

*Recognized as an  
American National Standard (ANSI)*

**IEEE Std 802.11d-2001**  
(Amendment to IEEE Std 802.11, 1999 Edition,  
IEEE Std 802.11a-1999, and IEEE Std 802.11b-1999)

**IEEE Standard for  
Information technology—**

**Telecommunications and information  
exchange between systems—**

**Local and metropolitan area networks—**

**Specific requirements**

**Part 11: Wireless LAN Medium Access Control (MAC) and  
Physical Layer (PHY) specifications**

**Amendment 3: Specification for operation in additional  
regulatory domains**

*Sponsor*

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

*Approved 14 June 2001*  
**IEEE-SA Standards Board**

*Approved 25 October 2001*  
**American National Standards Institute**

**Abstract:** This amendment specifies the extensions to IEEE Std 802.11<sup>□</sup> for Wireless Local Area Networks providing specifications for conformant operation beyond the original six regulatory domains of that standard. These extensions provide a mechanism for an IEEE Std 802.11 access point to deliver the required radio transmitter parameters to an IEEE Std 802.11 mobile station, which allows that station to configure its radio to operate within the applicable regulations of a geographic or political subdivision. This mechanism is applicable to all IEEE Std 802.11 PHY types. A secondary benefit of the mechanism described in this amendment is the ability for an IEEE Std 802.11 mobile station to roam between regulatory domains.

**Keywords:** *international roaming, local area network (LAN), mobility, radio, roam, roaming, wireless, wireless network*

---

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

*Copyright © 2001 by the Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 13 July 2001. Printed in the United States of America.*

*Print: ISBN 0-7381-2928-3 SH94941  
PDF: ISBN 0-7381-2929-1 SS94941*

*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 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 the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

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 not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

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 addressed to:

Secretary, IEEE-SA Standards Board  
445 Hoes Lane  
P.O. Box 1331  
Piscataway, NJ 08855-1331  
USA

Note: 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 shall not be responsible for identifying patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

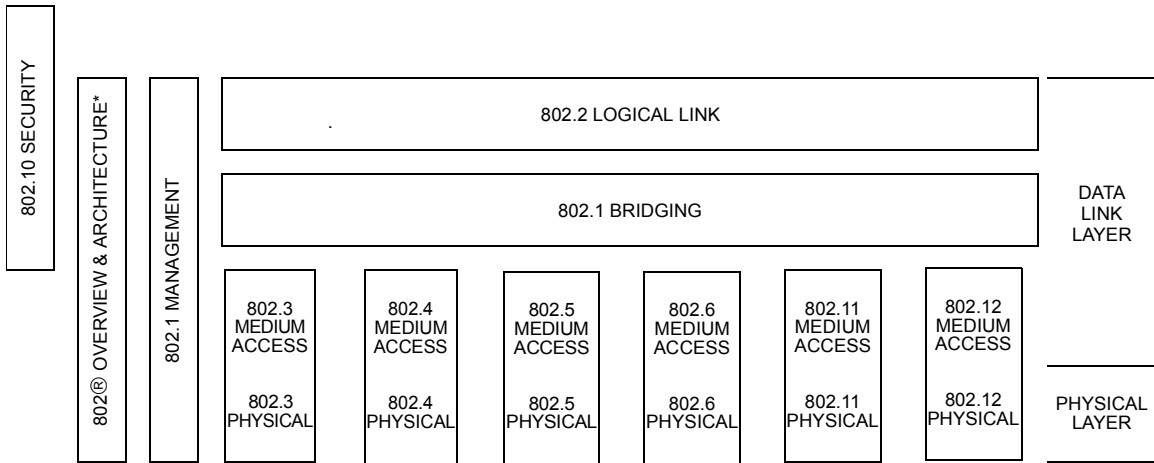
IEEE is the sole entity that may authorize the use of certification marks, trademarks, or other designations to indicate compliance with the materials set forth herein.

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; (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 a part of IEEE Std 802.11d-2001, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 11: Wireless Medium Access Control (MAC) and Physical Layer (PHY) specifications—Amendment 3: Specification for operation in additional regulatory domains.]

This standard is part of a family of standards for local and metropolitan area networks. The relationship between the standard and other members of the family is shown below. (The numbers in the figure refer to IEEE standard numbers.)



\* Formerly IEEE Std 802.1A.

This family of standards deals with the Physical and Data Link Layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model (ISO/IEC 7498-1:1994). The access standards define several types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining the technologies noted above are as follows:

- IEEE Std 802<sup>1</sup>: *Overview and Architecture*. This standard provides an overview to the family of IEEE 802<sup>®</sup> Standards. This document forms part of the IEEE 802.1 scope of work.

<sup>1</sup>The 802 Architecture and Overview Specification, originally known as IEEE Std 802.1A, has been renumbered as IEEE Std 802. This has been done to accommodate recognition of the base standard in a family of standards. References to IEEE Std 802.1A should be considered as references to IEEE Std 802.

- ANSI/IEEE Std 802.1B and 802.1K [ISO/IEC 15802-2]: *LAN/MAN Management*. Defines an Open Systems Interconnection (OSI) management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.
- ANSI/IEEE Std 802.1D *Medium Access Control (MAC) Bridges*. Specifies an architecture and protocol for the [ISO/IEC 15802-3]: interconnection of IEEE 802 LANs below the MAC service boundary.
- ANSI/IEEE Std 802.1E [ISO/IEC 15802-4]: *System Load Protocol*. Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.
- ANSI/IEEE Std 802.1F *Common Definitions and Procedures for IEEE 802 Management Information*.
- ANSI/IEEE Std 802.1G [ISO/IEC 15802-5]: *Remote Media Access Control (MAC) Bridging*. Specifies extensions for the interconnection, using non-LAN systems communication technologies, of geographically separated IEEE 802 LANs below the level of the logical link control protocol.
- ANSI/IEEE Std 802.1H [ISO/IEC TR 11802-5] *Recommended Practice for Media Access Control (MAC) Bridging of Ethernet V2.0 in IEEE 802 Local Area Networks*.
- ANSI/IEEE Std 802.1Q *Virtual Bridged Local Area Networks*. Defines an architecture for Virtual Bridged LANs, the services provided in Virtual Bridged LANs, and the protocols and algorithms involved in the provision of those services.
- ANSI/IEEE Std 802.2 [ISO/IEC 8802-2]: *Logical Link Control*.
- ANSI/IEEE Std 802.3 [ISO/IEC 8802-3]: *CSMA/CD Access Method and Physical Layer Specifications*.
- ANSI/IEEE Std 802.4 [ISO/IEC 8802-4]: *Token Bus Access Method and Physical Layer Specifications*.
- ANSI/IEEE Std 802.5 [ISO/IEC 8802-5]: *Token Ring Access Method and Physical Layer Specifications*.
- ANSI/IEEE Std 802.6 [ISO/IEC 8802-6]: *Distributed Queue Dual Bus Access Method and Physical Layer Specifications*.
- ANSI/IEEE Std 802.10: *Interoperable LAN/MAN Security*. Currently approved: Secure Data Exchange (SDE).
- ANSI/IEEE Std 802.11: [ISO/IEC 8802-11] *Wireless LAN Medium Access Control (MAC) Sublayer and Physical Layer Specifications*.
- ANSI/IEEE Std 802.12: [ISO/IEC 8802-12] *Demand Priority Access Method, Physical Layer and Repeater Specification*.
- IEEE Std 802.15: *Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for: Wireless Personal Area Networks*.

- IEEE Std 802.16: *Standard Air Interface for Fixed Broadband Wireless Access Systems.*
- IEEE Std 802.17: *Resilient Packet Ring Access Method and Physical Layer Specifications.*

In addition to the family of standards, the following is a recommended practice for a common physical layer technology:

- IEEE Std 802.7: *IEEE Recommended Practice for Broadband Local Area Networks.*

The reader of this standard is urged to become familiar with the complete family of standards.

### **Conformance test methodology**

An additional standards series, identified by the number 1802, has been established to identify the conformance test methodology documents for the IEEE 802 family of standards. Thus the conformance test documents for IEEE 802.3 are numbered IEEE 1802.3, the conformance test documents for IEEE 802.5 will be IEEE 1802.5, and so on. Similarly, ISO will use IEEE 18802 to number conformance test standards for IEEE 8802 standards.

