



**IEEE Standard for
Local and metropolitan area networks**

Part 16: Air Interface for Broadband Wireless Access Systems

**IEEE Computer Society
and the
IEEE Microwave Theory and Techniques Society**

Sponsored by the
LAN/MAN Standards Committee

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3 Park Avenue
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IEEE Std 802.16™-2009
(Revision of
IEEE Std 802.16-2004)

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IEEE-SA Standards Board



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Abstract: This standard specifies the air interface, including the medium access control layer (MAC) and physical layer (PHY), of combined fixed and mobile point-to-multipoint broadband wireless access (BWA) systems providing multiple services. The MAC is structured to support multiple physical layer (PHY) specifications, each suited to a particular operational environment. The standard enables rapid worldwide deployment of innovative, cost effective, and interoperable multivendor broadband wireless access products, facilitates competition in broadband access by providing alternatives to wireline broadband access, encourages consistent worldwide spectrum allocations, and accelerates the commercialization of broadband wireless access systems. The standard is a revision of IEEE Std 802.16-2004, and consolidates material from IEEE Std 802.16e™-2005, IEEE 802.16-2004/Cor1-2005, IEEE 802.16f™-2005, and IEEE Std 802.16g™-2007, along with additional maintenance items and enhancements to the management information base specifications. This revision supersedes and makes obsolete IEEE Std 802.16-2004 and all of its subsequent amendments and corrigenda.

Keywords: broadband wireless access (BWA), cellular layer, fixed broadband wireless access, MAN, management information base (MIB), microwave, mobile broadband wireless access, OFDM, OFDMA, radio, standard, wireless access systems (WAS), WirelessMAN®, wireless metropolitan area network

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Introduction

This introduction is not part of IEEE Std 802.16-2009, IEEE Standard for Local and metropolitan area networks—Part 16: Air Interface for Broadband Wireless Access Systems.

This standard specifies the air interface of combined fixed broadband wireless access (BWA) systems supporting multimedia services. The medium access control layer (MAC) supports a primarily point-to-multipoint architecture. The MAC is structured to support multiple physical layer (PHY) specifications, each suited to a particular operational environment. For operational frequencies from 10–66 GHz, the WirelessMAN-SC PHY, based on single-carrier modulation, is specified. For frequencies below 11 GHz, where propagation without a direct line of sight must be accommodated, two alternatives are provided: WirelessMAN-OFDM (using orthogonal frequency-division multiplexing) and WirelessMAN-OFDMA (using orthogonal frequency-division multiple access). This standard is a revision of IEEE Std 802.16-2004 and consolidates material from IEEE 802.16e-2005, IEEE 802.16-2004/Cor1-2005, IEEE 802.16f-2005, and IEEE 802.16g-2007, along with additional maintenance items and enhancements to the management information base specifications. This revision supersedes and makes obsolete IEEE Std 802.16-2004 as well as IEEE 802.16e-2005, IEEE 802.16-2004/Cor1-2005, IEEE 802.16f-2005, and IEEE 802.16g-2007.

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The multipart conformance test documents for IEEE Std 802.16 are designated by “IEEE Standard 802.16/ConformanceXX.”

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This document was developed by the IEEE 802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN[®] Standard for Wireless Metropolitan Area Networks.

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The following individuals participated in the IEEE 802.16 working group during various stages of the standard's development. Since the initial publication, many IEEE standards have added functionality or provided updates to material included in this standard. Included is a historical list of participants who have dedicated their valuable time, energy, and knowledge to the creation of this standard.

