IEEE P802.11
Wireless LANs

|  |
| --- |
| Frame Type Encoding |
| Date: 2014-09-18 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Donald Eastlake | Huawei Technologies | 155 Beaver Street, Milford, MA 01757 USA | +1-508-333-2270 | d3e3e3@gmail.com |
|  |  |  |  |  |

Abstract

This document proposes a resolution of CC17 comments related to EPD versus LPD, mixed GLK/non-GLK BSSes, GLK STA identification and capability indication, and the like, in 802.11ak D0.03 as amended by the adoption of 11-14/767r3.

**Table of Contents**

Background 5

Comment Resolutions 6

CID 36 6

CID 49 6

CID 59 6

CID 63 7

CID 64 7

CID 65 7

CID 68 8

CID 69 8

CID 78 8

CID 91 9

CID 98 9

CID 99 9

Draft Changes to P802.11ak\_D0.03 as amended by the adoption of 11-14/767r3 11

Introduction 11

3. Definitions, acronyms, and abbreviations 11

3.4 Abbreviations and acronyms 11

4. General Description 12

4.3 Components of the IEEE Std 802.11 architecture 12

4.3.14 STA transmission of Data frames outside the context of a BSS 12

4.3.23 General Link (GLK) 12

4.3.23.1 General 12

4.3.23.2 EtherType Protocol Discrimination (EPD) 12

4.3.23.3 Selective reception of a group addressed MPDUs 13

5. MAC service definition 14

5.1 Overview of MAC services 14

5.1.4 MSDU format 14

5.1.5 MAC data service architecture 14

5.1.5.1 General 14

6. Layer management 15

6.3 MLME SAP interface 15

6.3.3 Scan 15

6.3.3.3 MLME-SCAN.confirm 15

6.3.3.3.1 Function 15

6.3.3.3.2 Semantics of the primitive 15

6.3.4 Synchronization 16

6.3.4.1 Introduction 16

6.3.4.2 MLME-JOIN.request 16

6.3.4.2.1 Function 16

6.3.4.2.2 Semantics of the service primitive 16

6.3.11 Start 17

6.3.11.1 Introduction 17

6.3.11.2 MLME-START.request 17

6.3.11.2.1 Function 17

6.3.11.2.2 Semantics of the service primitive 17

8. Frame formats 18

8.1 General Requirements 18

8.2 MAC frame formats 18

8.3 Formats of individual frame types 18

8.3.1 Control Frames 18

8.3.2 Data Frames 18

8.3.2.1 Data frame format 18

8.3.2.1.1 General 18

8.3.2.1.2 Address and BSSID fields 18

8.3.2.1.3 Other MAC Header fields 20

8.3.2.1.4 The frame body 20

8.3.2.2 Aggregated MSDU (A-MSDU) format 21

8.3.2.2.1 General 21

8.3.2.3 Control Block (CB) A-MSDU (CBA-MSDU) format 21

8.3.3 Management frames 21

8.3.3.1 Format of Management frames 21

8.3.3.2 Beacon frame format 21

8.3.3.5 Association Request frame format 21

8.3.3.6 Associaton Response frame format 22

8.3.3.7 Reassociation Request frame format 22

8.3.3.8 Reassociation Response frame format 22

8.3.3.9 Probe Request frame format 22

8.3.3.10 Probe Response frame format 22

8.3.4 Extension frames 23

8.3.4.1 DMG Beacon 23

8.4 Management and Extension frame body components 23

8.4.1 Fields that are not elements 23

8.4.1.1 Authentication Algorithm Number field 23

8.4.1.2 Authentication Transaction Sequence Number field 23

8.4.1.3 Beacon Interval field 23

8.4.1.4 Capability Information field 23

8.4.2 Elements 24

8.4.2.1 General 24

8.4.2.2 SSID element 24

8.4.2.3 Supported Rates and BSS Membership Selectors element 24

8.4.2.12 Extended Supported Rates and BSS Membership Selectors element 25

8.4.2.127 DMG Capabilities element 25

8.4.2.127.1 General 25

8.4.2.127.2 DMG STA Information Capability element 25

8.4.2.147 Relay Capabilities element 26

8.4.2.171 GLK Capabilities element 26

8.5 Fields used in Management and Extension frame bodies and Control frames 27

8.6 Action frame format details 27

8.6.8 Public Action details 27

8.6.8.16 TDLS Discovery Response frame format 27

8.6.13 TDLS Action field formats 27

8.6.13.2 TDLS Setup Request Action field format 27

8.6.16 Self-protected Action frame details 28