### **Participants**

At the time this amendment to the standard was submitted to Sponsor Ballot, the working group had the following membership:

**Stuart J. Kerry**, *Chair*  
**Al Petrick** and **Harry Worstell**, *Vice-Chairs*  
**Tim Godfrey**, *Secretary*

**Bob O'Hara**, *Chair Task Group d*  
**Bob O'Hara**, *Technical Editor, 802.11d*

**John Fakatselis**, *Chair Task Group e*  
**Michael Fischer**, *Technical Editor, 802.11e*

**Dave Bagby**, *Chair Task Group f*  
**Bob O'Hara**, *Technical Editor, 802.11f*

**Matthew Shoemake**, *Chair Task Group g*

James Allen  
Matthew Alspaugh  
Keith Amann  
Keith B. Amundsen  
Carl F. Andren  
Jay Bain  
Kevin M. Barry  
Jan Boer  
Ronald Brockmann  
Colum Caldwell  
Naftali Chayat  
W. C. Chen  
Sunghyun Choi  
Ken Clements  
Wm. Caldwell Crosswy  
Wim Diepstraten  
Peter Ecclesine  
Richard Eckard  
Greg Ennis  
Amar Ghori  
Ian Gifford  
Steven D. Gray  
Evan Green  
Rajugopal Gubbi  
David Halasz  
Christopher J. Hansen  
Kei Hara  
Victor Hayes  
Allen Heberling  
Chris Heegard  
Robert Heile

Juha Heiskala  
Jin-Meng Ho  
Maarten Hoeben  
Frank P. Howley, Jr.  
Robert Y. Huang  
Masataka Iizuka  
Masayuki Ikeda  
Donald C. Johnson  
Tal Kaitz  
Kevin Karcz  
Mika Kasslin  
Jamshid Khun-Jush  
Ryoji Kido  
Ken Kimura  
Etsuzo Kimura  
Duncan Kitchin  
John M. Kowalski  
Bruce P. Kraemer  
Denis Kuwahara  
Jerry Loraine  
André Martin  
Bill McFarland  
Daniel R. McGlynn  
Michael D. McInnis  
Reiner Mim  
Masahiro Morikura  
Peter Murray  
Ravi P. Nalamati  
Erwin R. Noble  
Tomoki Ohsawa  
Kazuhiro Okanoue

Richard H. Paine  
Gregory Parks  
Victoria M. Poncini  
Anand R. Prasad  
Ivan Reede  
Stanley A. Reible  
Carlos A. Rios  
Gunnar Rydnell  
Anil K. Sanwalka  
Sid Schrum  
Thomas Siep  
David Skellern  
Donald I. Sloan  
Gary Spiess  
Hitoshi Takanashi  
Carl Temme  
Steve M. Thatcher  
Satoru Toguchi  
Mike Trompower  
Chih C. Tsien  
Tom Tsoulogiannis  
Jesse R. Walker  
Robert M. Ward Jr.  
Menzo Wentink  
Steven D. Williams  
Alan Winskowski  
Hidehiro Yamashita  
Wen-Ping Ying  
Albert Young  
Chris Zegelin  
Jim Zyren

Major contributions were received from the following individuals:

Ken Clements  
Darwin A. Engwer  
Chris Zegelin  
Johnny Zweig  
Arnoud Zwemmer

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

|                    |                     |                         |
|--------------------|---------------------|-------------------------|
| Carl F. Andren     | Julio Gonzalez-Sanz | Paul Nikolich           |
| Jack S. Andresen   | Chris G. Guy        | Erwin R. Noble          |
| Kevin M. Barry     | Simon Harrison      | Bob O'Hara              |
| Jan Boer           | Victor Hayes        | Roger Pandanda          |
| James T. Carlo     | Bob J. Hughes       | Vikram Punj             |
| Keith Chow         | James Ivers         | Gary S. Robinson        |
| Guru Dutt Dhingra  | Raj Jain            | James W. Romlein        |
| Muhammad Dhodhi    | Jacob W. Joergensen | Doug Rosener            |
| Thomas J. Dineen   | A. Kamerman         | Robert Russell          |
| Mary A. DuVal      | Stuart J. Kerry     | Chaim Shenhav           |
| Edward A. Dunlop   | Randolph S. Little  | Jerry A. Thrasher       |
| Sourav K. Dutta    | Gregory Luri        | Polychronis D. Tzerefos |
| Peter Ecclesine    | James S. Marin      | Mark-Rene Uchida        |
| Darwin A. Engwer   | Peter Martini       | Scott A. Valcourt       |
| John W. Fendrich   | Mobolaji Martins    | John Viaplana           |
| Michael A. Fischer | Richard McBride     | Paul A. Willis          |
| Gautam Garai       | Bennett Meyer       | Forrest D. Wright       |
| Patrick S. Gonia   | Robert Mortonson    | Oren Yuen               |
|                    | Wayne D. Moyers     |                         |

When the IEEE-SA Standards Board approved this standard on 14 June 2001, it had the following membership:

**Donald N. Heirman**, *Chair*

**James T. Carlo**, *Vice Chair*

**Judith Gorman**, *Secretary*

|                   |                       |                      |
|-------------------|-----------------------|----------------------|
| Chuck Adams       | James H. Gurney       | Paul J. Menchini     |
| Mark D. Bowman    | Raymond Hapeman       | Daleep C. Mohla      |
| Clyde R. Camp     | Richard J. Holleman   | Robert F. Munzner    |
| Richard DeBlasio  | Richard H. Hulett     | Ronald C. Petersen   |
| Harold E. Epstein | Lowell G. Johnson     | Malcolm V. Thaden    |
| H. Landis Floyd   | Joseph L. Koepfinger* | Geoffrey O. Thompson |
| Jay Forster*      | Peter H. Lips         | Akio Tojo            |
| Howard M. Frazier |                       | Howard L. Wolfman    |

\*Member Emeritus

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

Satish K. Aggarwal, *NRC Representative*

Alan H. Cookson, *NIST Representative*

Donald R. Volzka, *TAB Representative*

Jennifer McClain Longman  
IEEE Standards Project Editor

The marks “IEEE” and “802” are registered trademarks belonging to the IEEE. When using these marks to refer to The Institute of Electrical and Electronics Engineers, 802 standards or other standards, the marks should be in bold typeface and, at least once in text, use the registered trademark symbol “®”.

## Contents

|     |  |    |
|-----|--|----|
| 2.  | Normative references .....   | 1  |
| 4.  | Abbreviations and acronyms .....   | 1  |
| 7.  | Frame formats .....  | 2  |
| 9.  | MAC sublayer functional description .....  | 7  |
| 11. | MAC sublayer management entity .....   | 11 |
| 14. | Frequency-Hopping spread spectrum (FHSS) PHY specification for the 2.4 GHz Industrial, Scientific, and Medical (ISM) band..... | 11 |
|     | Annex A (normative) Protocol Implementation Conformance Statement (PICS) proforma .....  | 12 |
|     | Annex C (normative) Formal description of MAC operation .....  | 14 |
|     | Annex D (normative) ASN.1 encoding of the MAC and PHY MIB.....   | 18 |
|     | Annex E (informative) Bibliography .....   | 26 |



# IEEE Standard for Information technology—

## Telecommunications and information exchange between systems—

### Local and metropolitan area networks—

#### Specific requirements

## Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

### Amendment 3: Specification for operation in additional regulatory domains

[This amendment is based on the current edition of IEEE Std 802.11, 1999 Edition and the IEEE Std 802.11a-1999 and IEEE Std 802.11b-1999 amendments.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard to form the new comprehensive standard as created by the addition of IEEE Std 802.11-1999.

The editing instructions are shown in *bold italic*. Three editing instructions are used: change, delete, and insert. *Change* is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed either by using strikethrough (to remove old material) or underscore (to add new material). *Delete* removes existing material. *Insert* adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. Editorial notes will not be carried over into future editions.

## 2. Normative references

*Insert the following text into Clause 2 as follows:*

ISO/IEC 3166-1:1997, Codes for the representation of names of countries and their subdivisions—Part 1: Country codes.