IEEE 802.16 Standards	Date approved by IEEE	Officers at the time of Working Group Letter Ballot
IEEE Std 802.16-2001	6 December 2001	Roger B. Marks: <i>Working Group Chair, Task Group Chair, Technical Editor</i> Brian G. Kiernan: <i>Working Group Vice Chair</i> Carl J. Bushue: <i>Working Group Secretary</i> Carl Eklund: <i>MAC Chair</i> Jay Klein: <i>PHY Chair</i> Carl Eklund, Kenneth Stanwood, Stanley Wang: <i>MAC Editors</i> Jay Klein, Lars Lindh: <i>PHY Editors</i>
IEEE Std 802.16c-2002 (amendment)	12 December 2002	Roger B. Marks: <i>Working Group Chair</i> Paul F. Struhsaker: <i>Working Group Vice Chair</i> Dean Chang: <i>Working Group Secretary</i> Kenneth Stanwood: <i>Task Group Chair</i> Carl Eklund: <i>Technical Editor</i>
IEEE Std 802.16a-2003 (amendment)	29 January 2003	Roger B. Marks: <i>Working Group Chair</i> Carl Eklund: <i>Vice Chair</i> Dean Chang: <i>Working Group and Task Group Secretary</i> Brian G. Kiernan: <i>Task Group Chair</i> Nico van Waes: <i>Technical Editor</i> Brian Eidson: <i>Lead SCA PHY Editor</i>
IEEE Std 802.16-2004	24 June 2004	Roger B. Marks, <i>Working Group Chair</i> Kenneth Stanwood, <i>Vice Chair</i> Dean Chang, <i>Working Group Secretary</i> Gordon Antonello, <i>Task Group d Chair</i> Itzik Kitroser, <i>Chief Technical Editor</i> Robert Nelson, <i>Assistant Editor</i> Brian Eidson, <i>SCA PHY Editorial Contributor</i> Nico van Waes, <i>Former Chief Technical Editor</i>
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IEEE Std 802.16e-2005 and IEEE Std 802.16-2004/Cor1- 2005 (amendment and corrigendum)	7 December 2005 (amendment) and 8 November 2005 (corrigendum)	Roger B. Marks, <i>Working Group Chair</i> Kenneth Stanwood, <i>Vice Chair</i> Dean Chang, <i>Working Group Secretary</i> Brian Kiernan, <i>Task Group e Chair</i> Ron Murias, <i>Chief Technical Editor</i> Itzik Kitroser, <i>Assistant Editor</i> Jose Puthenkulam, <i>Assistant Editor</i> Jonathan Labs, <i>Maintenance Task Group Chair</i> Itzik Kitroser, <i>Chief Technical Editor</i> Ken Stanwood, <i>Former Maintenance Task Group Chair</i>

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IEEE Std 802.16-2009	May 2009	Roger B. Marks , <i>Working Group Chair</i> Peiyang Zhu , <i>Secretary</i> Jonathan Labs , <i>Maintenance Task Group Chair</i> Joseph Schumacher , <i>Chief Technical Editor</i> Joey Chou , <i>Assitant Editor</i> Itzik Kitroser , <i>Assitant Editor</i> Ron Murias , <i>Assitant Editor</i> Scott Probasco , <i>Assitant Editor</i>

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**IEEE Standard for
Local and metropolitan area networks**

Part 16: Air Interface for Broadband Wireless Access Systems

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1. Overview

1.1 Scope

This standard specifies the air interface, including the medium access control layer (MAC) and physical layer (PHY), of combined fixed and mobile point-to-multipoint broadband wireless access (BWA) systems providing multiple services. The MAC is structured to support multiple PHY specifications, each suited to a particular operational environment.

1.2 Purpose

This standard enables rapid worldwide deployment of innovative, cost-effective, and interoperable multivendor broadband wireless access products, facilitates competition in broadband access by providing alternatives to wireline broadband access, encourages consistent worldwide spectrum allocation, and accelerates the commercialization of broadband wireless access systems.

1.3 Variants and frequency bands

Several conforming variants of this standard are specified. The appropriate variant depends on the radio frequency band in which it operates. The primary bands of interest are described in 1.3.1 through 1.3.3. The variants are listed in 1.3.4.