

**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 8: IEEE 802.11 Wireless
Network Management**

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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USA

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(Amendment to IEEE Std 802.11™-2007
as amended by IEEE Std 802.11k™-2008,
IEEE Std 802.11r™-2008, IEEE Std 802.11y™-2008,
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IEEE Computer Society

Approved 2 February 2011
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Abstract: This amendment provides Wireless Network Management enhancements to the IEEE 802.11 MAC, and PHY, extending radio measurements to effect a complete and coherent upper layer interface for managing IEEE 802.11 devices in wireless networks.

Keywords: Radio Resource Management, Wireless Network Management

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This introduction is not part of IEEE Std 802.11v-2011, 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 8: IEEE 802.11 Wireless Network Management.

This amendment defines enhancements to the IEEE 802.11 physical layer (PHY) and medium access control (MAC) to support managing IEEE 802.11 devices in wireless networks.

The amendment specifies enhancements to the following standard and amendments, in order to support wireless network management:

- IEEE 802.11-2007
- IEEE 802.11k-2008
- IEEE 802.11r-2008
- IEEE 802.11y-2008
- IEEE 802.11w-2009
- IEEE 802.11n-2009
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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 8: IEEE 802.11 Wireless Network Management

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[This amendment is based on IEEE Std 802.11™-2007, as amended by IEEE Std 802.11k™-2008, IEEE Std 802.11r™-2008, IEEE Std 802.11y™-2008, IEEE Std 802.11w™-2009, IEEE Std 802.11n™-2009, IEEE Std 802.11p™-2010, and IEEE Std 802.11z™-2010.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard and its amendments to form a comprehensive standard.

The editing instructions are shown ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***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 by either using ~~striketrough~~ (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. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Overview

1.2 Purpose

Insert the following dash list item at the end of the list of items in 1.2:

- Defines mechanisms and services for Wireless Network Management of STAs that include BSS transition management, channel usage and coexistence, collocated interference reporting, diagnostic, multicast diagnostic and event reporting, flexible multicast, efficient beacon mechanisms, proxy ARP advertisement, location, timing measurement, directed multicast, extended sleep modes, traffic filtering, and management notification.

2. Normative references

Insert the following new references in alphabetical order:

IANA assigned EAP type, <http://www.iana.org/assignments/eap-numbers>.

IEEE Std 754™-2008, IEEE Standard for Binary Floating-Point Arithmetic.

IEEE P802.1AS™/Draft 7.7, Draft Standard for Local and Metropolitan Area Networks—Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks.

IETF RFC 791, Internet Protocol, September 1981.

IETF RFC 925, Multi-LAN Address Resolution, J. Postel, October 1984.

IETF RFC 2460, Internet Protocol, Version 6 (IPv6), S. Deering, R. Hinden, December 1998.

IETF RFC 3164, “The BSD Syslog Protocol,” August 2001.

IETF RFC 3693, “Geopriv Requirements,” Feb 2004.

IETF RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, January 2005.

IETF RFC 4776, “Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses Configuration Information,” November 2006.

IETF RFC 4861, Neighbor Discovery for IP version 6 (IPv6), T. Narten, E. Nordmark, W. Simpson, H. Soliman, September 2007.

3. Definitions

Insert the following definitions in alphabetical order into Clause 3, renumbering as necessary:

3.249 BSS Max idle period: A time period during which the access point (AP) does not disassociate a station (STA) due to non-receipt of frames from that STA.

3.250 colocated interference: Interference that is caused by another radio or station (STA) emitting radio energy located in the same physical device as the reporting STA, where the reported characteristics of the interference are known a priori without interference detection, measurement, or characterization by the reporting STA.

3.251 colocated radio: A radio capable of emitting radio-frequency energy located in the same physical device as the reporting station (STA), where the radio's type and some link characteristics are known without signal detection or measurement by the reporting STA.

3.252 configuration profile: A collection of parameters identified by a profile ID that represent a current or available configuration of a station (STA).

3.253 directed multicast service (DMS): A service in which the access point (AP) transmits group addressed frames as individually addressed frames to the requesting non-AP station (STA).

3.254 flexible multicast service (FMS): A service in which a non-access point (non-AP) station (STA) can request a multicast delivery interval longer than the delivery traffic indication message (DTIM) interval for the purposes of lengthening the period of time a STA may be in a power save state.

3.255 flexible multicast stream identifier (FMSID): An identifier assigned by the access point (AP) to a particular group addressed stream subsequent to a successful FMS Request.

3.256 flexible multicast service (FMS) stream: A succession of frames transmitted by the access point (AP) that correspond to a single flexible multicast stream identifier (FMSID).

3.257 flexible multicast service (FMS) stream set: A collection of FMS streams identified by an FMS Token, used during the FMS Request procedure.

3.258 location subject third party: The term used when the location request is for the location of a station (STA) other than the requesting STA or the requested STA, (i.e., when the requesting STA asks "Where is he/she?").

3.259 multiple BSSID capability: The capability to advertise information for multiple basic service set identifications (BSSIDs) using a single Beacon or Probe Response frame instead of using multiple Beacon or Probe Response frames, each corresponding to a single BSSID, and the capability to indicate buffered frames for these multiple BSSIDs using a single traffic indication map (TIM) element in a single Beacon.