## 4. Abbreviations and acronyms

*Insert the following text in the appropriate location in Clause 4 in alphabetical order:*

EHCC Extended hyperbolic congruence codes

HCC Hyperbolic congruence codes

## 7. Frame formats

### 7.2.3.1 Beacon frame format

*Insert the following text at the end of the first paragraph of 7.2.3.1:*

If the dot11MultiDomainCapabilityEnabled attribute is true, a STA shall include a Country Information element in the transmission of Beacon frames. Optionally, the Beacon frame format may also include the information described in either or both of orders 12 and 13. If the information in both orders 12 and 13 are sent, they shall describe the same hopping pattern. Note that the information described in orders 12 and 13 also may be contained in the Probe Response frame.

*Insert the following rows at the end of Table 5:*

**Table 5—Beacon frame body**

| Order | Information         | Notes  |
|-------|---------------------|--|
| 11    | Country Information | The Country Information element shall be present when dot11MultiDomainCapabilityEnabled is true                    |
| 12    | FH Parameters       | FH Parameters as specified in 7.3.2.13 may be included if dot11MultiDomainCapabilityEnabled is true                |
| 13    | FH Pattern Table    | FH Pattern Table information as specified in 7.3.2.14 may be included if dot11MultiDomainCapabilityEnabled is true |

### 7.2.3.8 Probe Request frame format

*Insert the following text at the end of the first paragraph of 7.2.3.8:*

If the dot11MultiDomainCapabilityEnabled attribute is true, a STA may include a Request Information Element in the Probe Request frame. The format of the Request Information Element is specified in 7.3.2.15.

*Insert order 3 with information field “Request information” in Table 11 as shown below:*

**Table 11—Probe Request frame body**

| Order | Information         | Notes  |
|-------|---------------------|--|
| 3     | Request information | May be included if dot11MultiDomainCapabilityEnabled is true |

**7.2.3.9 Probe Response frame format**

*Insert the following text at the end of the first paragraph of 7.2.3.9:*

If the dot11MultiDomainCapabilityEnabled attribute is true, the Probe Response frame contains a Country information element and all information elements identified by the Requested Element IDs of a Request Information Element. Note that the information returned as a result of a Probe Request frame with a Request Information Element may include the FH parameters and/or the FH Pattern Table possibly replicating optional elements identified by orders 12 and 13.

A STA shall return only those information elements that it supports. In an improperly formed Request Information Element, a STA may ignore the first information element requested that is not ordered properly and all subsequent information elements requested. In the probe response frame, the STA shall return the requested information elements in the same order as requested in the Request Information Element.

*Insert orders 10, 11, 12, and 13 with information fields in Table 12 as shown below.*

**Table 12—Probe response frame body**

| Order | Information                    | Notes  |
|-------|--------------------------------|--|
| 10    | Country information            | Included if dot11MultiDomainCapabilityEnabled is true  |
| 11    | FH Parameters                  | FH parameters, as specified in 7.3.2.13, may be included if dot11MultiDomainCapabilityEnabled is true                |
| 12    | FH Pattern Table               | FH Pattern Table information, as specified in 7.3.2.14, may be included if dot11MultiDomainCapabilityEnabled is true |
| 13-n  | Requested information elements | Elements requested by the Request information element of the Probe Request frame.                                    |

**7.3.2 Information elements**

*Insert the following information in Table 20 of 7.3.2 to identify new Element IDs in place of the Reserved place for IDs 7–15:*

**Table 20—Element IDs**

| Information Element        | Element ID |
|----------------------------|------------|
| Country                    | 7          |
| Hopping Pattern Parameters | 8          |
| Hopping Pattern Table      | 9          |
| Request                    | 10         |
| Reserved                   | 11-15      |

*Insert the following subclauses, beginning with 7.3.2.12. Renumber figures, tables, and equations, as appropriate.*

### 7.3.2.12 Country Information Element

The Country Information Element contains the information required to allow a station to identify the regulatory domain in which the station is located and to configure its PHY for operation in that regulatory domain. The format of this Information Element shall be as shown in Figure 42A.

NOTE—The following text may not be necessary due to its presence in the current standard. In figures, all bits within fields are numbered, from 0 to k, where the length of the field is k + 1 bits. The octet boundaries within a field can be obtained by taking the bit-numbers of the field modulo 8. Octets within numeric fields that are longer than a single octet are depicted in increasing order of significance, from lowest numbered bit to highest numbered bit. The octets in fields longer than a single octet are sent to the PLCP in order from the octet containing the lowest numbered bits to the octet containing the highest numbered bits.

| Element ID                   | Length                       |
|------------------------------|------------------------------|
| Country String (Octets 1, 2) |                              |
| Country String (Octet 3)     | First Channel Number         |
| Number of Channels           | Maximum Transmit Power Level |
| •<br>•<br>•                  |                              |
| First Channel Number         | Number of Channels           |
| Maximum Transmit Power Level | Pad (if needed)              |

**Figure 42A—Country information element**

The element identifier for this information element shall be 7. The length of the information element is variable, as the element may contain more than one triplet comprising the First Channel Number, Number of Channels, and Maximum Transmit Power Level fields. The minimum length of the information element is 8 octets.

The Country String field of the element shall be 3 octets in length. The AP shall set this field to the value contained in the dot11CountryString attribute before transmission in a Beacon or Probe Response frame. Upon reception of this element, a STA shall set the value of the dot11CountryString to the value contained in this field.

The First Channel Number field shall be 1 octet in length. It shall contain a positive integer value that indicates the lowest channel number in the subband described in this information element. The group of channels described by each pair of the First Channel Number and Number of Channels fields shall not overlap and shall be monotonically increasing in channel numbers.

The Number of Channels field of the subelement shall be 1 octet in length.

The Maximum Transmit Power Level field is a signed number and shall be 1 octet in length. It shall indicate the maximum power, in dBm, allowed to be transmitted.

The Pad field is 0 or 1 octet in length. The length of the Country information element shall be evenly divisible by 2. The Pad shall be used to add a single octet to the element if the length is not evenly divisible by 2. The value of the Pad field shall be 0.

### 7.3.2.13 Hopping Pattern Parameters Information Element

The Hopping Pattern Parameters information element contains the information necessary to allow a station to calculate the code family using the HCC and EHCC algorithms. See 9.9.2.1 for a description of the HCC and EHCC algorithms. The format of this information element shall be as shown in Figure 42B.

|             |                    |
|-------------|--------------------|
| Element ID  | Length             |
| Prime Radix | Number of Channels |

**Figure 42B—Hopping Pattern Parameters information element**

The Element ID of this information element shall be 8. The length of this element is 4 octets.

The Prime Radix field of this element shall indicate the value to be used as the prime radix ( $N$ ) in the HCC and EHCC algorithms. The value of this field shall be a positive integer. The size of this field is 1 octet.

The Number of Channels field of this element shall indicate the value to be used as the maximum for the family index ( $a$ ) in the HCC and EHCC algorithms. The value of this field shall be a positive integer and shall not be less than the prime radix minus 3 ( $N-3$ ). The size of this field is 1 octet.

### 7.3.2.14 Hopping Pattern Table Information Element

The Hopping Pattern information element contains the information necessary for a frequency hopping implementation to be able to create the hopping sequences necessary to operate in the regulatory domain in which the information element was received. The format of the information element shall be as shown in Figure 42C.

|                                    |                |
|------------------------------------|----------------|
| Element ID                         | Length         |
| Flag                               | Number of Sets |
| Modulus                            | Offset         |
| Random Table (Octets 1, 2)         |                |
| ⋮                                  |                |
| Random Table (Octets $N-1$ , $N$ ) |                |

**Figure 42C—Hopping Pattern Table information element**

The Element ID of this information element shall be 9. The information element is variable in length. The length of the information element is indicated by the Length field.

The Flag field indicates that a Random Table is present when the value is 1. When the flag value is 0, it indicates that a Random Table is not present and that the hop index method is to be used to determine the hopping sequence. The size of this field is 1 octet.

The Number of Sets field indicates the total number of sets within the hopping patterns. The size of this field is 1 octet.

The Modulus and Offset fields indicate the values to be used in the equations to create a hopping sequence from the Random Table information. The size of these fields are each 1 octet.

