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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 1: Prioritization of management frames (adoption of IEEE Std 802-11ae-2012)

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

Partie 11: Spécifications du contrôle d'accès du milieu sans fil (MAC) et de la couche physique (PHY)

AMENDEMENT 1: Hiérarchisation des cadres de gestion (adoption de la norme IEEE Std 802-11ae-2012)

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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 1: Prioritization of Management Frames

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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

6 April 2012

IEEE Std 802.11ae™-2012
(Amendment to
IEEE Std 802.11™-2012)

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(Amendment to
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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 1: Prioritization of Management Frames

Sponsor

LAN/MAN Standards Committee

of the

IEEE Computer Society

Approved 29 March 2012

IEEE-SA Standards Board

Abstract: A mechanism for prioritization of management frames is provided and a protocol to communicate management frame prioritization policy is specified in this amendment.

Keywords: IEEE 802.11, IEEE 802.11ae, management, QMF, QoS, quality-of-service management frame

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Introduction

This introduction is not part of IEEE Std 802.11ae-2012, 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 1: Prioritization of Management Frames.

This document provides amendments to the IEEE 802.11 PHY/MAC layers related to QoS for Management Frames.

Contents

**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 1: Prioritization of Management Frames

(This amendment specifies enhancements to IEEE Std 802.11™.)

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[1]Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Insert the following new definitions:

group-addressed quality-of-service management frame (GQMF): A group-addressed management frame that is transmitted using the quality-of-service management frame (QMF) service.

individually addressed quality-of-service management frame (IQMF): An individually addressed management frame that is transmitted using the quality-of-service management frame (QMF) service.

non-quality-of-service management frame (non-QMF) access point (AP): An AP that does not implement the quality-of-service management frame (QMF) service.

non-quality-of-service management frame (non-QMF) station (STA): A STA that does not implement the quality-of-service management frame (QMF) service.

quality-of-service management frame (QMF): A management frame that is transmitted using the QMF service.

quality-of-service management frame (QMF) access point (AP): A quality-of-service AP that implements the QMF service.

quality-of-service management frame (QMF) policy: A policy defining the access category of management frames. QMF stations (STAs) transmit their management frames using the access category defined by the policy.

quality-of-service management frame (QMF) service: A service in which the enhanced distributed channel access (EDCA) access category with which a management frame is sent is determined according to a configured policy.

quality-of-service management frame (QMF) station (STA): A quality-of-service STA that implements the QMF service.

3.3 Abbreviations and acronyms

Insert the following new acronyms in alphabetical order:

GQMF	group-addressed quality-of-service management frame
IQMF	individually addressed quality-of-service management frame
QACM	QMF access category mapping
QMF	quality-of-service management frame

4. General description

4.5 Overview of the services

4.5.6 Traffic differentiation and QoS support

Insert the following heading (4.5.6.1) immediately after the heading 4.5.6:

4.5.6.1 General

Insert the following new subclause at the end of 4.5.6:

4.5.6.2 Quality-of-service management frame support

When the quality-of-service management frame (QMF) service is enabled, some management frames might be transmitted using an access category other than the access category assigned to voice traffic (access category AC_VO, see 8.4.2.31) in order to improve the quality of service of other traffic streams. This is achievable by the use of a QMF policy. A QMF policy defines the access categories of different management frames. Only QoS STAs are able to implement QMF policy. A non-AP QMF STA uses the default QMF policy or the QMF policy accepted from a peer QMF STA to transmit management frames to that peer QMF STA. A QMF AP sets its own QMF policy for the transmission of QMFs to its associated STAs. A QMF STA uses access category AC_VO to transmit management frames to STAs that do not support the QMF service.

5. MAC service definition

5.1 Overview of MAC services

5.1.1 Data service

5.1.1.1 General

Change the first paragraph as follows:

This service provides peer LLC entities with the ability to exchange MSDUs. To support this service, the local MAC uses the underlying PHY-level services to transport an MSDU to a peer MAC entity, where it is delivered to the peer LLC. Such asynchronous MSDU transport is performed on a connectionless basis. By default, MSDU transport is on a best-effort basis. However, the QoS facility uses a traffic identifier (TID) to specify differentiated services on a per-MSDU basis. The QoS facility also permits more synchronous behavior to be supported on a connection-oriented basis using TSPECs. There are no guarantees that the submitted MSDU will be delivered successfully. Group addressed transport is part of the data service provided by the MAC. Due to the characteristics of the WM, group addressed MSDUs may experience a lower QoS, compared to that of individually addressed MSDUs. All STAs support the data service, but only QoS STAs in a QoS BSS differentiate their MSDU delivery according to the designated traffic category or traffic stream (TS) of individual MSDUs. QoS STAs that support the QMF service differentiate their MMPDU delivery according to the MMPDU's access category. The access category of each MMPDU is designated by the transmitter's current QMF policy.

6. Layer management

6.3 MLME SAP interface

6.3.3 Scan

6.3.3.3 MLME-SCAN.confirm

6.3.3.3.2 Semantics of the service primitive

Insert the following new row at the end of the BSSDescription parameter table:

Name	Type	Valid range	Description	IBSS adoption
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	The values from the QMF Policy element if such an element was present in the Probe Response or Beacon frame, else null.	Do not adopt

6.3.7 Associate

6.3.7.3 MLME-ASSOCIATE.confirm

6.3.7.3.2 Semantics of the service primitive

Change the primitive parameter list as follows:

The primitive parameters are as follows:

MLME-ASSOCIATE.confirm(
ResultCode,
CapabilityInformation,
AssociationID,
SupportedRates,
EDCAParameterSet,
RCPI.request,
RSNI.request,
RCPI.response,
RSNI.response,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
HT Capabilities,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
QosMapSet,
QMFPolicy,

VendorSpecificInfo
)

Insert the following new row before VendorSpecificInfo in the parameter table:

Name	Type	Valid range	Description
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	The values from the QMF Policy element if such an element was present in the Association Response frame else null.

