



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

**Part 20: Air Interface for Mobile
Broadband Wireless Access Systems
Supporting Vehicular Mobility—
Physical and Media Access Control Layer
Specification**

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997, USA
29 August 2008

IEEE Std 802.20™-2008

Currently in preview, click buy full version

IEEE Standard for
Local and metropolitan area networks

**Part 20: Air Interface for Mobile
Broadband Wireless Access Systems
Supporting Vehicular Mobility—
Physical and Media Access Control Layer
Specification**

Sponsor

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

Approved 12 June 2008

IEEE-SA Standards Board

The IEEE would like to acknowledge with thanks that permission has been granted by the Alliance for Telecommunications Industry Solutions (ATIS), on behalf of its Wireless Technologies and Systems Committee's (WTSC) Wireless Wideband Internet Access (WWINA), to the IEEE 802.20 Mobile Broadband Wireless Access (MBWA) Working Group to include specific references to the ATIS standard, ATIS High Capacity—Spatial Division Multiple Access (HC-SDMA) Standard (ATIS-0700004-2005), within IEEE Std 802.20.

Grateful acknowledgement is also made to the Telecommunications Industry Association (TIA) for granting permission the IEEE to use the below listed TIA standards for world rights distribution, with additional permission to modify and reprint in all future revisions and editions of IEEE Std 802.20 in all media known or hereinafter known.

- TIA-1121.000—Overview for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.001—Physical Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.002—MAC Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.003—Radio Link Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.004—Application Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.005—Security Functions for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.006—Connection Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.007—Session Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.008—Route Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification
- TIA-1121.009—Broadcast-Multicast Upper Layers for Ultra Mobile Broadband (UMB) Air Interface Specification

Abstract: The technical requirements of this standard form a compatibility standard for mobile broadband wireless access systems. The standard ensures that a compliant access terminal (AT) or user terminal (UT) can obtain service through any access node (AN) or base station (BS) conforming to properly selected modes of this standard, consistent with equipment and operator requirements, thus providing a framework for the rapid development of cost-effective, multivendor mobile broadband wireless access systems. This compatibility standard is targeted for use in a wide variety of licensed frequency bands and regulatory environments.

This standard provides for future standardized extension capabilities. The architecture defined by this standard permits such expansion without the loss of backward compatibility.

Keywords: access node, access terminal, base station, broadband, LAN, local area networks, MAN, metropolitan area networks, user terminal, vehicular mobility, wireless access

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

Copyright © 2008 by the Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 29 August 2008. Printed in the United States of America.

IEEE and 802 are registered trademarks in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 973-07381-5766-5 STD95805

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

Use of an IEEE Standard is wholly voluntary. The IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon this, or any other IEEE Standard document.

The IEEE does not warrant or represent the accuracy or content of the material contained herein, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained herein is free from patent infringement. IEEE Standards documents are supplied "AS IS."

The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation. When a document is more than five years old and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

In publishing and making this document available, the IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity. Nor is the IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing this, and any other IEEE Standards document, should rely upon his or her independent judgement in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE Standard.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are unable to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration. A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal interpretation of the IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should not be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Comments on standards and requests for interpretations should be submitted to the following address:

Secretary, IEEE-SA Standards Board

445 Hoes Lane

Piscataway, NJ 08854

USA

Authorization to photocopy portions of any individual standard for internal or personal use is granted by The Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Introduction

This introduction is not part of IEEE Std 802.20-2008, IEEE Standard for Local and metropolitan area networks—Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility—Physical and Media Access Control Layer Specification.

Notice to users

Laws and regulations

Users of these documents should consult all applicable laws and regulations. Compliance with the provisions of this standard does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

This document is copyrighted by the IEEE. It is made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

Updating of IEEE documents

Users of IEEE standards should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE Standards Association website at <http://ieeexplore.ieee.org/xpl/standards.jsp>, or contact the IEEE at the address listed previously.

For more information about the IEEE Standards Association or the IEEE standards development process, visit the IEEE-SA website at <http://standards.ieee.org>.

Errata

Errata, if any, for this and all other standards can be accessed at the following URL: <http://standards.ieee.org/reading/ieee/updates/errata/index.html>. Users are encouraged to check this URL for errata periodically.