3.260 non-transmitted BSSID: A basic service set identification (BSSID) corresponding to one of the basic service sets (BSSs) when the multiple BSSID capability is supported, where the BSSID is not announced explicitly but can be derived from the information encoded in the transmitted beacon frames.

3.261 Peer-to-Peer link: Either a direct link within a quality of service (QoS) basic service set (BSS), a tunnelled direct-link setup (TDLS) link or a STA-to-STA communication in an independent basic service set (IBSS).

3.262 TIM broadcast: A service in which a non-access point (non-AP) station (STA) can request periodic transmission of a traffic indication map (TIM) frame by the AP. TIM frames have shorter duration than Bea-

con frames and can be transmitted at a higher physical layer (PHY) rate, which allows the STA to save additional power while periodically checking for buffered traffic in standby mode, relative to the power consumed if the station (STA) were to periodically wake up to receive a beacon frame.

3.263 traffic filter: A set of traffic specifications defined by the use of traffic classification (TCLAS) information elements that are utilized by the traffic filtering service (TFS) to identify specific allowed frames.

3.264 traffic filtering service (TFS): A service provided by an access point (AP) to a non-AP station (STA) that can reduce the number of frames sent to the non-AP STA by not forwarding individually addressed frames addressed to the non-AP STA that do not match traffic filters specified by the non-AP STA.

3.265 transmitted BSSID: The basic service set identification (BSSID) included in the MAC Header transmitter address field of a Beacon frame when the multiple BSSID capability is supported.

3.266 WNM-Sleep mode: An extended power-save mode for non-access point (non-AP) stations (STAs) whereby a non-AP STA need not listen for every delivery traffic indication message (DTIM) Beacon frame, and does not perform group temporal key/integrity group temporal key (GTK/IGTK) updates.

4. Abbreviations and acronyms

Insert the following new acronyms in alphabetical order:

DMS	directed multicast service
DMSID	directed multicast service identifier
DST	daylight saving time
EDT	eastern daylight time
EST	eastern standard time
FMS	flexible multicast service
FMSID	flexible multicast stream identifier
TAI	Temps Atomique International (International Atomic Time)
TFS	traffic filtering service
TOA	time of arrival
TOD	time of departure
TTTT	target TIM transmission time
URI	uniform resource identifier
WNM	Wireless Network Management

5. General description

5.2 Components of the IEEE 802.11 architecture

Insert the following subclauses after 5.2.11:

5.2.12 Wireless Network Management

5.2.12.1 Overview

Wireless Network Management (WNM) enables STAs to exchange information for the purpose of improving the overall performance of the wireless network. STAs use WNM protocols to exchange operational data so that each STA is aware of the network conditions, allowing STAs to be more cognizant of the topology and state of the network. WNM protocols provide a means for STAs to be aware of the presence of collocated interference, and enable STAs to manage RF parameters based on network conditions.

In addition to providing information on network conditions, WNM also provides a means to exchange location information, provide support for the multiple BSSID capability on the same wireless infrastructure, support efficient delivery of group addressed frames, and enable a WNM-Sleep mode in which a STA can sleep for long periods of time without receiving frames from the AP.

The WNM service includes the following:

- BSS Max idle period management
- BSS transition management
- Channel usage
- Collocated interference reporting
- Diagnostic reporting
- Directed multicast service (DMS)
- Event reporting
- Flexible multicast service (FMS)
- Location services
- Multicast diagnostic reporting
- Multiple BSSID capability
- Proxy ARP
- QoS traffic capability
- SSID list
- Triggered STA statistics
- TIM broadcast
- Timing measurement
- Traffic filtering service
- U-APSD Coexistence
- WNM-Notification
- WNM-Sleep mode

A comprehensive statement on mandatory and optional functionality is available in A.4.21.

5.2.12.2 BSS Max idle period management

BSS Max idle period management enables an AP to indicate a time period during which the AP does not disassociate a STA due to non-receipt of frames from the STA. This supports improved STA power saving and AP resource management.

5.2.12.3 BSS transition management

BSS transition management enables an AP to request non-AP STAs to transition to a specific AP, or to indicate to a non-AP STA a set of preferred APs, due to network load balancing or BSS Termination.

5.2.12.4 Channel usage

Channel usage information is provided by the AP to the non-AP STA to recommend channels for non-infrastructure networks or an off-channel TDLS direct link. The non-AP STAs can use the channel usage information as part of channel selection processing for a non-infrastructure network or an off-channel TDLS direct link.

5.2.12.5 Collocated interference reporting

Collocated interference reporting enables the requesting STA to obtain information on interference due to collocated radios at the reporting STA. The requesting STA can use that information to schedule its transmissions to minimize the effects of the interference.

5.2.12.6 Diagnostic reporting

Diagnostic requests enable a STA to request a non-AP STA to report on information that may be helpful in diagnosing and resolving problems with the WLAN network. Diagnostic reports include information on hardware, configuration, and STA capabilities.

5.2.12.7 Directed multicast service (DMS)

The DMS enables a non-AP STA to request the AP to transmit group addressed frames destined to the requesting STA as individually addressed frames.