8.6.16.1 Self-protected Action fields 28

8.6.16.2 Mesh Peering Open frame format 28

8.6.16.2.1 Mesh Peering Open frame self-protection 28

8.6.16.2.2 Mesh Peering Open frame details 28

8.6.16.3 Mesh Peering Confirm frame format 28

8.6.16.3.1 Mesh Peering Confirm frame self-protection 28

8.6.16.3.2 Mesh Peering Confirm frame details 28

9. MAC sublayer functional description 28

10. MLME 28

10.45 GLK ~~BSS~~ Operation 28

10.46 EPD Operation 29

13. MLME Mesh procedures 29

13.11 Mesh Interworking ~~with the DS~~ 29

13.11.1 Overview of Mesh Interworking between a mesh BSS and a DS 29

Annex C, ASN.1 encoding of the MAC and PHY MIB 29

# Background

802.11ak (also known as GLK (General Link)) amends 802.11 to support 802.11 transit links within bridged networks.

P802.11ak drafts D0.01 thru D0.03 propose to handle this for GLK associations, which must be usable as transit links in an 802.1Q conformant network, by, among other things, using EPD for all MSDUs sent on such associations and restricting association with a GLK AP to GLK non-AP STAs.

To resolve the comments listed below, this document proposes changes to P802.11ak\_D0.03, as amended by the adoption of 11-14/767r3, to permit support for both EPD and LPD, permit mixed BSSes, and makes changes in the solution to the subsetting problem eliminating CBA-MSDUs, all as outlined in 11-14/977.

# Comment Resolutions

Note that references in comments are to 11ak\_D0.01.

 Clause Page Line

## CID 36

|  |  |  |
| --- | --- | --- |
| 6.3.11 | 16 | 38 |

**Comment:** While it seems technically accurate that the CapabilityInformation carries enough information to determine if an MLME-START is for a GLK BSS or not, indicating it only this way is not consistent with other BSS types. Others are also indicated in the BSSType parameter. I think we want to be consistent, even if a bit redundant, perhaps.

**Commenter’s Suggested Remedy:** Remove the Note about MLME-START, and instead modify MLME-START to have a GLK BSS type added to the BSSType parameter enumeration.

**New Response: Revise. GLK is really orthogonal to the existing BSS types so it is best to add a new GLK capabilities parameter to MLME.START.**

## CID 49

|  |  |  |
| --- | --- | --- |
| 4.3.21.3 | 7 | 18 |

**Comment:** Since only a group addressed MPDU transmitted by a GLK AP requires Control Block, using CBA-MSDU format every time causes unnecessary overhead. A GLK STA shall be able to use the normal A-MSDU for throughput improvement.
To distinguish a frame that contains Control Block from other frame, it shall be defined as a new Extension frame 'CB QoS Data'.

**Commenter’s Suggested Remedy:** 1) Replace 4.3.21.3 by follows;
---
A GLK AP may use the Control Block (CB) QoS Data frame to specify which members of the group addressed non-AP STAs by the CB QoS Data frame will process MSDU(s).
Support of the CB QoS Data frame is optional. When the GLK AP does not use the CB QoS Data frame, the GLK AP converts a group addressed MPDU to multiple individually addressed MPDUs.

2) Define a new Extension frame type CB QoS Data in 8.2.4.1.3 by modifying the Table 8-1 as follows;
----
11 Extension <ANA> CB QoS Data
11 Extension <ANA+1>-1111 Reserved

3) Specify a CB QoS Data frame in 8.3.4 and remove 8.3.2.3.

4) Replace "CBA-MSDU" by "CB QoS Data" throughout the draft

A submission 11-14/0539 will provide proposed texts.

N**ew Response: Revise: CBA-MSDU material deleted.**

## CID 59

|  |  |  |
| --- | --- | --- |
| 8.3.2.3 | 19 | 22 |

**Comment:** The current CB mechanism is too complex for efficient implementation. SIPD-CB and Vendor Specific CB are not necessary.