The Random Table field is a variable length field. It is a vector of single octet values that indicate the random sequence to be followed during a hopping sequence. The size of the Random Table field is found by subtracting 4 from the value of the Length field of this element.

Two equations are used to create a hopping sequence from the information in the Frequency Hopping information element and the Hopping Pattern Table information element. Equation (1), the Random Table Method, shall be used when the value of the Flag field of the Hopping Pattern Table information element is 1. Equation (2), the Hop Index Method, shall be used when the value of the Flag field of the Hopping Pattern Table information element is 0.

$$f_x(i) = [b(i) + x] \bmod(m) + q \quad (1)$$

$$f_x(i) = [(i - 1) \times x] \bmod(m) + q \quad (2)$$

$$x = n \times p + s - 1 \quad (3)$$

where

*i* is the index.

*m* is the modulus.

*q* is the offset.

*n* is the number of sets.

*p* is the current pattern.

*s* is the current set number.

The values of *i*, *p*, and *s* are found in the Frequency Hopping information element. The values of *m*, *n*, and *q* are found in the Hopping Pattern Table information element.

### 7.3.2.15 Request Information Element

This element is placed in a Probe Request frame to request that the responding STA include the requested information in the Probe Response frame. The format of the information element shall be as shown in Figure 42D.

The Element ID of this information element shall be 10. The information element is variable in length. The length of the information element is indicated in the Length field.

The Requested Element IDs are the list of elements that are to be included in the responding STA's Probe Response frame. The Requested Element IDs shall be listed in order of increasing element ID.

A STA shall return only those information elements that it supports. In an improperly formed Request Information Element, a STA may ignore the first information element requested that is not ordered properly and all subsequent information elements requested. In the probe response frame, the STA shall return the

requested information elements in the same order requested in the Request Information Element of the probe request frame.

| Element ID               | Length                 |
|--------------------------|------------------------|
| Requested Element ID 1   | Requested Element ID 2 |
| ⋮                        | ⋮                      |
| Requested Element ID N-1 | Requested Element ID N |

**Figure 42D—Request information element**

## 9. MAC sublayer functional description

*Insert 9.9 as follows, and renumber figures, tables, and equations, as appropriate:*

### 9.9 Operation across regulatory domains

The PHY layer of a WLAN is subject to regulations that can vary significantly from one geopolitical area to another. It is desirable that a mechanism exists that allows a conforming implementation to be built that is able to meet many different sets of regulations. The purpose of this clause is to allow conforming equipment to be able to operate in more than one regulatory domain over time. This clause describes the mechanism required to implement a capability in IEEE Std 802.11 stations that supports cross-domain mobility and operation in multiple regulatory domains, when the dot11MultiDomainCapabilityEnabled attribute is true.

NOTE—This clause does not eliminate the need to obtain type acceptance, regulatory approval, equipment authorization, or equipment certification in each of the regulatory domains in which the equipment will operate. The mechanisms described in this clause provide the information to the station to identify the regulatory domain in which it is located and to cease operation while in those domains for which it does not have type approval. It is incumbent upon the implementer to provide proof of compliance to the requirements of individual regulatory agencies.

This clause provides the framework for operation across regulatory domains. However, the method for configuring individual stations is outside the scope of this standard. A station must be properly configured for operation in a particular regulatory domain prior to beginning normal operation. Particular care must be taken when operating in an IBSS configuration.

#### 9.9.1 Operation upon entering a regulatory domain

A STA that is enabled for operation across regulatory domains shall default to passive scanning when it has lost connectivity with its ESS. Passive scanning is performed using only the receive capabilities of the station and is, thus, compatible with regulatory requirements. The timeout for determining the loss of connectivity is system dependent and beyond the scope of this standard.

When a STA enters a regulatory domain, it shall passively scan to learn at least one valid channel, i.e., a channel upon which it detects IEEE Std 802.11 frames. The Beacon frame contains information on the country code, the maximum allowable transmit power, and the channels to be used for the regulatory domain. Optionally, the Beacon frame may also include, on a periodic basis, the regulatory information that would be returned in a Probe Response frame. Once the STA has acquired the information so that it is able

to meet the transmit requirements of the regulatory domain, it shall transmit a Probe Request to an AP to gain the additional regulatory domain information contained in the Probe Response frame, unless the information was previously received in a Beacon frame. The STA then has sufficient information available to configure its PHY for operation in the regulatory domain.

## 9.9.2 Support for frequency hopping PHYs

### 9.9.2.1 Determination of hopping patterns

When operating in a regulatory domain that does not have a method for determining a hopping pattern described in 14.6.8 or a hopping table in Annex B, hopping patterns shall be determined by an AP using hyperbolic congruence codes (HCC) or extended HCCs (EHCC). The HCC hopping sequences are derived from a simple formula that uses field operations on a group. For full details of the HCC placement operator function, please see the references. The placement operator function shall be as shown in Equation (4).

$$y_{HCC}(k;a) = \frac{a}{k} \bmod N \quad \text{for } k, a \in J'_N \quad (4)$$

where

$N$  is the prime radix.  
 $a$  is the family index.  
 $k$  is in the group  $J'_N$ .

$J'_N$  is the group remaining when the element containing the value zero is removed from the field  $J_N$ .

Therefore,  $k$  does not take the value 0. The value  $1/k$  is the multiplicative inverse of  $k$  on the field  $J_N$ . The multiplicative inverse of  $k$  on the group  $J_N$  is the integer value  $w$ , such that  $(k \times w) \bmod N = 1$ . The values computed for  $y_{HCC}$  are the channel numbers,  $a$  corresponds to the hopping pattern number, and  $k$  corresponds to the index into the hopping pattern. A code family is the set of  $N-1$  hopping patterns generated for the prime radix  $N$ . There is no value equivalent to the hopping set of Clause 14. Each hopping pattern comprises  $N-1$  channels.

As an example, consider a code family that supports 10 channels. The prime radix for such a family is 11. The code family generated by the HCC algorithm is shown below in Table 22A.

The HCC method to calculate hopping sequences only generates sequences of a length that is one less than the prime radix. The EHCC algorithm extends the original HCC algorithm to support a larger number of possible hopping sequence lengths. The EHCC algorithm works through a process known as “deletion of the diagonals.” This creates hopping patterns with  $N-2$  and  $N-3$  channels.

Using the same example in Table 22A, a family of codes cannot be generated for code lengths of 9 or 8 by the HCC algorithm, since neither 9 or 8 is equal to a prime number minus one. However, the diagonals of the array in Table 22A represent the end points of the group. Thus, code families for code lengths 9 and 8 can be easily generated from the table simply by removing the diagonals. Table 22B shows such a code family with a code length of 9 (constructed by removing the diagonal of 10's).



**Table 22A—HCC code family –  $N = 11$ ; Family indices (SEQ) 1 through 10**

| INDEX (k) ----> |    |    |    |    |    |    |    |    |    |    |
|-----------------|----|----|----|----|----|----|----|----|----|----|
|                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| SEQ-----        |    |    |    |    |    |    |    |    |    |    |
| 1               | 1  | 6  | 4  | 3  | 9  | 2  | 8  | 7  | 5  | 10 |
| 2               | 2  | 1  | 8  | 6  | 7  | 4  | 5  | 3  | 10 | 9  |
| 3               | 3  | 7  | 1  | 9  | 5  | 6  | 2  | 10 | 4  | 8  |
| 4               | 4  | 2  | 5  | 1  | 3  | 8  | 10 | 6  | 9  | 7  |
| 5               | 5  | 8  | 9  | 4  | 1  | 10 | 7  | 2  | 3  | 6  |
| 6               | 6  | 3  | 2  | 7  | 10 | 1  | 4  | 9  | 8  | 5  |
| 7               | 7  | 9  | 6  | 10 | 8  | 3  | 1  | 5  | 2  | 4  |
| 8               | 8  | 4  | 10 | 2  | 6  | 5  | 9  | 1  | 7  | 3  |
| 9               | 9  | 10 | 3  | 5  | 4  | 7  | 6  | 8  | 1  | 2  |
| 10              | 10 | 5  | 7  | 8  | 2  | 9  | 3  | 4  | 6  | 1  |