5.2.12.8 Event reporting

Event requests enable a STA to request a non-AP STA to send particular real-time event messages. The types of events include Transition, RSNA, WNM Log, and Peer-to-Peer Link events. A transition event is transmitted after a non-AP STA successfully completes a BSS Transition. Transition events are used to diagnose transition performance problems. An RSNA event report describes the type of Authentication used for the RSNA. RSNA events are used to diagnose security and authentication performance problems. A WNM Log event report enables a non-AP STA to transmit a set of WNM Log event messages to the requesting STA. WNM Log event reports are used to access the contents of a STA's WNM Log. A Peer-to-Peer Link event report enables a non-AP STA to inform the requesting STA that a Peer-to-Peer link has been established. Peer-to-Peer Link event reports are used to monitor the use of Peer-to-Peer links in the network.

5.2.12.9 FMS

The flexible multicast service enables a non-AP STA to request an alternate DTIM delivery interval for one or more sets of group addressed streams that the non-AP STA receives. This enables the non-AP STA to wake up at the alternate DTIM interval rather than every DTIM and enables significant power saving when a non-AP STA receives group addressed traffic. The FMS also enables a STA to establish a data rate and delivery interval for group addressed traffic higher than the minimum data rate available.

5.2.12.10 Location services

Location Configuration Request and Response frames enable STAs to configure a collection of location related parameters for Location Track Notification frames. The AP can indicate that it can provide location data to support applications such as emergency services. Location services also provide the ability for STAs to exchange location information using Radio Measurement Request and Report frames. The protocol supports exchange-by-value and exchange-by-reference mechanisms. The location value can be exchanged in Geospatial (LCI) and Civic formats. The location reference is a URL that defines from where the location value is retrieved.

5.2.12.11 Multicast diagnostic reporting

Multicast diagnostic reports enable a non-AP STA to report statistics for multicast traffic it received from a transmitting STA. This can be used by an AP to measure quality of multicast reception by a non-AP STA.

5.2.12.12 Multiple BSSID capability

The Multiple BSSID capability enables the advertisement of information for BSSIDs using a single Beacon or Probe Response frame instead of multiple Beacon and Probe Response frames, each corresponding to a single BSSID. The Multiple BSSID capability also enables the indication of buffered frames for multiple BSSIDs using a single TIM element in a single beacon.

5.2.12.13 Proxy ARP

The Proxy ARP capability enables an AP to indicate that the non-AP STA will not receive ARP frames. The Proxy ARP capability enables the non-AP STA to remain in power-save for longer periods of time.

5.2.12.14 QoS traffic capability

QoS traffic capability procedures enable the QoS STA to indicate that it is capable of transmitting traffic belonging to the corresponding user priority (UP) from applications that require generation of such traffic. The QoS Traffic Capability can be used for example as an input to estimate the blocking probability of a voice application based on the number of voice capable non-AP STAs.

5.2.12.15 SSID list

The SSID List element enables the non-AP STA to request information on a list of SSIDs. This is intended to reduce the number of Probe Request frames sent by the non-AP STA.

5.2.12.16 Triggered STA statistics

The Triggered STA Statistics reporting capability enables generation of a STA statistics report (see 5.2.7.8) when the statistics of interest reach a predefined threshold.

5.2.12.17 TIM broadcast

The TIM broadcast protocol defines a mechanism to enable a STA to receive an indication of buffered individually addressed traffic, independent of the Beacon frame, reducing the wake time of the STA.

5.2.12.18 Timing measurement

Timing Measurement action frames allow a recipient STA to accurately measure the offset of its clock relative to a clock in the sending STA. With the regular transfer of Timing Measurement action frames from one

STA to another, it is possible for the recipient STA to track changes in the offset of its clock with respect to the sending STA over time and thus detect and compensate for any drift between the clocks.

5.2.12.19 Traffic filtering service

Traffic filtering is a service that may be provided by an AP to its associated STAs, where the AP examines MSDUs and management frames destined for a STA. The AP determines if any of those frames match a specific set of traffic filters that may be enabled at the AP per the request of the STA. Individually addressed frames that do not match any of the traffic filters in the set are discarded. Individually addressed frames that do match at least one of the set of the enabled traffic filters are delivered to the STA. The STA may also negotiate to have a notification frame sent prior to the delivery of the frame matching the traffic filter.

5.2.12.20 U-APSD Coexistence

The U-APSD Coexistence capability enables the non-AP STA to indicate a requested transmission duration to the AP for use of U-APSD service periods. Use of the transmission duration enables the AP to transmit frames during the service period and improve the likelihood that the non-AP STA receives the frames when the non-AP STA is experiencing interference. The U-APSD Coexistence capability reduces the likelihood that the AP transmits frames during the service period that are not received successfully.

5.2.12.21 WNM-Notification

WNM-Notification provides a mechanism for a STA to notify another STA of a management event. One event is defined: firmware update notification.

5.2.12.22 WNM-Sleep mode

WNM-Sleep mode is an extended power-save mode for non-AP STAs in which a non-AP STA need not listen for every DTIM Beacon frame, and need not perform GTK/IGTK updates. WNM-Sleep mode enables a non-AP STA to signal to an AP that it will be sleeping for a specified length of time. This enables a non-AP STA to reduce power consumption and remain associated while the non-AP STA has no traffic to send to or receive from the AP.