6.3.7.5 MLME-ASSOCIATE.response

6.3.7.5.2 Semantics of the service primitive

Change the primitive parameter list as follows:

The primitive parameters are as follows:

MLME-ASSOCIATE.response(
PeerSTAAddress,
ResultCode,
CapabilityInformation,
AssociationID,
EDCA Parameter Set,
RCPI,
RSNI,
RMEnabledCapabilities,
Content of FT Authentication Elements,
SupportedOperatingClasses,
DSERegisteredLocation,
HTCapabilities,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
QoSMapSet,
QMFPolicy,
VendorSpecificInfo
)

Insert the following new row before VendorSpecificInfo in the parameter table:

Name	Type	Valid range	Description
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	Describes the QMF policy of the AP. This parameter is present when dot11QMFActivated is true, and is not present otherwise.

6.3.8 Reassociate

6.3.8.3 MLME-REASSOCIATE.confirm

6.3.8.3.2 Semantics of the service primitive

Change the primitive parameter list as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.confirm(
ResultCode,
CapabilityInformation,
AssociationID,
SupportedRates,
EDCAParameterSet,
RCPI.request,
RSNI.request,
RCPI.response,
RSNI.response,
RMEnabledCapabilities,
Content of FT Authentication Elements,
SupportedOperatingClasses,
HT Capabilities,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
FMSResponse,
DMSResponse,
QoSMapSet,
QMFPolicy,
VendorSpecificInfo
)

Insert the following new row before VendorSpecificInfo in the parameter table:

Name	Type	Valid range	Description
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	The values from the QMF Policy element if such an element was present in the Reassociation Response frame, else null.

6.3.8.5 MLME-REASSOCIATE.response

6.3.8.5.2 Semantics of the service primitive

Change the primitive parameter list as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.response(
PeerSTAAddress,
ResultCode,
CapabilityInformation,
AssociationID,
EDCAParameterSet,
RCPI,
RSNI,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
DSERegisteredLocation,
HT Capabilities,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
FMSResponse,
DMSResponse,
QoSMapSet,
QMFPolicy,
VendorSpecificInfo
)

Insert the following new row before VendorSpecificInfo in the parameter table:

Name	Type	Valid range	Description
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	Describes the QMF policy of the AP. This parameter is present when dot11QMFActivated is true, and is not present otherwise.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Change the primitive parameter list as follows:

The primitive parameters are as follows:

MLME-START.request(
SSID,
SSIDEncoding,
BSSType,
BeaconPeriod,
DTIMPeriod,
CF parameter set,
PHY parameter set,
IBSS parameter set,
ProbeDelay,
CapabilityInformation,
BSSBasicRateSet,
OperationalRateSet,
Country,
IBSS DFS Recovery Interval,
EDCAParameterSet,
DSERegisteredLocation,
HT Capabilities,
HT Operation,
BSSMembershipSelectorSet,
BSSBasicMCSSet,
HTOperationalMCSSet,
Extended Capabilities,
20/40 BSS Coexistence,
Overlapping BSS Scan Parameters,
MultipleBSSID,
InterworkingInfo,
AdvertisementProtocolInfo,
RoamingConsortiumInfo,
Mesh ID,
Mesh Configuration,
QMFPolicy,
VendorSpecificInfo
)

Insert the following new row before VendorSpecificInfo in the parameter table:

Name	Type	Valid range	Description
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This element is present when dot11QMFActivated is true and BSSType = INFRASTRUCTURE or MESH, and is not present otherwise, and is provided by the SME to signal to the MLME the QMF policy to be used for this BSS.

Insert the following new subclauses:

6.3.83 QMF policy

6.3.83.1 Introduction

The following MLME primitives support the signaling of QMF policy.

6.3.83.2 MLME-QMFPOLICY.request

6.3.83.2.1 Function

This primitive requests the transmission of an unsolicited QMF Policy frame to a peer entity.

6.3.83.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-QMFPOLICY.request (
                        Peer STA Address,
                        QMFPolicy
                        )
```

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity to which the QMF policy is sent.
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This parameter describes the QMF policy the peer STA is required to use.

6.3.83.2.3 When generated

This primitive is generated by the SME to request that a QMF Policy frame be sent to a peer entity to communicate QMF policy information.

6.3.83.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a QMF Policy frame. This frame is then scheduled for transmission.

6.3.83.3 MLME-QMFPOLICY.indication

6.3.83.3.1 Function

This primitive indicates that an unsolicited QMF Policy frame has been received from a peer entity.

6.3.83.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-QMFPOLICY.indication (
                    Peer STA Address,
                    QMFPolicy
                    )
```

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC from which the QMF policy was received.
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This parameter describes the QMF policy the peer STA is requiring to be used.

6.3.83.3.3 When generated

This primitive is generated by the MLME when a valid QMF Policy frame with dialog token equal to 0 is received from a peer entity.

6.3.83.3.4 Effect of receipt

The SME is notified of the receipt of a QMF policy.

6.3.83.4 MLME-QMFPOLICYCHANGE.request

6.3.83.4.1 Function

This primitive supports the change of QMF Policy between peer STAs. The SME requests the transmission of a QMF Policy Change frame in order to request a change in the QMF policy the STA uses to transmit to the peer STA.