**Commenter’s Suggested Remedy:** 1) Change CBA-MSDU structure (Figure 8-48a) to include only one CB.
2) Delete SIPD-CB related description.
3) Delete Vendor Specific CB related description.
4) Change CB Header structure (Figure 8-48c) as follows;
 - B0 is CB Type (0 = SE-CB, 1 = SI-CB)
 - B1 to B5 is reserved
 - B6 to B15 is CB Data Length

N**ew Response: Revise: CBA-MSDU material deleted.**

## CID 63

|  |  |  |
| --- | --- | --- |
| 4.3.21.1 | 6 | 28 |

**Comment:** [for David Kloper] We are asserting that GLK is the role of the STA. I would recommend that this be the role in an association between 2 STA, so a device can both service Clients as an AP and provide bridging / backhaul as GLK over the same physical radio.

**Commenter’s Suggested Remedy:** We should reword this section to leave open the role being per association. To that end we should have 2 bits, so that Beacons/Probes can indicate both capable of accepting a GLK as well as requiring GLK only. Then Assoc/re-assoc can indicate role being requested.

N**ew Response: Revise. Requirement for GLK/EPD indicated by BSS membership selector values. Support for GLK indicated by presence of GLK Capabilities IE. Support for EPD indicated by capability bit. GLK is a property of an association/peering.**

## CID 64

|  |  |  |
| --- | --- | --- |
| 4.3.21.1 | 6 | 28 |

**Comment:** [for David Kloper] I don't think we should be adding capability bits to existing Info Elements vs creating a new GLK IE. This will allow negotiation of other GLK related options.

**Commenter’s Suggested Remedy:** Replace reference to those 2 IE, and add a reference to a new IE section we should create.

N**ew Response: Revise. We are adding a GLK IE but also using one capability bit for EPD.**

## CID 65

|  |  |  |
| --- | --- | --- |
| 4.3.21.1 | 7 | 4 |

**Comment:** [for David Kloper] The use of 4 address, as written looks optional and should be mandated. That is the purpose it was intended for, most specifically for unicast traffic.

**Commenter’s Suggested Remedy:** "GLK STAs support the 4-address format (see 8.2.3)" -> "Data frames between GLK STAs must use the 4-address format (see 8.2.3)"

N**ew Response: Revise. GLK support for four address format is mandatory and section 4 has more detail now but normative requirements do not belong in Clause 4. See changes in 11-14/826.**

## CID 68

|  |  |  |
| --- | --- | --- |
|  | 1 |  |

**Comment:** [for David Kloper] I think the use of Mcast (RA not DA), and the complexity you have added w/ CBA-MSDU is not worthwhile. With 10% PER + collisions + selection of lower data rates for Mcast, this may be unavoidable on the last hop to Clients, but on intermediate GLK links it will quickly add up over multiple hops, and make the network unusable. Better to layer Bridging on a reliable / low PER link, after unicast MAC layer retries.

**Commenter’s Suggested Remedy:** Recommend that: 1) Replication as unicast 4 Addr frames to the desired set of Peers is called out as mandatory; 2) If keeping support for Mcast RA, it is negotiated (support being optional), and only used to the set of supporting peers; 3) Simplification of CBA-MSDU format, which is only used for Mcast RA;

N**ew Response: Reject. CBA-MSDUs are eliminated but provisions for multidestination frames remains.**

## CID 69

|  |  |  |
| --- | --- | --- |
|  | 1 |  |

**Comment:** [for David Kloper] Concerns: Aggregation is critical to 11n/11ac/11ad performance, and subversion of A-MSDU can severely impact that. I think Egress processing would be an issue, as marking is by aggregate vs MSDU, and frames are entering the bridge function interleaved between interfaces/flows and so can be expected to have different sets of destination peers. Ingress processing can be expensive with a complicated format more applicable to Mgmt traffic, requiring linear walking a variable sized, unordered list. As the packet rates go up, this will be a serious concern. Again, these format changes might break any HW acceleration in chipsets.

