioritized channel access
- A variety of new PHY modulation, coding, and band options to support a wide variety of application needs including radio frequency identification (RFID), smart utility networks (SUNs), television white space (TVWS) operation, low-energy critical infrastructure monitoring (LECIM), and rail communications and control (RCC).

Much of the corrigenda and clarifications were collected from requests from individuals after the revision in 2011. Major corrigenda items included changes to the security text to correct errors and clarify the text, removal of the encrypt only mode, addition of security policy checks for the IEs, corrections regarding personal area network identifier (PAN ID) compression behavior to eliminate ambiguous specification, and changes to the IEs subclauses to include more information necessary for users of this standard.

The Project Authorization Request (PAR) for IEEE Std 802.15.4-2015 was first proposed in July 2013 and was approved in October 2013 by IEEE's New Standards Committee (NesCom). After three working group ballots and two sponsor ballots, the final standard was approved in December 2015, just over two years from start to finish.

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1. Overview

1.1 Scope

This standard defines the physical layer (PHY) and medium access control (MAC) sublayer specifications for low-data-rate wireless connectivity with fixed, portable, and moving devices with no battery or very limited battery consumption requirements. In addition, the standard provides modes that allow for precision ranging. PHYs are defined for devices operating various license-free bands in a variety of geographic regions.

1.2 Purpose

The standard provides for ultra low complexity, ultra low cost, ultra low power consumption, and low data rate wireless connectivity among inexpensive devices. In addition, one of the alternate PHYs provides precision ranging capability that is accurate to one meter. Multiple PHYs are defined to support a variety of frequency bands.