6.3.83.4.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-QMFPOLICYCHANGE.request (
                    Peer STA Address,
```


Dialog Token,
QMFPolicy
)

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity to which the QMF policy change request is sent.
Dialog Token	Integer	1–255	The dialog token to identify the QMF policy change transaction.
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This parameters describes the QMF policy the STA is requesting to use.

6.3.83.4.3 When generated

This primitive is generated by the SME when a STA wishes to request a change of the QMF policy it uses to transmit management frames to a peer entity.

6.3.83.4.4 Effect of receipt

On receipt of this primitive, the MLME constructs a QMF Policy Change frame containing the set of QMF policy parameters. This frame is then scheduled for transmission.

6.3.83.5 MLME-QMFPOLICYCHANGE.confirm

6.3.83.5.1 Function

This primitive reports the results of a policy change attempt with a peer QMF STA.

6.3.83.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-QMFPOLICYCHANGE.confirm (
Peer STA Address,
Dialog Token,
Result Code
)

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity from which the QMF policy was received.
Dialog Token	Integer	1–255	The dialog token to identify the QMF policy change transaction.
Result Code	Enumeration	SUCCESS, REJECT, TIMEOUT	Reports the receipt of a QMF Policy frame and the result of the QMF policy change at the peer SME or if no matching response is received within dot11QMFPolicyChangeTimeout TU.

6.3.83.5.3 When generated

This primitive is generated by the MLME as a result of receipt of a QMF Policy frame with a dialog token that matches the dialog token from the MLME-QMFPOLICYCHANGE.request.

6.3.83.5.4 Effect of receipt

The SME is notified of the results of the QMF policy change procedure.

6.3.83.6 MLME-QMFPOLICYCHANGE.indication

6.3.83.6.1 Function

This primitive indicates that a QMF Policy Change frame has been received from a peer entity.

6.3.83.6.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-QMFPOLICYCHANGE.indication (
                                    Peer STA Address,
                                    Dialog Token,
                                    QMFPolicy
                                    )
```

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity from which the QMF policy change request was received.
Dialog Token	Integer	1–255	The dialog token to identify the QMF policy change transaction.
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This parameter describes the QMF policy the peer STA is requesting to use.

6.3.83.6.3 When generated

This primitive is generated by the MLME when a valid QMF Policy Change frame is received from a peer entity.

6.3.83.6.4 Effect of receipt

On receipt of this primitive, the parameters of the QMF Policy Change frame are provided to the SME to be processed.

6.3.83.7 MLME-QMFPOLICYCHANGE.response

6.3.83.7.1 Function

This primitive requests the transmission of a QMF Policy frame with no QMF Policy field to a peer entity, in response to a received QMF Policy Change frame.

6.3.83.7.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-QMFPOLICYCHANGE.response (
Peer STA Address,
Dialog Token,
Result Code
)

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity to which the QMF Policy frame is sent in response to a QMF policy change request.
Dialog Token	Integer	1–255	The dialog token identifying the QMF policy change transaction.
Result Code	Enumeration	SUCCESS, REJECT	Reports the outcome of the transaction.

6.3.83.7.3 When generated

This primitive is generated by the SME to request that a QMF Policy frame be transmitted to a peer entity to convey the results of the QMF policy change procedure.

6.3.83.7.4 Effect of receipt

On receipt of this primitive, the MLME constructs a QMF Policy frame containing the set of QMF Policy elements specified. This frame is then scheduled for transmission.

6.3.83.8 MLME-QMFPOLICYSET.request

6.3.83.8.1 Function

This primitive directs the setting of a specific QMF policy in the local MLM.

6.3.83.8.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-QMFPOLICYSET.request (
Peer STA address,
QMFPolicy
)

6.3.83.8.3 When generated

This primitive is generated by the SME to set the MLME's QMF policy for a peer STA.

Name	Type	Valid range	Description
Peer STA Address	MAC Address	Any valid individual MAC address	The address of the peer STA for which the QMF policy is to be used. If this parameter is null, the QMF policy applies to all transmissions.
QMFPolicy	QMF Policy element	As defined in 8.4.2.122	This parameter describes the QMF policy the MLME is directed to use for all QMFs transmitted to the Peer STA Address.

6.3.83.8.4 Effect of receipt

On receipt of this primitive, the MLME uses the supplied set of QMF policy parameters in future transmissions to the peer.

8. Frame formats

8.2 MAC frame formats

8.2.4 Frame fields

8.2.4.1 Frame Control field

8.2.4.1.4 To DS and From DS fields

Change the clause as follows:

The meaning of the combinations of values for the To DS and From DS fields in data frames are shown in Table 8-2.

Table 8-2—To/From DS combinations in data frames

To DS and From DS values	Meaning
To DS = 0 From DS = 0	A data frame direct from one STA to another STA within the same IBSS, a data frame direct from one non-AP STA to another non-AP STA within the same BSS, or a data frame outside the context of a BSS~~, as well as all management and control frames~~.
To DS = 1 From DS = 0	A data frame destined for the DS or being sent by a STA associated with an AP to the Port Access Entity in that AP.
To DS = 0 From DS = 1	A data frame exiting the DS or being sent by the Port Access Entity in an AP, or a group addressed Mesh Data frame with Mesh Control field present using the three-address MAC header format.
To DS = 1 From DS = 1	A data frame using the four-address MAC header format. This standard defines procedures for using this combination of field values only in a mesh BSS.

Insert the following new text at the end of the clause:

The meanings of the combinations of values of the management frame To DS and From DS fields are shown in Table 8-2a.

Table 8-2a—To/From DS combinations in management frames

To DS and From DS values	Meaning
To DS = 0 From DS = 0	All non-QMF management frames.
To DS = 1 From DS = 0	All QMF management frames.
To DS = 0 From DS = 1	This combination is reserved.
To DS = 1 From DS = 1	This combination is reserved.

In all control frames, To DS and From DS are both zero.

8.2.4.4 Sequence Control field

8.2.4.4.2 Sequence Number field

Change the clause as follows:

Each MSDU, A-MSDU, or MMPDU transmitted by a STA is assigned a sequence number. See 9.3.2.10 (Duplicate detection and recovery). Sequence numbers are not assigned to control frames, as the Sequence Control field is not present in those frames.