**Commenter’s Suggested Remedy:** Recommendations if keeping CBA-MSDU: 1) Support is optional, and only used for Mcast RA, as adding no value for Ucast RA; 2) Replace complicated Mgmt frame like format with a fixed sized bitmap; 3) Rather than use AID that only exists in 1 direction, and thus arbitrarily limiting its usage, use the proposed GLK IE to inform each peer which bit is assigned for them in each direction; 4) Strongly prefer bitmap in 24 LSb of RA;

N**ew Response: Revise. CBA-MSDUs are eliminated. Bitmap in RA is one option available with bit number based on AID.**

## CID 78

|  |  |  |
| --- | --- | --- |
|  | 1 |  |

**Comment:** Current scheme with CBA-MSDU is more complexity than the use cases can support.

**Commenter’s Suggested Remedy:** 1) GLK stations use the 4-address format only. Whether that 4-address SDU/PDU is aggregated or not is an orthogonal question, and the current rules are followed.
2) The Receiver address (in 4-address format) can be the broadcast address, but we would not expect that to be used, much.
3) If we really, really feel that we need it, we could allow the Receiver Address to be a fixed upper 32 bits, and place the AID of the station to \*not\* receive the frame in the lower 16 bits of the Receiver Address. That would take care of the bulk of the issues raised by me (and others) early in the development of 11ak. It is not clear to me, any longer, that this is required, however.
4) A GLK station, of course, ignores all 3-address frames.

N**ew Response: Revise. CBA-MSDUs are eliminated. There is no need to restrict GLK STAs to 4-address MPDUs. See 11-14/826.**

## CID 91

|  |  |  |
| --- | --- | --- |
| 8.2.4.1.4 | 18 | 14 |

**Comment:** The procedure for using four address MAC header with both To and From DS "true" by a GLK STA has to be refered and be described there.

**Commenter’s Suggested Remedy:** As in comment.

N**ew Response: Reject. “Procedure” for using four address MAC should not be in clause 8 but in clause 9. See also CID 60.**

## CID 98

|  |  |  |
| --- | --- | --- |
| 8.3.2.3.1 | 21 | 8 |

**Comment:** Move the normative behavior from clause 8 to clause 9.
Especially, the below sentences are inappropriate to be placed in clause 8.
"The CB Data length of the SE-CB specifies the length of the list of AIDs. If the CB Data Length is not an even number, a receiving STA shall discard the CBA-MSDU.
If more than one SE-CB or both an SE-CB and an SI-CB or an SIPD-CB occur in a CBA-MSDU, a receiving STA shall discard the CBA-MSDU."
"A STA receiving a CBA-MSDU on an association whose AID appears in the SE-CB in that CBA-MSDU shall discard the CBA-MSDU."

**Commenter’s Suggested Remedy:** As per comment.

N**ew Response: Reject – all the CB material is going away. Equivalent new material will be put in Clause 9.**

## CID 99

|  |  |  |
| --- | --- | --- |
| 8.3.2.3.2 | 21 | 24 |

**Comment:** Move the normative behavior from clause 8 to clause 9.
Especially, the below sentences are inappropriate to be placed in clause 8.

"The CB Data length of the SI-CB specifies the length of the list of AIDs. If the CB Data Length is not an even number, a receiving STA shall discard the CBA-MSDU. If more than one SI-CB or both an SI-CB and an SE-CB or an SIPD-CB occur in a CBA-MSDU, a receiving STA shall discard the CBA-MSDU."
"An empty AID list, which is indicated by a CB data length of zero, indicates no receiver inclusions so all receiving STAs will discard the CBA-SMDU."

**Commenter’s Suggested Remedy:** As per comment.

N**ew Response: Reject – all the CB material is going away. Equivalent new material will be put in Clause 9.**

# Draft Changes to P802.11ak\_D0.03 as amended by the adoption of 11-14/767r3

# Introduction

***Change text as follows:***

Areas of extension are as follows:

1. Optional support ~~Use~~ of IEEE 802 length/type (EPD) frame encoding, as opposed to ISO/IEC 8802-2 LLC encoding (LPD)~~, in all MSDUs between GLK STAs~~;
2. Facilities for GLK STAs to send ~~an augmented A-MSDU, called a Control Block A-MSDU (CBA-MSDU), such that~~ group addressed ~~CBA-MSDUs~~ data GLK MPDUs that include the ability to send to an arbitrary subset of ~~an AP’s associated~~ receiving GLK STAs;
3. Priority Code Points in 802.1Q have a different default meaning that they do in IEEE Std 802.1D. For example, in 802.1Q, priority 2 is, by default, higher priority than priority 1 while in 802.1D it is lower. Thus it is suggested in Annex V that GLK associations use a Priority Code Point to media priority mapping in their corresponding 802.1Q bridge port.