6. MAC service definition

6.1 Overview of MAC services

6.1.3 MSDU ordering

Change the second paragraph as follows:

In a non-QoS STA, the MAC does not intentionally reorder MSDUs except as may be necessary to improve the likelihood of successful delivery based on the current operational (“power management” FMS, DMS) mode of the designated recipient STA(s). The sole effect of this reordering (if any), for the set of MSDUs received at the MAC service interface of any single STA, is a change in the delivery order of broadcast and multicast MSDUs, relative to directed MSDUs, originating from a single source STA address. If a higher layer protocol using the data service cannot tolerate this possible reordering, the optional StrictlyOrdered service class should be used. MSDUs transferred between any pair of STAs using the StrictlyOrdered service class are not subject to the relative reordering that is possible when the re-ordered Multicast service class is used. However, the desire to receive MSDUs sent using the StrictlyOrdered service class at a STA precludes simultaneous use of the MAC power management facilities at that STA.

7. Frame formats

7.2 Format of individual frame types

7.2.3 Management frames

7.2.3.1 Beacon frame format

Change the current element order 31 and insert three new elements orders 42 through 44 to Table 7-8 as follows:

Table 7-8—Beacon frame body

Order	Information	Notes
31	Multiple BSSID	~~One or more~~ The Multiple BSSID elements ~~is are~~ present if dot11RRMMeasurementPilotCapability is a value between 2 and 7 and the AP is a member of a Multiple BSSID Set (see 11.10.11) with two or more members, ~~or if~~ dot11MgmtOptionMultiBSSIDActivated is true.
<u>42</u>	<u>FMS Descriptor</u>	<u>The FMS Descriptor element is present if</u> <u>dot11MgmtOptionFMSActivated is true.</u>
<u>43</u>	<u>QoS Traffic Capability</u>	<u>The QoS Traffic Capability element is optionally present if</u> <u>dot11MgmtOptionACStationCountActivated is true.</u>
<u>44</u>	<u>Time Advertisement</u>	<u>The Time Advertisement element is present every</u> <u>dot11TimeAdvertisementIntervalDTIMs if</u> <u>dot11MgmtOptionUTCTSFOffsetActivated is true.</u>

7.2.3.4 Association Request frame format

Insert order 16 and 17 information fields into Table 7-10 as follows:

Table 7-10—Association Request frame body

Order	Information	Notes
16	QoS Traffic Capability	The QoS Traffic Capability element is present if dot11MgmtOptionQoSTrafficCapabilityActivated is true.
17	TIM Broadcast Request	The TIM Broadcast Request element is present if dot11MgmtOptionTIMBroadcastActivated is true.

7.2.3.5 Association Response frame format

Insert order 18 and 19 information fields into Table 7-11 as follows:

Table 7-11—Association Response frame body

Order	Information	Notes
18	BSS Max Idle Period	The BSS Max Idle Period element is present if dot11WirelessManagementImplemented is true.
19	TIM Broadcast Response	The TIM Broadcast Response element is present if dot11MgmtOptionTIMBroadcastActivated is true and the TIM Broadcast Request element is present in the Association Request that elicited this Association Response frame.

7.2.3.6 Reassociation Request frame format

Insert order 19 through 22 information fields into Table 7-12 as follows:

Table 7-12—Reassociation Request frame body

Order	Information	Notes
19	QoS Traffic Capability	The QoS Traffic Capability element is present if dot11MgmtOptionQoSTrafficCapabilityActivated is true.
20	TIM Broadcast Request	The TIM Broadcast Request element is present if dot11MgmtOptionTIMBroadcastActivated is true.
21	FMS Request	The FMS Request element may be present if dot11MgmtOptionFMSActivated is true.
22	DMS Request	The DMS Request element may be present if dot11MgmtOptionDMSActivated is true.

7.2.3.7 Reassociation Response frame format

Insert order 20 through 23 information fields into Table 7-13 as follows:

Table 7-13—Reassociation Response frame body

Order	Information	Notes
20	BSS Max Idle Period	The BSS Max Idle Period element is present if dot11WirelessManagementImplemented is true.
21	TIM Broadcast Response	The TIM Broadcast Response element is present if dot11MgmtOptionTIMBroadcastActivated is true and the TIM Broadcast Request element is present in the Reassociation Request frame that elicited this Reassociation Response frame.
22	FMS Response	The FMS Response element is present if dot11MgmtOptionFMSActivated is true and the FMS Request element is present in the Reassociation Request frame that elicited this Reassociation Response frame.
23	DMS Response	The DMS Response element is present if dot11MgmtOptionDMSActivated is true and the DMS Request element is present in the Reassociation Request frame that elicited this Reassociation Response frame.

7.2.3.8 Probe Request frame format

Insert order 10 and 11 information fields into Table 7-14 as follows:

Table 7-14—Probe Request frame body

Order	Information	Notes
10	SSID List	The SSID List element is optionally present if dot11MgmtOptionSSIDListActivated is true.
11	Channel Usage	The Channel Usage element is optionally present if dot11MgmtOptionChannelUsageActivated is true.