The Sequence Number field in data frames is a 12-bit field indicating the sequence number of ~~an~~the MSDU~~,~~ or A-MSDU.~~, or MMPDU. Each MSDU, A-MSDU or MMPDU transmitted by a STA is assigned a sequence number. Sequence numbers are not assigned to control frames, as the Sequence Control field is not present.~~

The Sequence Number field in QMFs comprises the QMF Sequence Number subfield and the AC Index (ACI) subfield. The QMF Sequence Number subfield is a 10-bit subfield indicating the sequence number of the frame. The ACI subfield is a 2-bit subfield indicating the ACI of the frame. The format of the Sequence Number field in QMFs is shown in Figure 8-3a.

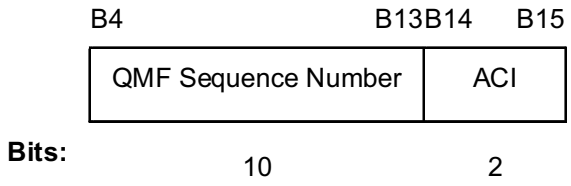

Figure 8-3a—Sequence Number field in QMFs

The value of the ACI subfield represents the ACI of the frame as defined in 8.4.2.31.

The Sequence Number field in management frames that are not QMFs is a 12-bit field indicating the sequence number of the frame.

Each fragment of an MSDU or MMPDU contains a copy of the sequence number assigned to that MSDU or MMPDU. The sequence number remains constant in all retransmissions of an MSDU, MMPDU, or fragment thereof.

8.3 Format of individual frame types

8.3.3 Management frames

8.3.3.1 Format of management frames

Insert the following text before the last two paragraphs in 8.3.3.1:

A management frame is an IQMF when both

— The RA of the management frame corresponds to an individual MAC address; and

— The To DS subfield is set to 1 and the From DS subfield of the Frame Control field is set to 0.

A management frame is a GQMF when both

— The RA of the management frame corresponds to a group MAC address; and

— The To DS subfield is set to 1 and the From DS subfield of the Frame Control field is set to 0.

8.3.3.2 Beacon frame format

Insert the following row in Table 8-20 before the "Vendor Specific" element:

Table 8-20—Beacon frame body

Order	Information	Notes
56	QMF Policy	Indicates the QMF policy parameters of the transmitting STA. The QMF Policy element is present when dot11QMFActivated is true, and is not present otherwise. The QMF Policy element is never present in Beacon frames in an IBSS.

8.3.3.6 Association Response frame format

Insert the following row in Table 8-23 before the "Vendor Specific" element:

Table 8-23—Association Response frame body

Order	Information	Notes
22	QMF Policy	The QMF Policy element is present if dot11QMFActivated is true and the QMFActivated subfield is 1 in the Extended Capabilities element in the Association Request that elicited this Association Response frame.

8.3.3.8 Reassociation Response frame format

Insert the following row in Table 8-25 before the "Vendor Specific" element:

Table 8-25—Reassociation Response frame body

Order	Information	Notes
26	QMF Policy	The QMF Policy element is present if dot11QMFActivated is true and the QMFActivated subfield is 1 in the Extended Capabilities element in the Reassociation Request that elicited this Reassociation Response frame.

8.3.3.10 Probe Response frame format

Insert the following row in Table 8-27 before the "Vendor Specific" element

Table 8-27—Probe Response frame body

Order	Information	Notes
55	QMF Policy	The QMF Policy element is present if dot11QMFActivated is true and the QMFActivated subfield is 1 in the Extended Capabilities element in the Probe Request that elicited this Probe Response frame.

8.4 Management frame body components

8.4.2 Information elements

8.4.2.1 General

Insert a new item in Table 8-54, and update the Reserved items as appropriate:

Table 8-54—Element IDs

Element	Element ID	Length of indicated element (in octets)	Extensible
QMF Policy (see 8.4.2.122)	181	3 to 257	

8.4.2.29 Extended Capabilities element

Insert two new items in Table 8-103, and update the reserved values as appropriate:

Table 8-103—Capabilities field

Bit	Information	Notes
49	QMFActivated	This subfield is set to 1 if dot11QMFActivated is true. Otherwise, it is set to 0. See 10.25.
50	QMFReconfigurationActivated	This subfield is set to 1 if dot11QMFReconfigurationActivated is true. Otherwise, it is set to 0. See 10.25.

Insert the following new subclause at the end of 8.4.2:

8.4.2.122 Quality-of-Service Management Frame Policy element

The Quality-of-Service Management Frame (QMF) Policy element defines a QMF access category mapping (QACM) of management frames and is used to advertise and exchange QMF policy between STAs. The use of the QMF Policy element is given in 10.25. See Figure 8-401a.

Element ID	Length	QACM #1	...	QACM #N
Octets: 1	1	variable		variable

Figure 8-401a—QMF Policy element format

The value of the Element ID field is equal to the QMF Policy value in Table 8-54.

The Length field is a 1-octet field whose value is dependent on the number and size of the QACM fields present in the element. The value of the Length field is between 1 and 255.

The QACM field specifies a group of management frames and their associated access categories. See Figure 8-401b and see 10.25.3.

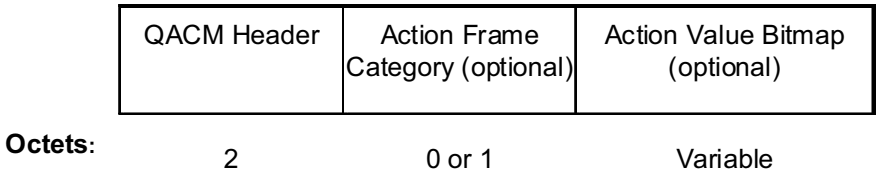

Figure 8-401b—QACM field format

The format of the QACM Header subfield of the QACM field is defined in Figure 8-401c.