**Table 22B—EHCC code family – Code length = 9,  $N = 11$ ; Family Indices (SEQ) 1 through 9**

| INDEX (k) ----> |   |   |   |   |   |   |   |   |   |
|-----------------|---|---|---|---|---|---|---|---|---|
|                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| SEQ-----        |   |   |   |   |   |   |   |   |   |
| 1               | 1 | 6 | 4 | 3 | 9 | 2 | 8 | 7 | 5 |
| 2               | 2 | 1 | 8 | 6 | 7 | 4 | 5 | 3 | 9 |
| 3               | 3 | 7 | 1 | 9 | 5 | 6 | 2 | 4 | 8 |
| 4               | 4 | 2 | 5 | 1 | 3 | 8 | 6 | 9 | 7 |
| 5               | 5 | 8 | 9 | 4 | 1 | 7 | 2 | 3 | 6 |
| 6               | 6 | 3 | 2 | 7 | 1 | 4 | 9 | 8 | 5 |
| 7               | 7 | 9 | 6 | 8 | 3 | 1 | 5 | 2 | 4 |
| 8               | 8 | 4 | 2 | 6 | 5 | 9 | 1 | 7 | 3 |
| 9               | 9 | 3 | 5 | 4 | 7 | 6 | 8 | 1 | 2 |

Table 22B now contains a near diagonal (upper left to lower right) consisting entirely of 1's. This is a necessary mathematical property of the result of removing the initial diagonal of (p-1) in the previous operation, and will be exhibited for any prime p.

Extending the process, Table 22C shows a code family with a code length of 8 (constructed from Table 22B by removing the entry from each row that has a value of 1, subtracting 1 from each value remaining in the row, and discarding the last row).

**Table 22C—EHCC code family – Code length = 8, N = 11; Family indices (SEQ) 1 through 8**

|       |       |       |   |   |   |   |   |   |   |  |
|-------|-------|-------|---|---|---|---|---|---|---|--|
| INDEX | (k)   | ----> |   |   |   |   |   |   |   |  |
|       | 1     | 2     | 3 | 4 | 5 | 6 | 7 | 8 |   |  |
| SEQ   | ----- |       |   |   |   |   |   |   |   |  |
| 1     |       | 5     | 3 | 2 | 8 | 1 | 7 | 6 | 4 |  |
| 2     |       | 1     | 7 | 5 | 6 | 3 | 4 | 2 | 8 |  |
| 3     |       | 2     | 6 | 8 | 4 | 5 | 1 | 3 | 7 |  |
| 4     |       | 3     | 1 | 4 | 2 | 7 | 5 | 8 | 6 |  |
| 5     |       | 4     | 7 | 8 | 3 | 6 | 1 | 2 | 5 |  |
| 6     |       | 5     | 2 | 1 | 6 | 3 | 8 | 7 | 4 |  |
| 7     |       | 6     | 8 | 5 | 7 | 2 | 4 | 1 | 3 |  |
| 8     |       | 7     | 3 | 1 | 5 | 4 | 8 | 6 | 2 |  |

To obtain a code family of length  $N-2$ , the code family of length  $N-1$  calculated by the HCC algorithm shall be modified by deleting the diagonal of the code family with the value of  $N-1$  and removing the row of the code family with the family coefficient of  $N-1$ . This results in a code family represented in a square  $(N-2)$  by  $(N-2)$  array.

To obtain a code family of length  $N-3$ , the code family of length  $N-1$  calculated by the HCC algorithm shall be modified by deleting the diagonals of the code family with the values of 1 and  $N-1$ , removing the rows of the code family with the family coefficients of  $N-1$  and  $N-2$ , and subtracting 1 from all remaining values in the code family array. This results in a code family represented in a square  $(N-3)$  by  $(N-3)$  array with array values of 1 through  $N-3$ .

When using hopping patterns calculated using the HCC or EHCC algorithms, the values in the FH parameter set element shall be set as follows:

- a) The Hop Set field shall be 0; the value of 0 for the Hop Set field indicates that the HCC/EHCC algorithm is in use and that the Hop Pattern field contains the HCC/EHCC family index and the Hop Index field contains the HCC/EHCC index.
- b) The family index of the code being used shall be placed in the Hop Pattern field.
- c) The index shall be placed in the Hop Index field.

## 11. MAC sublayer management entity

### 11.1.3.3 Initializing a BSS

*Insert the following text at the end of the first paragraph of 11.1.3.3:*

If the dot11MultiDomainCapabilityEnabled attribute is true, a STA shall not start a BSS, neither an infrastructure BSS nor an IBSS, unless a properly formed Beacon frame including a Country information element can be constructed, and the dot11CountryString attribute has been set.

### 11.1.3.4 Synchronizing with a BSS

*Insert the following text at the end of the first paragraph of 11.1.3.4:*

If the dot11MultiDomainCapabilityEnabled attribute is true, a STA receiving a Beacon or Probe Response frame containing a Country information element shall adopt the parameters included in that element when joining a BSS. If a Hopping Pattern Parameters element is present in the Beacon or Probe Response frame, and if the dot11MultiDomainCapabilityEnabled attribute is true, a STA shall adopt the pattern parameters in the element and calculate the hopping patterns using one of the algorithms defined in 7.3.2.13 or 7.3.2.14. Using the appropriate pattern, set, and index values from the FH Parameter Set element, the STA shall adopt the values in use by the BSS when joining. The dot11RegDomainsSupportedEntry shall be set to Other when the STA is operating using country code settings.

## 14. Frequency-Hopping spread spectrum (FHSS) PHY specification for the 2.4 GHz Industrial, Scientific, and Medical (ISM) band

### 14.8.2 FH PHY attributes

*Insert a new default value for dot11RegDomainsSupported in Table 49 of 14.8.2 as follows:*

Other=X'00'

#### 14.8.2.1 FH PHY attribute definitions

##### 14.8.2.1.20 dot11CurrentSet

*Insert the following text at the end of the first paragraph of 14.8.2.1.20:*

When dot11MultiDomainOperationImplemented is true, this value may also be 0. A value of 0 indicates that the hopping pattern is to be obtained from the Hopping Pattern Table information element most recently received in a beacon or Probe Response frame.

## Annex A

(normative)

### Protocol Implementation Conformance Statement (PICS) proforma

#### A.4 PICS proforma—ISO/IEC 8802-11:1997

##### A.4.3 IUT Configuration

*Insert the following row at the bottom of the table:*

|      |  |                                   |     |  |
|------|--|-----------------------------------|-----|--|
| *CF8 | Is multidomain operation capability implemented? | 7.3.2.13, 7.3.2.14, 9.9, 11.1.3.4 | O.3 | Yes <input type="checkbox"/> No <input type="checkbox"/> |
|------|--|-----------------------------------|-----|--|

*Insert the following table as subclause A.4.10:*

##### A.4.10 Regulatory Domain Extensions

| Item | Protocol Capability  | References                      | Status | Support   |
|------|--|---------------------------------|--------|---|
| MD1  | Country Information Element<br>dot11MultiDomainCapability<br>Enabled attribute<br><br>dot11MultiDomainCapability<br>Enabled<br><br>Length<br><br>CountryString<br>FieldChannel Number<br>First Channel Number<br><br>Maximum Transmit Power<br>Level<br><br>Number of Channels | 7.2.3.1,<br>7.2.3.9<br>7.3.2.12 | CF8:M  | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD2  | Inclusion of the Request<br>information in the Probe<br>Request frame  | 7.2.3.8                         | CF8:O  | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |

|      |  |                             |                                    |   |
|------|--|-----------------------------|------------------------------------|---|
| MD3  | Hopping Pattern Parameters<br><br>Element ID<br>Prime Radix<br>Number of Channels  | 7.3.2.13                    | (CF3 or (CF7 and HRDS2)) and CF8:M | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD4  | Hopping Pattern Information Element<br><br>Format<br>Element ID<br>Random table method   | 7.3.2.14                    | (CF3 or (CF7 and HRDS2)) and CF8:M | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD5  | Request Information Element<br><br>Format<br>Element ID<br>Order of the Requested Elemented IDs  | 7.3.2.15                    | CF8:M                              | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD5  | Entering a Regulatory Domain<br>Lost Connectivity with its ESS<br>Passive Scanning to learn Beacon information<br>Transmit Probe Request | 9.9.1                       | CF8:M                              | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD6  | Determination of the Hopping Patterns<br>(Hop Index Method without table, Hop Index Method with table, and HCC/EHCC)                     | 7.3.2.14, 9.9.2.1,          | (CF3 or (CF7 and HRDS2)) and CF8:M | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD7  | Roaming requires Beacon frame with country information element   | 11.1.3.3                    | CF8:M                              | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD8  | Actions to be taken upon the receipt of the beacon   | 11.1.3.4                    | CF8:M                              | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD9  | Ignore improperly formed Request Information Element   | 7.2.3.9                     | CF8:O                              | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |
| MD10 | Hopping Pattern set attribute.   | Paragraph after 14.8.2.1.20 | (CF3 or (CF7 and HRDS2)) and CF8:M | Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> |