Interpretations

Current interpretations can be accessed at the following URL: <http://standards.ieee.org/reading/ieee/interp/index.html>.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard no position is taken with respect to the existence or validity of any patent rights in connection therewith. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the Module Broadband Wireless Access Working Group had the following membership:

Arnold Greenspan, Chair

Mark Klerer, Vice Chair

James Mollenauer, Vice Chair

Donald Gillies, Recording Secretary

Gwen Barriac
Moussa Bavafa
Jaffrey Bernstein
Nancy S. Bravin
Petru Budianu
Chris Bussey
Radhakrishna Canchi
Peter Carson
Harold Castel
Chris Dean
Doug Dunn
Mark Epstein
Peretz Feder
Graham C. Freeland
Daniel Garcia-Alis
Deepshikha Garg
Eladio Gomes
Dhananjay Gore
Svetlana Gorodetsky
Alexei Gorokhov
Radhika Gowarhar
Victor Hou
Kazuyoshi Imuro
Kazuhiko Ishida
Allan Jett
Tingfang Ji
Dennis Jones
Tomer Kadous

Amit Kalhan
Majid Khademi
Aamod Khandekar
Farrokh Khatibi
Shigeru Kimura
Minako Kitahara
Douglas Knifely
Tom Kolze
Changhoi Koo
Lisa Lawrence
Hosung Lee
Marty Martynov
Marty Martynov
Anthony McMahon
Donald McMillan
Max Miyazano
Kazuhiro Murakami
Mullagru Naidu
Kenichi Nakamura
Tetsuya Nakamura
Shinji Nakano
Nha Nguyen
Fred Novick
Francis O'Brien
Hiroshi Oguma
Eugen Pfann
Riku Pirhonen
Sebastien Poisson

Rajat Prakash
Rob Preece
James H. Ragsdale
Ajay Rajkumar
Hemanth Sampath
Masato Sano
Shigenobu Sasaki
Judy Shields
David Shively
Roshni Srinivasian
Doug Staver
Richard Stuby
Mark Suh
Jing Sun
Valentin Surcobe
Tomohiro Suzuki
Harris Teague
Lai-King Anna Tee
James Tomcik
Jerry Upton
Jaun Carlos Valls
Rajiv Vijayan
Silvia Vivanco
Michael Wang
Thomas Wasilewski
Joanne Wilson
Rao Yallapragada
Michael Youssefmir
Masaaki Yuza

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

Toru Aihara
Thomas Alexander
Danilo Antonelli
Matthew Ball
Phillip Barber
John Barr
Gennaro Boggia
Nancy S. Bravin
William Byrd
Sean Cai
Peter J. Calderon
Radhakrishna Canchi
Juan Carreon
Yung-Mu Chen
Keith Chow
Joseph Cleveland
Todor Cooklev
Russell Dietz
Carlo Donati
Carl Eklund
Marc Emmelmann
Mark Epstein
Bernard Eydtt
Prince Francis
Avraham Freedman
Graham C. Freeland
Devon Gayle
Pieter-Paul Giesberts
James Gilb
Donald Gillies
Mariana Goldhamer
Sergiu Goma
Radhika Gowaikar
Arnold Greenspan

Randall Groves
C. Guy
Gavin Horn
Victor Hou
John Humbert
Tetsushi Ikegami
Atsushi Ito
Raj Jain
Tony Jeffree
Alan Jette
Tingfang Ji
Stuart J. Kerry
Farrokh Khatibi
Brian Kiernan
Eunkyung Kim
Yongho Kim
Mark Klerer
Tom Kolze
Jonathan Labs
Jeremy Landt
Heesoo Lee
Jan-Ray Liao
G. Luri
Roger Marks
Peter Martini
Gary Michel
Apurva Mody
Avygdor Moise
Jose Morales
Ronald G. Murias
Ayman Nagu
Juichi Nakada
Hiroyuki Nakase
Michael S. Newman

Satoshi Obara
Francis O'Brien
Hiroshi Oguma
Chris Osterloh
Satoshi Oyama
Stephen Palm
William Pechey
Eugen Pfann
Riku Pirhonen
Subburajan Ponnuswamy
Michael Probasco
Jose Puthenkulam
James H. Ragsdale
Maximilian Riegel
Robert Robinson
Herbert Ruck
Shigenobu Sasaki
Thomas Scharf
Carl Sorenson
Walter Stappeler
Thomas Sully
Jin Sun
Masato Tanahashi
John Terry
Geoffrey Thompson
James Tomcik
Jerry Upton
Prabodh Varshney
Stanley Wang
Fujio Watanabe
David Willow
Joanne Wilson
Michael Youssefmir
Oren Yuen

When the IEEE-SA Standards Board approved this standard on 12 June 2008, it had the following membership:

Robert M. Grow, *Chair*
Thomas Prevost, *Vice Chair*
Steve M. Mills, *Past Chair*
Judith Gorman, *Secretary*

Victor Berman
Richard DeBlasio
Andy Drozd
Mark Epstein
Alexander Gelman
William Goldbach
Arnie Greenspan
Ken Hanus

Jim Hughes
Richard Hulett
Young Kyun Kim
Joseph L. Koepfinger*
John Kulick
David J. Law
Glenn Parsons

Ron Petersen
Chuck Powers
Narayanan Ramachandran
Jon Walter Rosdahl
Anne-Marie Sahazizian
Malcolm Thaden
Howard Wolfman
Don Wright

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Satish K. Aggarwal, *NRC Representative*
Michael H. Kelley, *NIST Representative*

Michelle Turner
IEEE Standards Program Manager, Document Development

Michael D. Lipner
IEEE Standards Program Manager, Technical Program Development

Contents

1.	Scope.....	1
2.	Normative references.....	2
3.	Definitions.....	4
4.	Abbreviations and acronyms.....	19
5.	General introduction.....	1
5.1	General.....	2
5.2	Modes of the standard.....	21
5.3	Requirements language.....	21
5.4	Wideband mode overview.....	21
5.5	System overview of 625k-MC (625kiloHertz-spaced MultiCarrier) Mode.....	38
6.	Services Sublayer.....	41
6.1	Introduction.....	41
6.2	Basic Signaling Protocol.....	41
6.3	Basic Inter-Route Tunneling Protocol.....	45
6.4	Basic Robust Header Compression Support Protocol.....	53
6.5	Basic EAP Support Protocol.....	58
7.	Radio Link Sublayer.....	62
7.1	Introduction.....	62
7.2	Basic QOS Management Protocol.....	63
7.3	Basic Radio Link Protocol.....	94
7.4	Basic Stream Protocol.....	131
7.5	Basic Route Protocol.....	135
8.	Lower MAC Sublayer.....	146
8.1	General.....	146
8.2	Basic Packet Consolidation Protocol.....	159
8.3	Basic Superframe Preamble Mac Protocol.....	166
8.4	Basic Access Channel MAC Protocol.....	176
8.5	Basic Forward Link Control Segment MAC Protocol.....	189
8.6	Basic Forward Traffic Channel MAC Protocol.....	218
8.7	Basic Reverse Control Channel MAC Protocol.....	291
8.8	Basic Reverse Traffic Channel MAC Protocol.....	346
9.	Physical Layer.....	389
9.1	Basic Physical Layer Protocol.....	389
9.2	General.....	390
9.3	Requirements for access terminal operation.....	496
9.4	Access network requirements.....	521
9.5	Broadcast Multicast Services (BCMCS).....	569

10.	Security functions	586
	10.1 Introduction	586
	10.2 AES Ciphering Protocol.....	586
	10.3 Basic Message Integrity Protocol.....	595
	10.4 Basic Key Exchange Protocol	603
11.	Connection Control Sublayer.....	614
	11.1 Introduction	614
	11.2 Basic Air Link Management Protocol.....	615
	11.3 Basic Initialization State Protocol	640
	11.4 Basic Idle State Protocol.....	644
	11.5 Basic Connected State Protocol.....	659
	11.6 Overhead Messages Protocol.....	681
	11.7 Basic Active Set Management Protocol	714
12.	Session Control Plane	754
	12.1 Introduction	754
	12.2 Basic Session Control Protocol.....	755
13.	Route Control Plane.....	798
	13.1 Introduction	798
	13.2 Basic Route Control Protocol.....	798
14.	Broadcast support	825
	14.1 Introduction	825
	14.2 Basic Broadcast Protocol Suite	825
15.	Common procedures and data structures	877
	15.1 Common procedures	877
	15.2 Common data structures.....	880
16.	Assigned names and numbers.....	889
	16.1 Protocol types and subtypes	889
	16.2 ANID, SectorID, and UATI provisioning.....	892
17.	MAC and PHY MIB	894
	17.1 Overview	894
	17.2 MIB structure	894
	17.3 Definition	894
18.	625k-MC spectral layout terminology and requirements	935
19.	625k-MC slot and frame structure	936
	19.1 Overview	936
	19.2 RF channel and frame structure.....	936