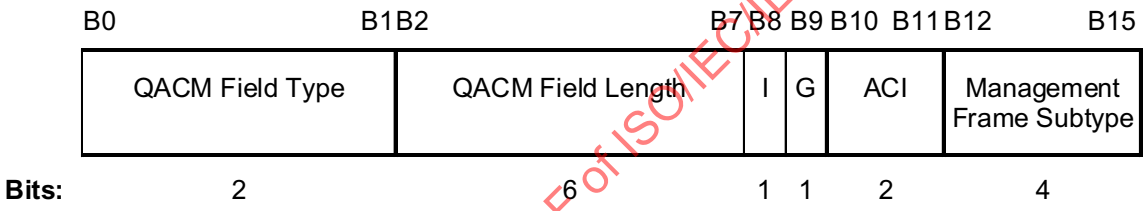

Figure 8-401c—QACM Header subfield

The QACM Field Type subfield is 2 bits in length and defines the structure of the QACM field. Its value is 0. Values 1, 2, and 3 are reserved.

The QACM Field Length subfield is 6 bits in length and defines the length in octets of the QACM field excluding the QACM Header subfield.

The Individually Addressed subfield (I) is 1 bit in length. When the QACM applies to individually addressed management frames, the value of the Individually Addressed subfield is 1. Otherwise, it is 0.

The Group Addressed subfield (G) is 1 bit in length. When the QACM applies to group addressed management frames, the value of the Group Addressed subfield is 1. Otherwise, it is 0.

The combination of I = 0 and G = 0 is not allowed.

The ACI subfield is 2 bits in length. Each frame of type management that is listed in the QACM Header subfield is transmitted using the access category identified by the accompanying ACI subfield.

The Management Frame Subtype subfield is 4 bits in length. It indicates the subtype of management frames that are sent using the access category indicated in the ACI subfield. The valid values for this subfield are the subtypes in Table 8-1 that correspond to frames of type management.

The Action Frame Category subfield is 1 octet in length and indicates the category of the Action frame, as defined in 8.4.1.11, of Action frames that are sent using the access category indicated in the ACI subfield. The Action Frame Category subfield is included only when the Management Frame Subtype subfield indicates Action or Action No Ack subtype as specified in 10.25.3.

The Action Value Bitmap subfield is included when the QACM Policy is specified for a subset of Action frame types in a Action Frame Category. The Action Value Bitmap subfield is of variable length and indicates the action values, as defined in 8.5, for the corresponding Action frame category that are sent using the access category indicated in the ACI subfield. The Action Value Bitmap subfield is included only when the Management Frame Subtype subfield indicates Action or Action No Ack subtype and the QACM Field Length subfield is greater than or equal to 2. Each bit in the Action Value Bitmap subfield is mapped to the corresponding action value. The Action Value Bitmap subfield is zero padded to complete any incomplete octet. When included, the size in octets of the Action Value Bitmap field is found by subtracting 1 from the value of the QACM Field Length subfield.

8.5 Action frame format details

8.5.8 Public Action details

8.5.8.1 Public Action frames

Insert two new items in Table 8-210 and update the reserved values as appropriate:

Table 8-210—Public Action field values

Public Action field value	Description
18	QMF Policy
19	QMF Policy Change

Insert the following new subclauses at the end of 8.5.8:

8.5.8.18 QMF Policy frame format

The QMF Policy frame uses the Action frame format and is transmitted by a requesting STA to a receiving STA with the included QMF policy. It is either sent unsolicited by the requesting STA or in response to a QMF Policy Change frame from a receiving STA. The format of the Action field of the QMF Policy frame is shown in Figure 8-460a.

	Category	Public Action	Dialog Token	Status Code	QMF Policy element (optional)
Octets:	1	1	1	2	3-257

Figure 8-460a—QMF Policy frame Action field contents

The Category field is set to the value for public action defined in Table 8-38.

The Public Action field is set to indicate a QMF Policy frame, as defined in Table 8-210.

The Dialog Token field is set to the value in the corresponding QMF Policy Change frame. If the QMF Policy frame is not being transmitted in response to a QMF Policy Change frame, then the Dialog Token field is set to zero.

The Status Code field is defined in 8.4.1.9.

The QMF Policy element is set as described in 8.4.2.122. It indicates the new access categories configured for management frame(s). This field is included if the Status Code is 0 (“Successful”) and this frame is not being transmitted in response to a QMF Policy Change frame, and optionally included if the Status Code is 37 (The request has been declined).

8.5.8.19 QMF Policy Change frame format

The QMF Policy Change frame uses the Action frame format and is transmitted by a requesting STA to request a change to the QMF policy it most recently received from the destination STA. The format of the Action field of the QMF Policy Change frame is shown in Figure 8-460b.

	Category	Public Action	Dialog Token	QMF Policy element
Octets:	1	1	1	3-257

Figure 8-460b—QMF Policy Change Action field contents

The Category field is set to the value for public action defined in Table 8-38.

The Public Action field is set to indicate a QMF Policy Change frame, as defined in Table 8-210.

The Dialog Token field is set to a nonzero value chosen by the STA sending the QMF Policy Change frame to identify the transaction.

The QMF Policy element is set as described in 8.4.2.122. It indicates the new access categories requested for management frame(s).