## Annex C

(normative)

### Formal description of MAC operation

#### C.2 Data type and operator definitions for the MAC state machines

*Make the following changes to the MAC state machines data types in C.2:*

*Replace the text in Package macmib, under StationConfig Table with the following:*

```
remote dot11MediumOccupancyLimit TU nodelay;  
synonym dot11CfPollable Boolean = <<package macsorts>> sCFPollable;  
remote dot11CfpPeriod Integer nodelay;  
remote dot11CfpMaxDuration Integer nodelay;  
remote dot11AuthenticationResponseTimeOut Integer nodelay;  
synonym dot11PrivacyOptionImplemented Boolean = true;  
remote dot11PowerManagementMode PsMode = sta_active;  
remote dot11DesiredSSID Octetstring nodelay;  
remote dot11DesiredBSSType BssType nodelay;  
remote dot11OperationalRateSet Octetstring nodelay;  
remote dot11BeaconPeriod TU nodelay;  
remote dot11DtimPeriod Integer nodelay;  
remote dot11AssociationResponseTimeOut TU nodelay;  
remote dot11DisassociateReason ReasonCode nodelay;  
remote dot11DisassociateStation MacAddr nodelay;  
remote dot11DeauthenticateReason ReasonCode nodelay;  
remote dot11DeauthenticateStation MacAddr nodelay;  
remote dot11AuthenticateFailStatus StatusCode nodelay;  
remote dot11AuthenticateFailStation MacAddr nodelay;  
synonym dot11MultiDomainOperationImplemented Boolean = true;
```

*{The previous text adds MultiDomainOperationImplemented as well as several MIB changes that appear in Annex D but were omitted from C.2 in IEEE Std 802.11-1999.}*

*Insert the following text in Package macsorts, definition of StatusCode sort, immediately after "unsup\_rate == mkOS(18, 2);" :*

```
no_short_preamble == mkOS(19, 2);  
no_Pbcc == mkOS(20, 2);  
no_agility == mkOS(21, 2);
```

*{The previous text adds new status codes that appear in the Clause 7 updates of IEEE Std 802.11b-1999 but were omitted from the C.2 updates.}*

*Insert the following text in Package macsorts, definition of Capability field bit assignment sort, just above “endnewtype Capability”:*

```
cShortPreamble == S8(0,0,0,0,0,1,0,0) // 0x00; /* Short Preamble 802.11b */
cPBCC == S8(0,0,0,0,0,0,1,0) // 0x00; /* PBCC 802.11b */
cChannelAgility == S8(0,0,0,0,0,0,0,1) // 0x00; /* Channel Agility 802.11b */
cShortPreamble == S8(0,0,0,0,0,1,0,0) // 0x00; /* Short Preamble 802.11b */
```

*{The previous text adds new capability bits that appear in the Clause 7 updates of IEEE Std 802.11b-1999, but were omitted from the C.2 updates.}*

*Insert the following text in Package macsorts, definition of ElementID sort, just above “endnewtype ElementID”:*

```
eCountry == mkOS(7, 1); /* Country Information (8:254) */
eHopParm == mkOS(8, 1); /* FH Hopping Parameters (4) */
eHopTable == mkOS(9, 1); /* FH Hopping Table (6:254) */
eRequest == mkOS(10, 1); /* Request (3:254) */
```

*{The previous text adds new elements.}*

*Delete from Package macmib, definition of Privacy Table the text “remote dot11PrivacyInvoked Boolean nodelay;”*

*Insert to Package macmib, below “Operation Table” a text box containing the following:*

```
/******
* MultiDomainCapability Table
*****/
remote dot11MultiDomainCapabilityEnabled Boolean nodelay;
remote dot11CountryString Octetstring nodelay;
```

### C.3 State machines for MAC stations

*Make the following changes to the MAC station state machines in C.3:*

*Insert in the diagram sta\_Mm\_svc\_1.1a in the text symbol beginning “/\* Intra-MAC remote variables \*/” a line containing “dot11MultiDomainCapabilityEnabled Boolean:= false”; and update diagram name to “sta\_Mm\_svc1.1b”.*

*Insert in diagram sta\_Start\_Ibss\_3c, on the (independent) branch from the decision symbol “yBtyp”, before the decision symbol “ ‘parameters valid’ ” a new decision symbol containing “dot11MultiDomainOperationImplemented”. On the (true) branch from this new decision symbol, add a decision symbol containing “dot11MultiDomainCapabilityEnabled ‘and country information valid’ ” with a (false) branch that joins the (false) branch from the existing “ ‘parameters valid’ ” decision symbol and a (true) branch that connects to the top of the existing “ ‘parameters valid’ ” decision symbol. The (false) branch from the inserted decision symbol containing “dot11MultiDomainOperationImplemented” joins the existing transition flow at the top of the existing “ ‘parameters valid’ ” decision symbol. Update diagram name to “sta\_Start\_Ibss\_3d”.*

*{The previous text provides the changes for starting an IBSS from 11.1.3.3.}*

*Insert in diagram `sta_TSF_Ibss_5a`, in the transition beginning with input “`Tbcn`”, just above the output symbol “`Xport, Send(ytdu, imed)`” add a decision symbol containing “`dot11MultiDomainCapabilityEnabled`”. On the (true) branch from this new decision symbol, add a task symbol containing “ ‘add country information element’ ” which joins the (false) branch from this decision symbol to connect to the existing output symbol. Update the diagram name to “`sta_TSF_Ibss_5b`”.*

*{The previous text provides insertion of the country information element in IBSS beacons.}*

*Insert in diagram `sta_Scan_2d`, in the (active\_scan) branch of decision “`ystype`” a new decision symbol containing “`dot11MultiDomainCapabilityEnabled ‘and country information valid’`”. Connect the (true) branch from this new decision symbol to the task symbol at the start of the existing (active\_scan) branch. Connect the (false) branch of this new decision symbol to the (false) branch of the “ ‘parameters valid’ ” decision symbol earlier in the same transition. Update the diagram name to “`sta_Scan_2e`”.*

*{The previous text prevents active scanning in the absence of valid country information.}*

*Insert in diagram “`sta_Join_4c`” in the transition beginning with input “`Beacon...`”, just above the task symbol “ ‘adopt values from yrdu’ ” a new decision symbol containing “`dot11MultiDomainCapabilityEnabled`”. Connect the (false) branch of this new decision symbol to the existing task symbol. Connect the (true) branch of this new decision symbol to another new decision symbol containing “ ‘country information present in beacon’ ” with a (true) branch that connects to the existing task symbol and a (false) branch that connects to a new “`nextstate-`” symbol. Update the diagram name to “`sta_Join_4d`”.*

*{The previous text provides the changes for joining a BSS from 11.1.3.4.}*

## C.4 State machines for MAC access point

*Make the following changes to the MAC access point state machines in C.4:*

*Insert to diagram `ap_Mm_svc_1b` in the text symbol beginning “`/* Intra-MAC remote variables */`” a line containing “`dot11MultiDomainCapabilityEnabled Boolean:= false;`” and update diagram name to “`ap_Mm_svc_1c`”.*

*Insert in diagram `ap_Start_Bss_2b`, on the (independent) branch from the decision symbol “`yBtyp`”, before the decision symbol “ ‘parameters valid’ ” a new decision symbol containing “`dot11MultiDomainOperationImplemented`”. On the (true) branch from this new decision symbol, add a decision symbol containing “`dot11MultiDomainCapabilityEnabled ‘and country information valid’`” with a (false) branch that joins the (false) branch from the existing “ ‘parameters valid’ ” decision symbol and a (true) branch that connects to the top of the existing “ ‘parameters valid’ ” decision symbol. The (false) branch from the inserted decision symbol containing “`dot11MultiDomainOperationImplemented`” joins the existing transition flow at the top of the existing “ ‘parameters valid’ ” decision symbol. Update diagram name to “`ap_Start_Bss_2c`”.*