7.2.3.9 Probe Response frame format

Change the current element order 24 and insert order 40 through 43 information fields into Table 7-15 as follows:

Table 7-15—Probe Response frame body

Order	Information	Notes
24	Multiple BSSID	~~One or more Multiple BSSID elements are present included if~~ <u>dot11RRMMeasurementPilotCapability is a value between 2 and 7 and the AP is a member of a Multiple BSSID Set (see 11.10.11) with two or more members, or if</u> <u>dot11MgmtOptionMultiBSSIDActivated is true.</u>
<u>40</u>	<u>QoS Traffic Capability</u>	<u>The QoS Traffic Capability element is optionally present if</u> <u>dot11MgmtOptionACStationCountActivated is true.</u>
<u>41</u>	<u>Channel Usage</u>	<u>The Channel Usage element is present if the Channel Usage</u> <u>element is present in the Probe Request frame and</u> <u>dot11MgmtOptionChannelUsageActivated is true.</u>
<u>42</u>	<u>Time Advertisement</u>	<u>The Time Advertisement element is present if</u> <u>dot11MgmtOptionUTCTSOOffsetActivated is true.</u>
<u>43</u>	<u>Time Zone</u>	<u>The Time Zone element is present if</u> <u>dot11MgmtOptionUTCTSOOffsetActivated is true.</u>

7.3 Management frame body components

7.3.1 Fields that are not information elements

7.3.1.7 Reason Code field

Insert reason code 12 and change the Reserved reason code row in Table 7-22 as follows (note that the entire table is not shown here):

Table 7-22—Reason codes

Reason code	Meaning
12	Disassociated due to BSS Transition Management
~~1334~~ –65535	Reserved

7.3.1.9 Status Code field

Insert status codes 56-58, 73-75, 80-82 and change the Reserved status code row in Table 7-23 as follows (note that the entire table is not shown here):

Table 7-23—Status codes

Status code	Meaning
56	Requested TCLAS processing is not supported by the AP.
57	The AP has insufficient TCLAS processing resources to satisfy the request.
58	The TS has not been created because the request cannot be honored; however, the HC suggests the STA transitions to other BSSs to setup the TS.
73	U-APSD Coexistence is not supported.
74	Requested U-APSD Coexistence mode is not supported.
75	Requested Interval/Duration value cannot be supported with U-APSD Coexistence.
80	Requested TCLAS Not Supported.
81	TCLAS Resources Exhausted.
82	Rejected with Suggested BSS Transition.
~~83-84~~ 65535	Reserved

7.3.1.11 Action field

Insert category codes 10, 11 and change the Reserved category code row in Table 7-24 as follows (note that the entire table is not shown here):

Table 7-24—Category values

Code	Meaning	See subclause	Robust
10	WNM	7.4.12	Yes
11	Unprotected WNM	7.4.13	No
~~12-14~~ 125	Reserved	—	—

Insert the following new subclauses after 7.3.1.31 (TGp uses 31):

7.3.1.32 Rate Identification field

The Rate Identification field is 4 octets in length and contains the rate identification information for a frame that is not the current frame transmitted or received by a STA. This information allows services to exchange frame rate information prior to use of the frames that will use the rate specified by the Rate Identification field. The contents of the field is defined in Figure 7-36p.

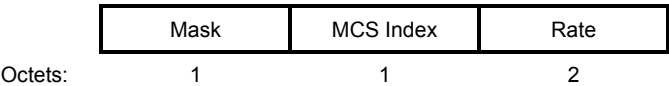


Figure 7-36p—Identification field format

The Mask field specifies which other fields in the Rate Identification field are used by a STA. The format of the Mask field is shown in Figure 7-36q.



Figure 7-36q—Mask field format

The MCS Selector field set to 0 indicates the MCS Index field is reserved. The MCS Selector field set to 1 indicates the MCS Index field specifies an index value that is taken from Table 20-29 through Table 20-32 and Table 20-38 through Table 20-40 in 20.6. The MCS Selector field set to 2 indicates the MCS Index field specifies an index value that is taken from Table 20-33 through Table 20-37 and Table 20-41 through Table 20-43 in 20.6. The MCS Selector field values 3 to 7 are reserved.

The Rate Type field set to 0 indicates the Rate field is reserved. The Rate Type field set to 1 indicates the Rate field specifies a data rate that is in the basic rate set. The Rate Type field set to 2 indicates the Rate field specifies a data rate that is not in the basic rate set.

The MCS Index field is a 1 octet unsigned integer that specifies the row index for one of the MCS parameter tables in 20.6.

The Rate field contains a 2-octet unsigned integer that specifies the PHY rate in 0.5 Mb/s units.

7.3.2 Information elements

In Table 7-26, insert the following Element IDs and renumber the reserved values accordingly (note that the entire table is not shown here):

Table 7-26—Element IDs

Information element	Element ID	Length (in octets)	Extensible
Event Request (see 7.3.2.67)	78	5 to 257	Subelements
Event Report (see 7.3.2.68)	79	5 to 257	
Diagnostic Request (see 7.3.2.69)	80	6 to 257	Subelements
Diagnostic Report (see 7.3.2.70)	81	5 to 257	Subelements
Location Parameters (see 7.3.2.71)	82	2 to 257	Subelements
Non-transmitted BSSID Capability (see 7.3.2.72)	83	4	
SSID List (see 7.3.2.73)	84	2 to 257	
Multiple BSSID-Index (see 7.3.2.74)	85	3 to 5	
FMS Descriptor (see 7.3.2.75)	86	3 to 257	
FMS Request (see 7.3.2.76)	87	3 to 257	Subelements
FMS Response (see 7.3.2.77)	88	18 to 257	Subelements
QoS Traffic Capability (see 7.3.2.78)	89	3 to 5	Yes
BSS Max Idle Period (see 7.3.2.79)	90	5	Yes
TFS Request (see 7.3.2.80)	91	6 to 257	Subelements
TFS Response (see 7.3.2.81)	92	6 to 256	Subelements
WNM-Sleep Mode (see 7.3.2.82)	93	6	Yes
TIM Broadcast Request (see 7.3.2.83)	94	3	Yes
TIM Broadcast Response (see 7.3.2.84)	95	3 or 12	Yes
Collocated Interference Report (see 7.3.2.85)	96	23	Yes
Channel Usage (see 7.3.2.86)	97	3 to 257	Subelements
Time Zone (see 7.3.2.87)	98	3 to 257	Yes
DMS Request (see 7.3.2.88)	99	3 to 257	Subelements
DMS Response (see 7.3.2.89)	100	3 to 257	Subelements
Destination URI (see 7.3.2.90)	141	3 to 257	Yes
U-APSD Coexistence (see 7.3.2.91)	142	14 to 257	Subelements