8.5.11 Protected Dual of Public Action frames

Insert two new items at the end of Table 8-228 and update the reserved values as appropriate:

Table 8-228—Public Action field values defined for Protected Dual of Public Action frames

Public Action field value	Description	Defined in
18	Protected QMF Policy	8.5.8.18
19	Protected QMF Policy Change	8.5.8.19

9. MAC sublayer functional description

9.2 MAC architecture

9.2.4 Hybrid coordination function (HCF)

9.2.4.2 HCF contention-based channel access (EDCA)

Change the second-to-last paragraph of 9.2.4.2 as follows:

If dot11QMFActivated is false or not present for a QoS STA, a~~A~~ QoS STA should send individually addressed Management frames that are addressed to a non-QoS STA using the access category AC_BE and shall send all other management frames using the access category AC_VO, whether or not it is associated with a BSS or there is a QoS facility in the BSS. If dot11QMFActivated is false or not present for a QoS STA, a~~A~~ QoS STA that does not send individually addressed Management frames that are addressed to a non-QoS STA using the access category AC_BE shall send them using the access category AC_VO. Management frames are exempted from any and all restrictions on transmissions arising from admission control procedures. ~~A QoS STA shall also send management frames using the access category AC_VO beforeassociating with any BSS and before establishing mesh peerings in an MBSS, even if there is no QoS facility available in that BSS.~~ If dot11QMFActivated is true for a STA, the STA shall send management frames as described in 10.25. BlockAckReq and BlockAck frames shall be sent using the same access category as the corresponding QoS data frames. PS-Poll frames shall be sent using the access category AC_BE (to reduce the likelihood of collision following a Beacon frame) and are exempted from any and all restrictions on transmissions arising from admission control procedures. When the first frame in a frame exchange sequence is an RTS or CTS frame, the RTS or CTS frame shall be transmitted using the access category of the corresponding QoS Data/QoS Null frame(s) or AC_VO for management frames. Control Wrapper frames shall be sent using the access category that would apply to the carried control frame.

9.3 DCF

9.3.2 Procedures common to the DCF and EDCAF

9.3.2.10 Duplicate detection and recovery

Change 9.3.2.10 as follows:

Because MAC-level acknowledgments and retransmissions are incorporated into the protocol, there is the possibility that a frame may be received more than once. The procedures defined in this subclause attempt to filter out these duplicates. Additional duplicate filtering is performed during Receive Buffer Operation for frames that are part of a Block Ack agreement as described in 9.21.4 and 9.21.7.

Duplicate frame filtering is facilitated through the inclusion of a Sequence Control field (consisting of a sequence number and fragment number) within data and management frames ~~as well as,~~ a TID subfield in the QoS Control field within QoS data frames, and an ACI subfield in the Sequence Number field within QMFs. MPDUs that are part of the same MSDU or A-MSDU shall have the same sequence number, and different MSDUs or A-MSDUs have (with a high probability) a different sequence number.

A non-QoS STA shall assign sequence numbers to management frames and data frames (QoS subfield of the Subtype field is equal to 0) from a single modulo-4096 counter, starting at 0 and incrementing by 1, for each MSDU or MMPDU. A QoS STA operating as a non-QoS STA because it is in a non-QoS BSS or non-QoS IBSS shall assign sequence numbers to management frames and data frames (QoS subfield of the Subtype field is equal to 0) from a single modulo-4096 counter, starting at 0 and incrementing by 1, for each MSDU or MMPDU. A transmitting STA should cache the last used sequence number per RA for frames that are assigned sequence numbers from this counter and should ensure that the successively assigned sequence numbers for frames transmitted to a single RA do not have the same value by incrementing the counter by 2, if incrementing by 1 would have produced the same sequence number as is found in the cache for that RA.

A STA operating as a QoS STA shall maintain one modulo-4096 counter per <Address 1, TID> tuple, for individually addressed QoS Data frames. Sequence numbers for these frames are assigned using the counter identified by the Address 1 field and the TID subfield of the QoS Control field of the frame, and that counter is incremented by 1 for each MSDU or A-MSDU corresponding to that <Address 1, TID> tuple. Sequence numbers for management frames, QoS data frames with a group address in the Address 1 field, and all non-QoS data frames transmitted by QoS STAs with dot11QMFActivated false or not present shall be assigned using an additional single modulo-4096 counter, starting at 0 and incrementing by 1 for each such MSDU, A-MSDU or MMPDU, except that a QoS STA may use values from additional modulo-4096 counters per <Address 1, TID> for sequence numbers assigned to time priority management frames. A transmitting STA should cache the last used sequence number per RA for frames that are assigned sequence numbers from this counter and should ensure that the successively assigned sequence numbers for frames transmitted to a single RA do not have the same value by incrementing the counter by 2, if incrementing by 1 would have produced the same sequence number as is found in the cache for that RA.

When transmitted by a QMF STA, the STA shall assign sequence numbers for the frames listed below using a modulo-4096 counter, starting at 0 and incrementing by 1 for each such MSDU or MMPDU:

- Management frames that are not QMFs
- Group addressed QoS data frames
- All non-QoS data frames

and shall assign the sequence number for QMFs from one modulo-1024 counter per <Address 1, AC> tuple starting at 0 and incrementing by 1 for each MMPDU carried in one or more QMFs with Address 1 and ACI fields matching the <Address 1, AC> tuple values corresponding to that counter.

Sequence numbers for QoS (+)Null frames may be set to any value.

A receiving STA shall keep a cache of recently received <Address 2, sequence-number, fragment-number> tuples from frames that are not QoS Data frames. The receiving STA shall keep at least the most recent cache entry per <Address 2> value in this cache. ~~The~~A receiving QoS STA shall also keep a cache of recently received <Address 2, TID, sequence-number, fragment-number> tuples from QoS Data frames from all STAs from which it has received QoS data frames. The receiving QoS STA shall keep at least the most recent cache entry per <Address 2, TID> pair in this cache. The receiving STA should maintain two

additional caches, one containing entries of recently received <Address 2, sequence-number, fragment-number> tuples from received management frames that are not time priority management frames and the other containing entries of recently received <Address 2, sequence-number, fragment-number> tuples from received time priority management frames. The receiving STA should not include the entries in these two additional caches in any other caches. In each of these two caches, the receiving STA should keep at least the most recent cache entry per <Address 2> value. A receiving STA with dot11QMFActivated false or not present should omit tuples obtained from group addressed or ATIM frames from all caches.

A receiving QMF STA shall also keep a cache of recently received <Address 2, AC, sequence-number, fragment-number> tuples from QMFs for all STAs from which the QoS STA has received QMFs. A receiving QMF STA is required to keep only the most recent cache entry per <Address 2, AC, sequence-number, fragment-number> for QMFs. A receiving QMF STA shall omit from the caches all tuples obtained from group addressed data frames and tuples obtained from ATIM frames.