# Definitions, acronyms, and abbreviations

## Abbreviations and acronyms

***Change inserted text for Section 3.4:***

~~CB Control Block~~

~~CBA-MDSU Control Block Aggregated MSDU~~

EPD EtherType Protocol Discrimination

GLK General Link

LPD LLC Protocol Discrimination

~~SE-CB Subsetting Exclusion CB~~

~~SI-CB Subsetting Inclusion CB~~

SYNRA Synthetic Receiver Address

# General Description

## Components of the IEEE Std 802.11 architecture

### 4.3.14 STA transmission of Data frames outside the context of a BSS

Editor’s Note: I am told that users of this service are anxious to save every bit they can. Thus it is possible they will want to use EPD.

### General Link (GLK)

#### General

***Replace the text of clause 4.3.23.1 with the following:***

GLK STAs establish links with other GLK STAs that are suitable to be used as a transit link inside an IEEE Std 802.1Q conformant network insofar as the capabilities of IEEE 802.11 permit.

A GLK STA provides a MAC\_SAP to an IEEE 802.1Q bridge for each peer GLK STA with which it is communicating.

A GLK STA that starts a BSS uses membership selector values in the Suported Rates and BSS Membership Selectors IE to set the BSS policy of requiring or not requiring GLK or EPD support for each member of the BSS.

Every non-AP STA acts as either a GLK STA or a non-GLK STA. A GLK AP may permit associations from non-GLK non-AP STAs and acts as a non-GLK AP for those associated non-GLK non-AP STAs.

The four address frame format (with both From DS and To DS set to 1) may be used in data MPDUs between non-mesh GLK STAs. The use of the four address frame format is required for such MPDUs if the SA, TA, RA, and DA are all different from each other. The three address frame format may be used if SA equals TA and/or RA equals DA as described in clause 8.3.2.1.

As described in clause 4.3.23.3: in a data MPDU, transmitted between GLK STAs, that has a group address RA, the RA will be a SYNRA and therefore not equal the DA; a non-AP GLK STA supports selective reception of group addressed MPDUs using SYNRA.

#### EtherType Protocol Discrimination (EPD)

***Replace the contents of this clause with the following:***

LLC Protocol Discrimination (LPD) is the default format of MSDUs. EtherType Protocol Discrimination (EPD) is only used where it is known that all STAs involved support EPD.

An EPD STA is a STA that supports EPD formatted MSDUs. EPD STAs indicate their support through a bit in one or more of the Capability Information, DMG Capability Information, and Relay Capabilities fields. Pairwise communication between two EPD STAs in a BSS uses EPD, otherwise LPD is used.

The choice between EPD or LPD format of MSDUs in MPDUs transmitted with a group address RA is controlled by the announced policy of the BSS. An EPD STA that transmits Beacon frames announces whether non-EPD STAs are permitted to associate or peer with it. If non-EPD STAs may not associate or peer, then the beaconing STA uses EPD for all MSDUs in MPDUs with a group address RA. If non-EPD STAs may associate or peer with the STA, then the beaconing STA uses LPD for all MSDUs in MPDUs with a group address RA.

#### Selective reception of a group addressed MPDUs

***Replace contents of this clause with the following:***

For the reasons given below, when transmitting data MPDUs to a set of receiving GLK STAs, the GLK transmitter must be able to indicate an arbitrary subset of receivers that are to discard the MPDU.

Reasons for such selective reception include the MAC service requirement that, when an MSDU is sent, it is not returned to and processed by the transmitting station. When a GLK non-AP STA associated with a GLK AP sends an MSDU to that AP with a group address destination, the AP retransmits it but can use the selective reception facility to stop the originating GLK non-AP STA from accepting it. Also, since the AP MAC\_SAP is mapped to 802.1Q Bridge ports, loop prevention can require blocking traffic to one or more of the associated GLK non-AP STAs. Such blocking can be implemented by the selective reception facility.

Implementation of this selective reception facility includes use of a synthetic group address RA (SYNRA, see clause 8.3.2.1.2). As an alternative to the use of a SYNRA, a copy of the data MPDU can be sent to each intended receiver using MPDUs with individual address RAs, a process known as serial unicast. In either case, an appropriate address format must be used given that the DA will differ from the RA, because the RA is the SYNRA or a serial unicast individual RA.

All GLK STAs support receipt of SYNRAs (see 8.3.2.1.2) but are not required to be able to construct a SYNRA MPDU since it is always possible to use serial unicast.