7.3.2.6 TIM

Change the second to last paragraph in 7.3.2.6 as follows:

When `dot11MgmtOptionMultiBSSIDActivated` is false, ~~t~~The Partial Virtual Bitmap field consists of octets numbered $N1$ through $N2$ of the traffic indication virtual bitmap, where $N1$ is the largest even number such that bits numbered 1 through $(N1 \times 8) - 1$ in the bitmap are all 0 and $N2$ is the smallest number such that bits numbered $(N2 + 1) \times 8$ through 2007 in the bitmap are all 0. In this case, the Bitmap Offset subfield value contains the number $\lfloor (N1)/2 \rfloor$, and the Length field is $(N2 - N1) + 4$.

Insert the following paragraphs at the end of 7.3.2.6:

When `dot11MgmtOptionMultiBSSIDActivated` is true, the Partial Virtual Bitmap field of the TIM element is constructed as follows, where the maximum possible number of BSSIDs is an integer power of 2, $n = \log_2$ (maximum possible number of BSSIDs), k is the number of actually supported non-transmitted BSSIDs, and $k \leq (2^n - 1)$.

- The bits 1 to k of the bitmap are used to indicate that one or more group addressed frames are buffered for each AP corresponding to a non-transmitted BSSID. The AIDs from 1 to k are not allocated to a STA. The AIDs from $(k + 1)$ to $(2^n - 1)$ are reserved and set to 0. The remaining AIDs are shared by the BSSs corresponding to the transmitted BSSID and all non-transmitted BSSIDs.
- When the DTIM Count field is 0 for a BSS that has a non-transmitted BSSID, and one or more group addressed frames are buffered at the AP for this BSS, the corresponding bits from bit 1 to bit k is set to 1.
- Each bit starting from bit 2^n in the traffic-indication virtual bitmap corresponds to unicast traffic buffered for a specific STA within any BSS corresponding to a transmitted or non-transmitted BSSID at the time the Beacon frame is transmitted. The correspondence is based on the AID of the STA.
- Based upon its knowledge of the capability of associated stations to support the multiple BSSID capability, as indicated by the corresponding field in the Extended Capabilities element and the content of the traffic indication virtual bitmap, an AP shall encode the Partial Virtual Bitmap and the Bitmap Control field of the TIM element using one of the two following methods. Specifically, an AP uses Method B when it determines that the bit for each associated non-AP STA in the virtual bitmap that will be reconstructed by each non-AP STA from the received TIM element encoded using Method B is set correctly. Otherwise, an AP uses Method A.

Method A and Method B are described as follows:

- a) Method A: The Partial Virtual Bitmap field consists of octets numbered 0 through $N2$ of the traffic indication virtual bitmap, where $N2$ is the smallest number such that bits numbered $(N2 + 1) \times 8$ through 2007 in the bitmap are all 0. If such a value $N2$ does not exist, that is, when not all bits in the last octet of the traffic indication virtual bitmap are equal to 0, $N2 = 250$. When using this method, the Bitmap Offset subfield value always contains the number 0, and the Length field is $N2 + 4$.
- b) Method B: The Partial Virtual Bitmap field consists of a concatenation of octets numbered 0 through $N0 - 1$ and octets numbered $N1$ through $N2$ of the traffic indication virtual bitmap, where $N0$ is the smallest positive integer such that $N0 \times 8 - 2^n < 8$. If $N0$ is an odd number, then $N1$ is the largest odd number such that $N0 < N1$ and each of the bits $N0 \times 8$ to $(N1 \times 8 - 1)$ is equal to zero. When $N0$ is an even number, $N1$ is the largest even number such that $N0 < N1$ and each of the bits $N0 \times 8$ to $(N1 \times 8 - 1)$ is equal to zero. If such a value $N1 > N0$ does not exist, $N1 = N0$. Additionally, $N2$ is the smallest integer value for which the values for bit $(N2 + 1) \times 8$ to 2007 in the bitmap are all 0. If such a value $N2$ does not exist, that is, when not all bits in the last octet of the traffic indication virtual bitmap are equal to 0, $N2 = 250$. When using this method, the Bitmap Offset subfield contains the value of $(N1 - N0)/2$, and the Length field is $N0 + N2 - N1 + 4$.

NOTE — When $N1 = N0$, Method B reduces to Method A.

For both Method A and Method B, when there are no frames buffered for any BSS corresponding to a transmitted or non-transmitted BSSID supported, the Partial Virtual Bitmap field is encoded as a single octet equal to 0, the Bitmap Offset subfield is 0, and the Length field is 4. When there are no buffered unicast frames for any BSS corresponding to a transmitted or non-transmitted BSSID, but there are buffered broadcast and/or multicast frames for one or more of the BSSs, the Partial Virtual Bitmap field consists of the octets number 0 through $N0 - 1$ where $N0$ is the smallest positive integer such that $(N0 \times 8 - 2^n < 8)$. In this case, the Bitmap Offset subfield value contains the number 0, and the Length field is $N0+3$.