A receiving STA shall reject as a duplicate frame any frame that is not a QoS Data frame in which the Retry bit in the Frame Control field is 1 and that matches an <Address 2, sequence-number, fragment-number> tuple of an entry in the cache that contains tuples of that format, unless the frame is a management frame and the STA is maintaining separate caches for <Address 2, sequence-number, fragment-number> tuples from received management frames. A receiving QoS STA shall also reject as a duplicate frame any QoS Data frame in which the Retry bit in the Frame Control field is 1 and that matches an <Address 2, TID, sequence-number, fragment number> tuple of an entry in the cache that contains tuples of that format. A STA that is maintaining separate caches for <Address 2, sequence-number, fragment-number> tuples from received management frames shall reject as a duplicate frame any management frame that is not a time priority management frame in which the Retry bit in the Frame Control field is 1 and that matches an <Address 2, sequence-number, fragment-number> tuple of an entry in the management cache that contains tuples from frames that are not time priority management frames. A STA that is maintaining separate caches for <Address 2, sequence-number, fragment- number> tuples from received management frames shall reject as a duplicate frame any time priority management frame in which the Retry bit in the Frame Control field is 1 and that matches an <Address 2, sequence-number, fragment-number> tuple of an entry in the cache that contains tuples from time priority management frames. A receiving QoS STA shall also reject as a duplicate frame any QMF in which the Retry bit in the Frame Control field is 1 and that matches an <Address 2, AC, sequence-number, fragment number> tuple of an entry in the cache of tuples obtained from QMFs.

There is a small possibility that a frame may be improperly rejected due to such a match; however, this occurrence would be rare and simply results in a lost frame (similar to an FCS error in other LAN protocols).

NOTE—The receiver STA performs the ACK and (for an AP) PS procedures on all successfully received frames requiring acknowledgment, even if the frame is discarded due to duplicate filtering.

10. MLME

10.23 Wireless network management procedures

10.23.14 Channel usage procedures

Change the 6th paragraph of 10.23.14 as follows:

Upon receipt of a Channel Usage element in the Probe Response or Channel Usage Response frame, the receiving STA may use the following:

— The channel usage information as part of channel selection processing to start a non-infrastructure network or an off-channel TDLS direct link

— The Power Constraint element, if present, as part of determining its maximum transmit power for transmissions for the non-infrastructure network or an off-channel TDLS direct link
— The EDCA Parameter Set element, if present, as part of determining its EDCA parameters for transmissions for the non-infrastructure network or an off-channel TDLS direct link
— The QMF Policy element, if present and dot11QMFActivated is true, as part of determining its classification of management frames for transmissions for the non-infrastructure network or an off-channel TDLS direct link

Insert the following new subclauses at the end of Clause 10:

10.25 Quality-of-service management frame (QMF)

10.25.1 General

10.25.1.1 Overview

A QMF STA shall set dot11QMFActivated and dot11QosOptionImplemented to true. The QMF STA shall assign an access category to each management frame according to the access category assignments indicated in the QMF policy that has been configured using the configuration procedures described in 10.25.2.

A QMF STA shall set the QMFActivated subfield in the Extended Capabilities element to 1.

A management frame shall be transmitted as an IQMF when all five of the following conditions are met:

— The RA of the management frame corresponds to an individual MAC address.
— The frame is transmitted by a QMF STA.
— The transmitting STA has previously received an Extended Capabilities element from the STA corresponding to the RA of the frame being transmitted.
— The most recently received such Extended Capabilities element indicated that the STA is a QoS STA and has the value of 1 in the QMFActivated subfield.
— The frame is not a time priority management frame.

A QMF AP shall transmit a management frame as a GQMF when all three of the following conditions are met:

— The RA of the management frame corresponds to a group MAC address.
— The transmitting STA has received an Extended Capabilities element that has the QMFActivated subfield equal to 1 from every member of the BSS corresponding to the BSSID of the management frame.
— The frame is not a time priority management frame.

A non-AP QMF STA shall transmit a management frame as a GQMF when all three of the following conditions are met:

— The RA of the management frame corresponds to a group MAC address.
— The transmitting STA has received an Extended Capabilities element that has the QMFActivated subfield equal to 1 from its associated AP.
— The frame is not a time priority management frame.

NOTE—This standard assumes all APs within an ESS are configured consistently for QMF service when GQMF has been enabled for use by associated non-AP STAs.

When the QMFActivated subfield is zero in the most recently received Extended Capabilities element from a destination STA, or when an Extended Capabilities element has not been received from a destination STA,

a transmitting QMF STA shall transmit individually addressed management frames to that destination STA using access category AC_VO.

If the QMFActivated subfield in the most recently received Extended Capabilities element from a destination QMF STA is equal to one, but no QMF Policy element has been received from the destination QMF STA, and, if associated, no QMF Policy element has been received from the QMF AP with which the STA is associated, then a QMF STA shall transmit all IQMFs to the destination QMF STA using the default QMF policy access categories defined in Table 10-12. Otherwise, the QMF STA shall transmit individually addressed management frames as defined in the QMF policy included in the QMF Policy element accepted from the destination QMF STA. In either case, the transmitted management frames are IQMFs, and the transmitting QMF STA shall indicate the access category used to transmit the frame in the ACI subfield of the sequence number field.

A QMF STA in an unassociated state shall transmit all group-addresses management frames as non-QMF. An associated QMF STA shall follow the QMF policy dictated by its associated AP for transmitting GQMFs as described in 10.25.2. The specific access category assignments of different management frames within a non-default QMF policy are beyond the scope of this document. The transmitting QMF STA shall indicate the access category used to transmit GQMFs in the ACI subfield of the sequence number field.

Time-priority management frames, when not sent as an immediate response, shall be transmitted using AC_VO.