# MAC service definition

## Overview of MAC services

### MSDU format

***Replace the text of clause 5.1.4 with the following:***

MSDUs use LPD as defined in IEEE Std 802-2014 (Overview and Architecture) for all OCB transmissions and for transmissons within a BSS unless one of the two conditions below applies, in which case EPD is used:

 1. Data MPDUs with individually addressed RAs, if both the transmitter and receiver are EPD STAs;

 2. Data MPDUs with group addressed RAs, if the transmitter will not associate or peer with a non-EPD STA as indicated by the presence of the EPD BSS membership selector advertised by the transmitter in the Supported Rates and BSS Memebership Selector IE or Extended Supported Rates and BSS Membership Selector IE.

The MAC service user provides LPD or EPD formated MSDUs as indicated by a MIB attribute.

Need to add stuff to MIB.

When LPD is used, in order to achieve interoperability, implementors are recommended to apply the procedures described in ISO/IEC Technical Report 11802-5:1997(E) (previously known as IEEE Std 802.1H-1997 [B21]), along with a selective translation table (STT) that handles a few specific network protocols, with specific attention to the operations required when passing MSDUs to or from LANs or operating system components that use EPD. Note that such translations might be required in a STA.

### MAC data service architecture

#### General

***Modify changes to 5.1.5.1 to be the following:***

During transmission, an MSDU goes through some or all of the following processes: MSDU rate limiting, aggregate MSDU (A-MSDU) aggregation ~~including CBA-MSDU construction~~, frame delivery deferral during power save mode, sequence number assignment, fragmentation, encryption, integrity protection, frame formatting (including optional SYNRA construction), and aggregate MAC protocol data unit (A-MPDU) aggregation. When transparent FST is used, an MSDU goes through an additional transparent FST entity that contains a demultiplexing process that forwards the MSDU down to the selected TX MSDU Rate Limiting process and thence further MAC data plane processing. IEEE Std 802.1X-2010 may block the MSDU at the Controlled Port. At some point, the Data frames that contain all or part of the MSDU are queued per AC/TS.

During reception, a received Data frame goes through processes of possible A-MPDU deaggregation, MPDU header and cyclic redundancy code (CRC) validation, Address 1 filtering (including optional discard based on SYNRA), duplicate removal, on possible reordering if the block ack mechanism is used, decryption, defragmentation, integrity checking, and replay detection. After replay detection (or defragmentation if security is not used), possible A-MSDU deaggregation ~~including CBA-MSDU processing~~, and possible MSDU rate limiting, one ~~zero~~ or more MSDUs are, delivered to the MAC\_SAP or to the DS. When transparent FST is used, MSDUs originating from different PHY-SAPs go through an additional transparent FST entity that contains a multiplexing process before forwarding the MSDU to the MSDU rate limiting process. The IEEE 802.1X Controlled~~/Uncontrolled~~ Port~~s~~ discards any received MSDU if the Controlled Port is not enabled. The Uncontrolled Port admits the frame for use if it is ~~and if the MSDU does not represent~~ an IEEE Std 802.1X frame and optionally for other protocols that use the Uncontrolled Port. Frame order enforcement provided by the enhanced data cryptographic encapsulation mechanisms occurs after decryption, but prior to MSDU defragmentation; therefore, defragmentation fails if MPDUs arrive out of order.

# Layer management

## MLME SAP interface

### Scan

#### MLME-SCAN.confirm

##### Function

##### Semantics of the primitive

***Add the following to the BSSDescription table:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| GLK Capabilities | GLK Capabilities element | As defined in 8.4.2.171. | Specifies the GLK capabilities supported by the STA. This parameter is present if dot11GeneralLinkImplemented is true and not present otherwise. | Do Not Adopt |

### Synchronization

#### Introduction

#### MLME-JOIN.request

##### Function

##### Semantics of the service primitive

***Add a parameter as follows:***

The primitive parameters are as follows:

MLME-JOIN.request(

SelectedBSS,

JoinFailureTimeout,

ProbeDelay,

OperationalRateSet,

Capability Information,

HT Capabilities,

Extended Capabilities,

20/40 BSS Coexistence,

InterworkingInfo,

AdvertisementProtocolInfo,

GLKCapabilities,

VendorSpecificInfo

)

***Add a new row as the next-to-last row in the table describing MLME-JOIN.request parameters as follows:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | GLK Capabilities | As defined in GLK Capabilities element | As defined in 8.4.2.171 (GLK Capabiities element) | Specifies the GLK capabilities supported by the STA. This parameter is present if dot11GeneralLinkImplemented is true and not present otherwise. |  |
|  |  |  |  |  |  |