7.3.2.21 Measurement Request element

Change Table 7-29 in 7.3.2.21 and split the “Measurement Use” column into multiple separate entries as follows:

Table 7-29—Measurement Type definitions for measurement requests

Name	Measurement type	Measurement use
Basic Request	0	Spectrum Management
Clear Channel Assessment (CCA) request	1	
Receive power indication (RPI) histogram request	2	
Channel load request	3	Radio Resource Measurement
Noise histogram request	4	
Beacon request	5	
Frame request	6	
STA statistics request	7	Radio Resource Measurement <u>and</u> <u>WNM</u>
LCI request	8	Radio Resource Measurement <u>and</u> <u>WNM</u>
Transmit stream/category measurement request	9	Radio Resource Measurement
<u>Multicast diagnostics request</u>	<u>10</u>	<u>WNM</u>
<u>Location Civic request</u>	<u>11</u>	<u>Radio Resource Measurement and</u> <u>WNM</u>
<u>Location Identifier request</u>	<u>12</u>	<u>Radio Resource Measurement and</u> <u>WNM</u>
Reserved	<u>1340–254</u>	N/A
Measurement Pause request	255	Radio Resource Measurement

7.3.2.21.8 STA Statistics Request

Change Table 7-29j in 7.3.2.21.8 as follows:

Table 7-29j—Group Identity for a STA Statistics Request

Statistics Group Name	Group Identity
<u>RSNA Counters</u>	<u>16</u>
Reserved	4617–255

Change the paragraph starting with “The Measurement Duration field...” as follows:

The Measurement Duration field is the duration of the requested measurement in TUs except when triggered reporting is used. When triggered reporting is used, the measurement duration is 0.

Change Table 7-29k as follows:

Table 7-29k—Optional Subelement IDs for STA Statistics Request

Subelement ID	Name	Length field (octets)	Extensible
<u>0</u>	Reserved		
<u>1</u>	<u>Triggered Reporting</u>	<u>variable</u>	
<u>02–220</u>	Reserved		
221	Vendor Specific	1 to 239	
222–255	Reserved		

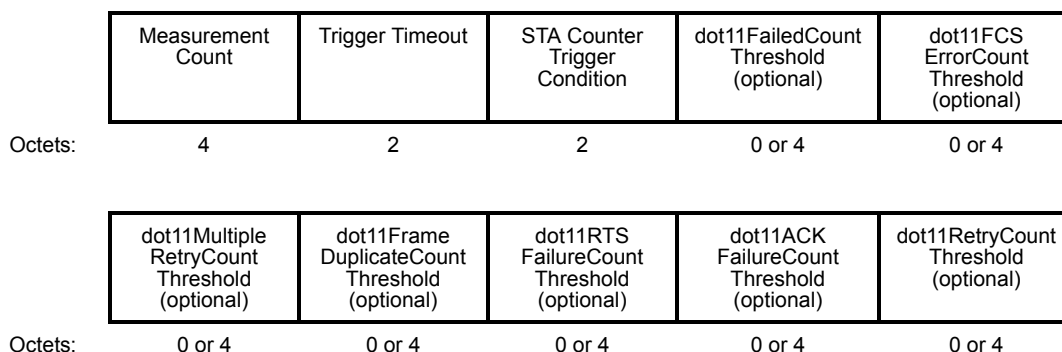
Insert the following before the paragraph that reads “The Vendor Specific subelements ...”:

The Triggered Reporting subelement is used to specify trigger conditions and thresholds for triggered STA Statistics measurements. It is present when setting up triggered reporting from STA Counters, QoS STA Counters, or RSNA Counters, see 11.10.8.5.

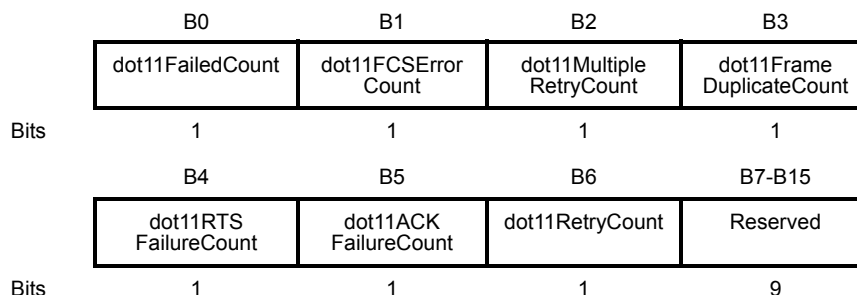
The format of the Triggered Reporting subelement for STA Counters is shown in Figure 7-62h1. The fields marked as optional are only present if the appropriate bit in the STA Counter Trigger Condition field is 1.

The value in the Measurement Count field specifies the number of MSDUs or MPDUs transmitted and/or received by the STA that are to be used to determine if one or more of the trigger conditions have been met.

The Trigger Timeout field contains a value in units of 100 TUs during which a measuring STA does not generate further triggered STA Statistics Reports after a trigger condition has been met.