*The previous text provides the changes for starting a BSS from 11.1.3.3.}*



*Insert in diagram ap\_TSF\_bss\_3b, in the transition beginning with input “Tbcn”, just above the output symbol “Xport, Send(ytd, imed)” add a decision symbol containing “dot11MultiDomainCapabilityEnabled”. On the (true) branch from this new decision symbol, add a task symbol containing “add country information element” which joins the (false) branch from this decision symbol to connect to the existing output symbol.*

*In the transition beginning with input “ProbeReq(yRdu)”, just below the input symbol insert a task symbol containing “process request information element (if present) according to 7.3.2.14” and just above the output symbol “Send(ytd, norm)” add a decision symbol containing “dot11MultiDomainCapabilityEnabled”. On the (true) branch from this new decision symbol, add a task symbol containing “add country information element” which joins the (false) branch from this decision symbol to connect to the existing output symbol. Update diagram name to “ap\_TSF\_bss\_3c”.*

*{The previous text provides insertion of the country information element in BSS beacons and probe responses and the request information element in probe requests.}*

## Annex D

(normative)

### ASN.1 encoding of the MAC and PHY MIB

*In the “Module Identity” section of Annex D, make the following changes:*

```
ieee802dot11 MODULE-IDENTITY
  LAST-UPDATED "9807080103270000Z"
  ORGANIZATION "IEEE 802.11"
  CONTACT-INFO
    "WG E-mail: stds-802-11@ieee.org

    Chair: Vic HayesStuart J. Kerry
    Postal: Lucent TechnologiesPhilips Semiconductors, Inc.
           Zadelstede 1-101109 McKay Drive
           Nieuwegein, NetherlandsM/S 48 SJ
           3431 JZSan Jose, CA 95130-1706 USA
    Tel: +31 30 609 7528+1 408 474 7356
    Fax: +31 30 231 6233+1 408 474 7247
    E-mail: vichayes@lucent.comstuart.kerry@philips.com
```

*Insert a new description value in the dot11RegDomainsSupported Table:*

```
Other=X'00'
```

*In “Major Sections” of Annex D, insert the following text to the end of Station Management attributes:*

```
-- dot11MultiDomainCapabilityTable ::= {dot11smt 7}
```

*In “SMT Station Config Table” of Annex D, insert the following text to the end of dot11StationConfigEntry sequence list:*

```
dot11MultiDomainCapabilityImplemented TruthValue,
dot11MultiDomainCapabilityEnabled TruthValue,
dot11CountryString OCTET STRING
```

*In “Major Sections” of Annex D, insert the following text to the end of PHY Attributes:*

```
-- dot11EHCHoppingPatternTable ::= {dot11phy 13}
```

*Insert the following elements to the end of dot11StationConfigEntry element definitions behind dot11AuthenticateFailStation:*

```
dot11MultiDomainCapabilityImplemented OBJECT-TYPE
  SYNTAX TruthValue
  MAX-ACCESS read-write
  STATUS current

  DESCRIPTION
```

"This attribute, when TRUE, indicates that the station implementation is capable of supporting multiple regulatory domains. The capability is disabled, otherwise. The default value of this attribute is FALSE."

::= { dot11StationConfigEntry 21 }

dot11MultiDomainCapabilityEnabled OBJECT-TYPE

SYNTAX TruthValue  
 MAX-ACCESS read-write  
 STATUS current

DESCRIPTION

"This attribute, when TRUE, indicates that the capability of the station to operate in multiple regulatory domains is enabled. The capability is disabled, otherwise. The default value of this attribute is FALSE."

::= { dot11StationConfigEntry 22 }

dot11CountryString OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (3))  
 MAX-ACCESS read-only  
 STATUS current

DESCRIPTION

"This attribute identifies the country in which the station is operating. The first two octets of this string is the two character country code as described in document ISO/IEC 3166-1. The third octet shall be one of the following:

1. an ASCII space character, if the regulations under which the station is operating encompass all environments in the country,
2. an ASCII 'O' character, if the regulations under which the station is operating are for an Outdoor environment only, or
3. an ASCII 'I' character, if the regulations under which the station is operating are for an Indoor environment only."

::= { dot11StationConfigEntry 23 }

***Insert the following changes to the 802.11 MIB in Annex D, before the MAC Attribute Templates:***

```
-- *****
-- * dot11MultiDomainCapability TABLE
-- *****
```

dot11MultiDomainCapabilityTable OBJECT-TYPE

SYNTAX SEQUENCE OF Dot11MultiDomainCapabilityEntry  
 MAX-ACCESS not-accessible  
 STATUS current

DESCRIPTION

"This (conceptual) table of attributes for cross-domain mobility."

::= { dot11smt 7 }

```
dot11MultiDomainCapabilityEntry OBJECT-TYPE
    SYNTAX Dot11MultiDomainCapabilityEntry
    MAX-ACCESS not-accessible
    STATUS current

    DESCRIPTION
        "An entry (conceptual row) in the Multiple Domain Capability Table.

        IfIndex - Each 802.11 interface is represented by an ifEntry. Interface
        tables in this MIB are indexed by ifIndex."

    INDEX { ifIndex,
            dot11MultiDomainCapabilityIndex}

 ::= { dot11MultiDomainCapabilityTable 1}

Dot11MultiDomainCapabilityEntry ::=
    SEQUENCE {
        dot11MultiDomainCapabilityIndex          Integer32,
        dot11FirstChannelNumber                 Integer32,
        dot11NumberOfChannels                   Integer32,
        dot11MaximumTransmitPowerLevel         Integer32}

dot11MultiDomainCapabilityIndex OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS not-accessible
    STATUS current

    DESCRIPTION
        "The auxiliary variable used to identify instances of the columnar objects
        in the Multi Domain Capability Table."

 ::= { dot11MultiDomainCapabilityEntry 1}

dot11FirstChannelNumber OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute shall indicate the value of the lowest channel number in
        the subband for the associated domain country string. The default value of
        this attribute shall be zero."

 ::= { dot11MultiDomainCapabilityEntry 2}

dot11NumberOfChannels OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute shall indicate the value of the total number of channels
        allowed in the subband for the associated domain country string. The
        default value of this attribute shall be zero."

 ::= { dot11MultiDomainCapabilityEntry 3}
```

```
dot11MaximumTransmitPowerLevel OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute shall indicate the maximum transmit power, in dBm, allowed
        in the subband for the associated domain country string. The default value
        of this attribute shall be zero."

 ::= { dot11MultiDomainCapabilityEntry 4 }

-- *****
-- * End of dot11MultiDomainCapability TABLE
-- *****
```

***In “dot11PhyFHSS Table” of Annex D, insert the following text at the end of dot11PhyFHSSEntry sequence list:***

|                                      |             |
|--------------------------------------|-------------|
| dot11EHCCPrimeRadix                  | Integer32,  |
| dot11EHCCNumberOfChannelsFamilyIndex | Integer32,  |
| dot11EHCCCapabilityImplemented       | TruthValue, |
| dot11EHCCCapabilityEnabled           | TruthValue, |
| dot11HopAlgorithmAdopted             | INTEGER,    |
| dot11RandomTableFlag                 | TruthValue, |
| dot11NumberOfHoppingSets             | Integer32,  |
| dot11HopModulus                      | Integer32,  |
| dot11HopOffset                       | Integer32   |

***Insert the following elements at the end of dot11PhyFHSSEntry definitions behind dot11CurrentIndex:***

```
dot11EHCCPrimeRadix OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute indicates the value to be used as the prime radix (N) in
        the HCC and EHCC algorithms."

 ::= { dot11PhyFHSSEntry 8 }

dot11EHCCNumberOfChannelsFamilyIndex OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute indicates the value to be used as the maximum for the
        family index (a) in the HCC and EHCC algorithms. The value of this field
        shall not be less than the prime radix minus 3 (N - 3). The valid range of
        allowed values is (N - 1), (N - 2), and (N - 3)."
```

```
 ::= { dot11PhyFHSSEntry 9 }

dot11EHCCCapabilityImplemented OBJECT-TYPE
    SYNTAX TruthValue
```

MAX-ACCESS read-write  
STATUS current

DESCRIPTION

"This attribute, when TRUE, indicates that the station implementation is capable of generating the HCC or EHCC algorithms for determining Hopping patterns. The capability is disabled, otherwise. The default value of this attribute is FALSE."