19.3	Burst formats	936
20.	625k-MC modulation and channel coding.....	937
20.1	625k-MC modulation and channel coding overview	937
20.2	Standard modulation and coding.....	937
20.3	Broadcast channel modulation and coding	944
21.	625k-MC user terminal radio transmission and reception.....	945
21.1	625k-MC user terminal nominal output power for modulation formats	945
21.2	625k-MC UT modulation accuracy for modulation formats.....	945
21.3	625k-MC UT reference sensitivity level.....	945
21.4	625k-MC UT receiver SINR estimation accuracy	946
21.5	625k-MC UT receiver adjacent channel selectivity	946
22.	625k-MC base station radio transmission and reception	947
22.1	625k-MC base station transmitter modulation accuracy	947
22.2	625k-MC base station receiver reference sensitivity level.....	947
22.3	625k-MC BS receiver SINR estimation accuracy.....	947
23.	625k-MC L2 MAC Protocol Sublayer Specification	948
23.1	Logical channels.....	948
23.2	625k-MC minimized RMU header.....	950
24.	625k-MC L2 RLC Protocol Sublayer Specification.....	953
24.1	625k-MC AM RMU	953
24.2	625k-MC transmit procedure	953
24.3	Receive procedure	955
25.	625k-MC L3 Protocol Specification.....	957
26.	625k-MC Protocol layer primitives (informative).....	958
26.1	Interface list	958
26.2	Individual interfaces	958
27.	625k-MC QoS Enhancements	965
27.1	Classes of services.....	965
27.2	Session QoS information exchange procedures	965
27.3	QoS priority	966
28.	625k-MC Broadcast and Multicast Service (BCMCS) Support Enhancement	968
28.1	Overview	968
28.2	Broadcast service	968
28.3	Multicast service	969
29.	625k-MC Privacy and Authentication Enhancement	975

29.1	Overview	975
29.2	625k-MC Handshake and BS Authentication Protocol, i-HAP	975
29.3	625k-MC Terminal Authentication Protocol, i-TAP.....	976
29.4	625k-MC Secure Communications Protocol, i-SEC	976
30.	625k-MC Sleep Mode Control Protocol.....	981
31.	625k-MC OA & M Radio Network Quality Monitor and Control Enhancement	982
31.1	625k-MC Mode MIB	982
Annex A	(informative) 625K-MC Glossary of Technical Terms.....	1038
Annex B	(informative) Bibliography.....	1039

IEEE Standard for
Local and metropolitan area networks

Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility— Physical and Media Access Control Layer Specification

IMPORTANT NOTICE: This standard is not intended to assure safety, security, health, or environmental protection in all circumstances. Implementers of the standard are responsible for determining appropriate safety, security, environmental, and health practices or regulatory requirements.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.

1. Scope

This standard specifies the physical and medium access control layers of an air interface for interoperable mobile broadband wireless access systems, operating in licensed bands below 3.5 GHz. The system is optimized for IP-data transport, with peak data rates per user in excess of 1 Mbps.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

3GPP2 C.R1001-F v1.0, Administration of Parameter Value Assignments for cdma2000TM Spread Spectrum Standards.¹

3GPP2 C.S0001, Introduction to cdma2000 Standards for Spread Spectrum Systems.

3GPP2 C.S0010-C v2.0, Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations, March 2006.

3GPP2 C.S0011-C, Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations, March 2006.

3GPP2 C.S0024, cdma2000 High Rate Packet Data Air Interface Specification.

3GPP2 C.S0057-B, Band Class Specification for cdma2000 Spread Spectrum Systems.

3GPP2 S.S0055A v2.0, Enhanced Cryptographic Algorithms.

3GPP2 S.S0078, Common Security Algorithms.

ATIS-0700004.2005, High Capacity-Spatial Division Multiple Access (HC-SDMA) Radio Interface Standard, September 2005.²

IEEE Std 802.1QTM, IEEE Standard for Local and Metropolitan Area Networks: 2 Virtual Bridged Local Area Networks.^{3, 4}

IEEE Std 802.2TM, IEEE Standard for Local Area Networks—Logical link control.

IEEE Std 802.3TM, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

IETF RFC 791, Internet Protocol.⁵

IETF RFC 2210, The Use of RSVP with IETF Integrated Services.

IETF RFC 2216, Network Element Service Specification Template, S. Shenker, J. Wroclawski, September 1987.

IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification.

¹3GPP2 publications are available at <http://www.3gpp2.org/Public>.

²© Copyright 2006 by the Alliance for Telecommunications Industry Solutions, Inc. ATIS publications are available from the ATIS Document Store at <https://www.atis.org/docstore/default.aspx>.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

⁴The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.

⁵IETF publications are available from the Internet Engineering Task Force at <http://www.ietf.org/>.