**Figure 7-62h1—Triggered Reporting subelement for STA Counters**

The STA Counter Trigger Condition field specifies trigger values used when requesting triggered STA Statistics reporting. The format of the STA Counter Trigger Condition field is shown in Figure 7-62h2.

**Figure 7-62h2—STA Counter Trigger Condition field**

For each bit in the STA Counter Trigger Condition field that is 1, a corresponding threshold value exists (defined in Figure 7-62h1) in the Triggered Reporting subelement for STA Counters. With this, the STA Statistics Request indicates that a STA Statistics Report be generated when the corresponding STA counter defined in Figure 7-68i and Figure 7-68j (in 7.3.2.22.8) exceeds the value of the specified threshold, within the total number of MSDUs or MPDUs indicated in the Measurement Count field. See 11.10.8.5. One or more trigger conditions are set with specified thresholds. In the triggered STA Statistics request, the value of the Group Identity field is either 0 or 1. When the Group Identity field value of the triggered STA Statistics request is 0, B2–B6 in the STA Counter Trigger Condition field are set to 0. When the group identity of the triggered STA Statistics request is 1, B0 and B1 in the STA Counter Trigger Condition field are set to 0.

The format of the Triggered Reporting subelement for QoS STA Counters is shown in Figure 7-62h3. The fields marked as optional are only present if the appropriate bit in the QoS STA Counter Trigger Condition is 1.

The UP of the QoS STA Counters for triggered QoS Statistics measurement is determined by the group identity of the measurement request field for a STA Statistics Request frame as defined in Table 7-29j.

The value in the Measurement Count field specifies the number of MSDUs or MPDUs transmitted and/or received by the STAs that are to be used to determine if one or more of the trigger conditions have been met.

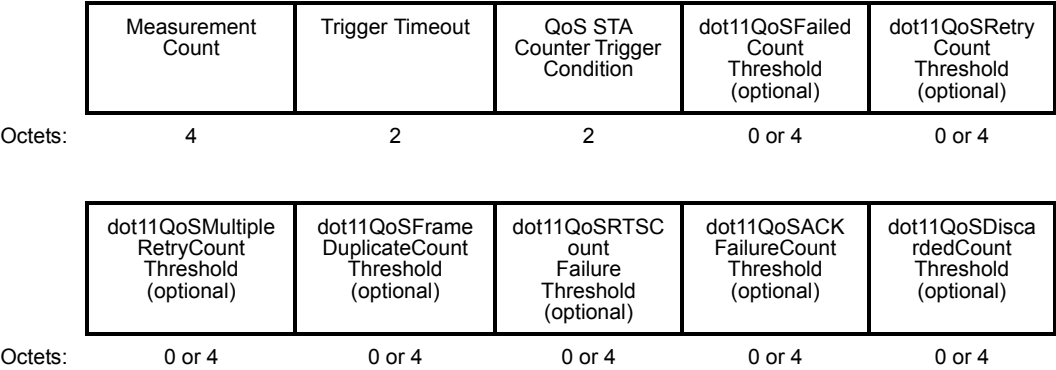


Figure 7-62h3—Triggered Reporting subelement for QoS STA Counters

The Trigger Timeout field contains a value in units of 100 TUs during which a measuring STA does not generate further triggered STA Statistics Reports after a trigger condition has been met.

The QoS STA Counter Trigger Condition field specifies reporting triggers when requesting triggered STA Statistics reporting. The format of the QoS STA Counter Trigger Condition field is shown in Figure 7-62h4.

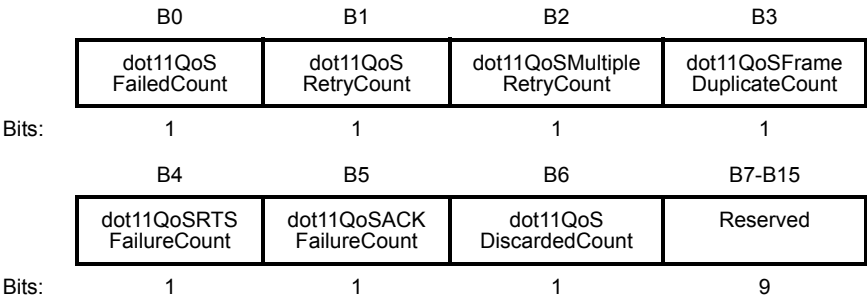


Figure 7-62h4—QoS STA Counter Trigger Condition field

For each bit in the QoS STA Counter Trigger Condition field that is 1, a corresponding threshold value exists (defined in Figure 7-62h3) in the Triggered Reporting subelement for QoS STA Counters. With this, the STA Statistics Request indicates that a STA Statistics Report be generated when the corresponding QoS STA counter defined in Figure 7-85j (in 7.3.2.22.8) exceeds the value of the specified threshold, within the total number of MSDUs or MPDUs indicated in the Measurement Count field. See 11.10.8.5. One or more trigger conditions are set with specified thresholds.

The format of the Triggered Reporting subelement for RSNA Counters is shown in Figure 7-62h5. The fields marked as optional are only present if the appropriate bit in the RSNA Trigger Condition is 1.

The value in the Measurement Count field specifies the number of MPDUs transmitted and/or received by the STA that are to be used to determine if one or more of the trigger conditions have been met.

The Trigger Timeout field contains a value in units of 100 TUs during which a measuring STA does not generate further triggered STA Statistics Reports after a trigger condition has been met.