***Add a GLK Capabilities parameter to MLME-ASSOCIATE.request, MLME-ASSOCIATE.confirm, MLME-ASSOCIATE.indication, MLME-ASSOCIATE.response, MLME-REASSOCIATE.request, MLME-REASSOCIATE.confirm, MLME-REASSOCIATE.indication, and MLME-REASSOCIATE.response similarly to the addition to MLME-JOIN.request above and MLME-START.request below.***

### Start

#### Introduction

#### MLME-START.request

##### Function

##### Semantics of the service primitive

***Add a parameter as follows:***

…
MG Operation,
Clustering Control,
CBAP Only,
PCP Association Ready,
VHT Capabilities,
VHT Operation,
GLK Capabilities,
VendorSpecificInfo )

***Add a new row as the next-to-last row in the table describing MLME-START.request parameters as follows:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | GLK Capabilities | As defined in GLK Capabilities element | As defined in 8.4.2.171 (GLK Capabiities element) | Specifies the GLK capabilities supported by the STA. This parameter is present if dot11GeneralLinkImplemented is true and not present otherwise. |  |
|  |  |  |  |  |  |

***Add GLK Capabilities as above to MLME-DLS.confirm, MLME-DLS.indication, and MLME-DLS.response.***

# Frame formats

## General Requirements

## MAC frame formats

## Formats of individual frame types

### Control Frames

### Data Frames

#### Data frame format

***Insert additional level 5 headings and change text for clause 8.3.2.1 as below:***

##### General

The format of a Data frame is defined in Figure 8-52 (Data frame). The Frame Control, Duration/ID, Address 1, Address 2, Address 3, and Sequence Control fields are present in all data frame subtypes. The presence of the Address 4 field is determined by the setting of the To DS and From DS subfields of the Frame Control field (see below). The QoS Control field is present when the QoS subfield of the Subtype field is set to 1.

No change to material after above paragraph and before below paragraph.

A QoS STA always uses QoS Data frames for data transmissions to other QoS STAs. A QoS STA uses frames with the QoS subfield of the Subtype field set to 0 for data transmissions to non-QoS STAs. A non-QoS STA always uses frames with the QoS subfield of the Subtype field set to 0 for data transmissions to other STAs. All STAs use frames with the QoS subfield of the Subtype field set to 0 for nonconcealed GCR broadcast Data frames unless a transmitting STA knows that all STAs in a BSS have QoS capability, in which case the transmitting STAs use QoS Data frames. All STAs use frames with the QoS subfield of the Subtype field set to 0 for nonconcealed GCR group addressed Data frames unless it is known to the transmitter that all STAs in the BSS that are members of the multicast group have QoS capability, in which case STAs use QoS Data frames. APs where dot11RobustAVStreamingImplemented is true or mesh STAs where dot11MeshGCRImplemented is true use frames with the QoS subfield of the Subtype field set to 1 for concealed GCR frames, as described in 10.24.16.3.5 (Concealment of GCR transmissions).

##### Address and BSSID fields

The content of the address fields of Data frames are dependent upon the values of the To DS and From DS fields in the Frame Control field and whether the Frame Body field contains either an MSDU (or fragment thereof) or an entire A-MSDU, as determined by the A-MSDU Present subfield of the QoS Control field (see 8.2.4.5.9 (A-MSDU Present subfield)). The content of the address fields is defined in Table 8-34 (Address field contents). Where the content of a field is shown as not applicable (N/A), the field is omitted. Note that Address 1 always holds the receiver address of the intended receiver (or, in the case of group addressed frames, receivers), and that Address 2 always holds the address of the STA that is transmitting the frame.

Table 8-34 – Address field contents

Unchanged table goes here.

A STA uses the contents of the Address 2 field to direct the acknowledgment if an acknowledgment is necessary.

The DA field contains the destination of the MSDU (or fragment thereof) or A-MSDU in the Frame Body field.

The SA field contains the address of the MAC entity that initiated the MSDU (or fragment thereof) or A-MSDU in the Frame Body field.

When a Data frame carries an MSDU (or fragment thereof), the DA and SA values related to that MSDU are carried in the Address 1, Address 2, Address 3, and Address 4 fields (according to the setting of the To DS and From DS fields) as defined in Table 8-34 (Address field contents).