10.25.1.2 Default QMF policy

The default QMF policy is as defined in Table 10-12. It defines the access category of each management frame based on management subtype value, category value, and action value. QMFs not included in this table shall be assigned an access category AC_BE.

Table 10-12—Default QMF policy

Description	Management Frame Subtype value from Table 8-1	Category value from Table 8-38	Action class	QMF access category
(Re)Association Request/ Response	0000–0011	N/A	N/A	AC_VO
Probe Request (individually addressed	0100	N/A	N/A	AC_VO
Probe Request (group addressed)	0100	N/A	N/A	AC_BE
Probe Response	0101	N/A	N/A	AC_BE
Timing Advertisement	0110	N/A	N/A	AC_BE
Beacon, ATIM, Disassociation, Authentication, Deauthentication	1000–1100	N/A	N/A	AC_VO
Spectrum management	1101	0	0–3	AC_BE
Spectrum management—channel switch announcement	1101	0	4	AC_VO
QoS	1101	1	0–3	AC_VO

Table 10-12—Default QMF policy *(continued)*

Description	Management Frame Subtype value from Table 8-1	Category value from Table 8-38	Action class	QMF access category
DLS	1101	2	0–2	AC_BE
Block Ack	1101	3	0–2	AC_VO
Public	1101	4	0, 1, 3, 5–6, 8–9	AC_BE
Public—DSE deenablement, extended channel switch announcement	1101	4	2, 4	AC_VO
Public—measurement pilot	1101	4	7	AC_VO
Public—TDLS Discovery Response	1101	4	14	AC_VO
Radio measurement	1101	5	0–5	AC_BE
Fast BSS Transition	1101	6	0–4	AC_VO
HT	1101	7	0–3	AC_VO
HT	1101, 1110	7	4–7	AC_VO
SA Query	1101	8	0–1	AC_VO
Protected Dual of Public Action	1101	9	1–2, 5–6, 8–9	AC_BE
Protected Dual of Public Action—extended channel switch announcement	1101	9	4	AC_VO
WNM	1101	10	0–24	AC_BE
Unprotected WNM	1101	11	0–1	AC_BE
Mesh Action—HWMP Mesh Path Selection	1101	13	1	AC_VO
Mesh Action—Congestion Control	1011	13	3	AC_VO
Mesh Action	1101	13	0, 2, 4–10	AC_BE
Multihop Action	1101	14	0–1	AC_BE
Self Protected	1101	15	0–5	AC_VI
Reserved (used by WFA)	1101	17	All	AC_BE
Vendor-specific Protected	1101	126	N/A	AC_BE
Vendor-specific	1101	127	N/A	AC_BE

10.25.2 QMF policy advertisement and configuration procedures

10.25.2.1 Overview

QMF policies are exchanged and implemented between two QMF STAs. QMF policy is communicated through the QMF Policy element as described in 8.4.2.122.

A non-AP QMF STA operating in a BSS shall not transmit a QMF Policy frame to an AP.

The access category for a QMF that is transmitted by a non-AP QMF STA to a peer QMF STA shall be determined from the QMF policy received from the peer if a QMF policy has been received from the peer. Otherwise, the default policy shall be used. The access category for a QMF that is transmitted by a QMF AP is determined from the QMF policy configured at that AP.

In a BSS or MBSS, the access category for any management frame may be reconfigured. For example, vendor-specific and vendor-specific protected management frames might be reconfigured to suit the vendor application requirements.

10.25.2.2 QMF policy change in an infrastructure BSS or in an MBSS

A QMF Policy Change frame is transmitted by a QMF STA to request a change to the QMF policy that the requesting QMF STA will use for transmitting management frames to the peer QMF STA in an infrastructure BSS or in an MBSS.

A STA may transmit a QMF Policy Change frame to request a change in the QMF policy for transmitting to a peer STA. A non-AP QMF STA that receives a QMF Policy Change frame may either accept or reject the request. An associated non-AP QMF STA may transmit a QMF Policy Change to the QMF AP in its BSS only if the most recently received Extended Capabilities element from the AP has its QMFReconfiguration-Activated subfield equal to 1. If the AP rejects the request, the associated QMF STA shall not request the same policy reconfiguration from the AP within the lifetime of its association.

An AP shall respond to a QMF Policy Change frame received from an associated STA by transmitting a QMF Policy frame. If the QMFReconfigurationActivated subfield is zero in the Extended Capabilities element in the Beacon frame, an AP that receives a QMF Policy Change frame from an associated STA shall respond with a QMF Policy frame, with Status Code set to 37 (The request has been declined). If the QMFReconfigurationActivated subfield is 1 in the Extended Capabilities element in the Beacon frame, an AP that receives a QMF Policy Change frame from an associated STA shall evaluate the QMF Policy included in the frame, and shall respond to the request with the resulting QMF Policy element and Status Code set to 0 (Successful) if it accepts the policy change, or 37 (The request has been declined) if it rejects the policy change. A QMF AP may transmit a QMF Policy frame with Status Code set to 0 (Successful) to an associated QMF STA without having first received a QMF Policy Change frame from that STA.

If an accept status is received in a QMF Policy frame within dot11QMFPolicyChangeTimeout of having transmitted a QMF Policy Change frame with the same dialog token to the STA that transmitted the QMF Policy frame, then the requesting QMF STA shall transmit any subsequently queued management frames to the peer QMF STA in accordance with the changes to the QMF policy that were indicated in the QMF Policy Change frame.

If a reject status is received in a QMF Policy frame within dot11QMFPolicyChangeTimeout of having transmitted a QMF Policy Change frame with the same dialog token to the STA that transmitted the QMF Policy frame as a response to a QMF Policy Change frame, then the configuration change request is rejected and the requesting QMF STA shall continue to transmit Management frames to the peer QMF STA in accordance with the previously configured QMF policy. The requesting QMF STA shall not transmit a QMF