::= { dot11PhyFHSSEntry 10 }

dot11EHCCCapabilityEnabled OBJECT-TYPE

SYNTAX TruthValue  
MAX-ACCESS read-write  
STATUS current

DESCRIPTION

"This attribute, when TRUE, indicates that the capability of the station to operate using the HCC or EHCC algorithms for determining Hopping Patterns is enabled. The capability is disabled, otherwise. The default value of this attribute is FALSE."

::= { dot11PhyFHSSEntry 11 }

dot11HopAlgorithmAdopted OBJECT-TYPE

SYNTAX INTEGER { current(0), hop\_index(1), hcc(2) }  
MAX-ACCESS read-write  
STATUS current

DESCRIPTION

"This attribute, indicates which of the algorithms will be used to generate the Hopping Patterns. Valid Values are:

- 0 - hopping patterns as defined in clause 14 of the current version of IEEE Std 802.11
- 1 - hop index method (with or without table)
- 2 - HCC/EHCC method"

::= { dot11PhyFHSSEntry 12 }

dot11RandomTableFlag OBJECT-TYPE

SYNTAX TruthValue  
MAX-ACCESS read-write  
STATUS current

DESCRIPTION

"This attribute, indicates that a Random Table is present when the value is True. When the value is False it indicates that a Random Table is not present and that the hop index method is to be used to determine the hopping sequence. The default value of this attribute is True."

::= { dot11PhyFHSSEntry 13 }

dot11NumberOfHoppingSets OBJECT-TYPE

SYNTAX Integer32  
MAX-ACCESS read-only  
STATUS current

```

DESCRIPTION
    "The Number of Sets field indicates the total number of sets within the
    hopping patterns."

 ::= { dot11PhyFHSSEntry 14 }

dot11HopModulus OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-only
    STATUS current

DESCRIPTION
    "The number of allowed channels for the hopping set. This is defined by
    the governing regulatory agency for the country code of the country in
    which this device is operating."
 ::= { dot11PhyFHSSEntry 15 }

dot11HopOffset OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

DESCRIPTION
    The next position in the hopping set."

 ::= { dot11PhyFHSSEntry 16 }

-- *****
-- * dot11 Hopping Pattern TABLE
-- *****

dot11HoppingPatternTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11HoppingPatternEntry
    MAX-ACCESS not-accessible
    STATUS current

DESCRIPTION
    "The (conceptual) table of attributes necessary for a frequency hopping
    implementation to be able to create the hopping sequences necessary to
    operate in the subband for the associated domain country string."

 ::= { dot11phy 13 }

dot11HoppingPatternEntry OBJECT-TYPE
    SYNTAX Dot11HoppingPatternEntry
    MAX-ACCESS not-accessible
    STATUS current
DESCRIPTION
    "An entry (conceptual row) in the Hopping Pattern Table that indicates the
    random hopping sequence to be followed.

    IfIndex - Each 802.11 interface is represented by an ifEntry. Interface
    tables in this MIB are indexed by ifIndex."

    INDEX { ifIndex,
            dot11HoppingPatternIndex}

 ::= {dot11HoppingPatternTable 1}

```

```

Dot11HoppingPatternEntry ::=
    SEQUENCE {
        dot11HoppingPatternIndex          Integer32,
        dot11RandomTableFieldNumber      Integer32}

dot11HoppingPatternIndex OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS not-accessible
    STATUS current

    DESCRIPTION
        "The auxiliary variable used to identify instances of the columnar objects
        in the Hopping Pattern Table."

 ::= { dot11HoppingPatternEntry 1}

dot11RandomTableFieldNumber OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-write
    STATUS current

    DESCRIPTION
        "This attribute shall indicate the value of the starting channel number in
        the hopping sequence of the subband for the associated domain country
        string. The default value of this attribute shall be zero."

 ::= { dot11HoppingPatternEntry 2}

-- *****
-- * End of dot11 Hopping Pattern TABLE
-- *****

```

***Make the following changes to the Optional Groups section:***

```

-- OPTIONAL-GROUPS { dot11SMTprivacy, dot11MACStatistics,
-- dot11PhyAntennaComplianceGroup, dot11PhyTxPowerComplianceGroup,
-- dot11PhyRegDomainsSupportGroup,
-- dot11PhyAntennasListGroup, dot11PhyRateGroup,
-- dot11SMTbase3, dot11MultiDomainCapabilityGroup,
-- dot11PhyFHSSComplianceGroup2 }
--

 ::= { dot11Compliances 1 }

```

***Insert the following Object Groups after {dot11Groups 19}:***

```

dot11SMTbase3 OBJECT-GROUP

    OBJECTS { dot11MediumOccupancyLimit,
        dot11CFPollable,
        dot11CFPPeriod,
        dot11CFPMaxDuration,
        dot11AuthenticationResponseTimeOut,
        dot11PrivacyOptionImplemented,
        dot11PowerManagementMode,
        dot11DesiredSSID, dot11DesiredBSSType,
        dot11OperationalRateSet,

```



```

        dot11BeaconPeriod, dot11DTIMPeriod,
        dot11AssociationResponseTimeOut,
        dot11DisassociateReason,
        dot11DisassociateStation,
        dot11DeauthenticateReason,
        dot11DeauthenticateStation,
        dot11AuthenticateFailStatus,
        dot11AuthenticateFailStation,
        dot11MultiDomainCapabilityImplemented,
        dot11MultiDomainCapabilityEnabled,
        dot11CountryString
    }
STATUS current
DESCRIPTION
    "The SMTbase3 object class provides the necessary support at the
    STA to manage the processes in the STA such that the STA may
    work cooperatively as a part of an IEEE 802.11 network, when the STA
    is capable of multi-domain operation. This object group should be
    implemented when the multi-domain capability option is implemented."
 ::= { dot11Groups 20 }

dot11MultiDomainCapabilityGroup OBJECT-GROUP
    OBJECTS {
        dot11FirstChannelNumber,
        dot11NumberOfChannels,
        dot11MaximumTransmitPowerLevel
    }
STATUS current
DESCRIPTION
    "The dot11MultiDomainCapabilityGroup object class provides the objects
    necessary to manage the channels usable by a STA, when the multi-domain
    capability option is implemented."
 ::= { dot11Groups 21}

dot11PhyFHSSComplianceGroup2 OBJECT-GROUP

    OBJECTS {dot11HopTime, dot11CurrentChannelNumber, dot11MaxDwellTime,
        dot11CurrentDwellTime, dot11CurrentSet, dot11CurrentPattern,
        dot11CurrentIndex, dot11EHCCPrimeRadix,
dot11EHCCNumberOfChannelsFamilyIndex,
        dot11EHCCCapabilityImplemented, dot11EHCCCapabilityEnabled,
        dot11HopAlgorithmAdopted, dot11RandomTableFlag,
dot11NumberOfHoppingSets,
        dot11HopModulus, dot11HopOffset, dot11RandomTableFieldNumber}
STATUS current
DESCRIPTION
    "Attributes that configure the Frequency Hopping for operation when
    multi-domain capability option is implemented."
 ::= { dot11Groups 22 }

```

## **Annex E**

(informative)

## **Bibliography**

### **E.1 General**

*Insert the following references into E.1 and renumber references as appropriate:*

[B4] Engwer, D. and Zweig, J., "Algorithmically Derived Hop Sequences," submission 99/195 to the IEEE P802.11 Working Group, September 1999.

[B5] Maric, S. V. and Titlebaum, E. L., "A Class of Frequency Hop Codes with Nearly Ideal Characteristics for Use in Multiple-Access Spread-Spectrum Communications and Radar and Sonar Systems," *IEEE Transactions on Communications*, Vol. 40, No. 9, September 1992, pp. 1442-1447