When a Data frame carries an A-MSDU, the DA and SA values related to each MSDU carried by the A-MSDU are carried within the A-MSDU. One or both of these fields may also be present in the Address 1 and Address 2 fields as indicated in Table 8-34 (Address field contents).

NOTE 2 – If a DA or SA value also appears in any of these address fields, the value is necessarily the same for all MSDUs within the A-MSDU because this is guaranteed by the To DS and From DS field settings.

The RA field is the individual address of the STA that is the immediate intended receiver of the frame or the group address of the STAs that are the immediate intended receivers of the frame.

The TA field is the address of the STA that is transmitting the frame.

When a GLK STA transmits a data MPDU to a group address RA to GLK STAs, that RA s a If the intended receipients due to a broadcast, multicast, or unknown unicast destination MAC are GLK STAs, the RA shall be a SYNRA as shown in Figure 8a – SYNRA structure.

SYNRA Type

SYNRA OUI + group bit

SYNRA Control field

 B0 B23 B24 B25 B26 B47

Bits: 24 2 22

 **Figure 8-3a – SYNRA structure**

Values of the SYNRA Type field are listed in Table 8-34a.

Table 8-34a – SYNRA Types

tbd

The BSSID of the Data frame is determined as follows:

 a) If the STA is contained within an AP or is associated with an AP, the BSSID is the address currently in use by the STA contained in the AP.

 b) If the STA is a member of an IBSS, the BSSID is the BSSID of the IBSS.

 c) If the STA is transmitting a Data frame when dot11OCBActivated is true, the BSSID is the wildcard BSSID.

 d) If the STA is a member of an MBSS, the BSSID is the address of the transmitter and is equal to the Data frame’s TA.

 e) If the STA participates in a PBSS, the BSSID is the address of the STA contained in the PCP of the PBSS.

##### Other MAC Header fields

The Sequence Control field is defined in 8.2.4.4 (Sequence Control field).

The QoS Control field is defined in 8.2.4.5 (QoS Control field).

The HT Control field is defined in 8.2.4.6 (HT Control field). The presence of the HT Control field is determined by the Order subfield of the Frame Control field, as specified in 8.2.4.1.10 (Order field).

NOTE – The HT Control field is not present in frames transmitted by a DMG STA.

NOTE above moved up from end of previous monolithic clause.

##### The frame body

The frame body consists of either:

- The MSDU (or a fragment thereof), the Mesh Control field (present if the frame is transmitted by a mesh STA and the Mesh Control Present subfield of the QoS Control field is 1, otherwise absent), and a security header and trailer (present if the Protected Frame subfield in the Frame Control field is 1, otherwise absent)

- The A-MSDU and a security header and trailer (present if the Protected Frame subfield in the Frame Control field is 1, otherwise absent)

The presence of an A-MSDU in the frame body is indicated by setting the A-MSDU Present subfield of the QoS Control field to 1, as shown in Table 8-6 (QoS Control field).

For Data frames of subtype Null (no data), CF-Ack (no data), CF-Poll (no data), and CF-Ack+CF-Poll (no data) and for the corresponding QoS data frame subtypes, the Frame Body field is null (i.e., has a length of 0 octets); these subtypes are used for MAC control purposes. For Data frames of subtypes Data, Data+CF-Ack, Data+CF-Poll, and Data+CF-Ack+CF-Poll, the Frame Body field contains all of, or a fragment of, an MSDU after any encapsulation for security. For Data frames of subtypes QoS Data, QoS Data+CF-Ack, QoS Data+CF-Poll, and QoS Data+CF-Ack+CF-Poll, the Frame Body field contains an MSDU (or fragment thereof) or A-MSDU after any encapsulation for security. For Data frames of subtype QoS Data that are transmitted by a mesh STA, the Frame Body field also contains a Mesh Control field, as described in 8.2.4.7.3 (Mesh Control field).

The maximum length of the Frame Body field can be determined from the maximum MSDU length plus the length of the Mesh Control field (if present) plus any overhead from encapsulation for encryption (i.e., it is always possible to send a maximum length MSDU, with any encapsulations provided by the MAC layer within a single Data frame). When the frame body carries an A-MSDU, the size of the frame body field is limited by:

***Rest of of 8.3.2.1 copied here.***

#### Aggregated MSDU (A-MSDU) format

##### General

***Delete the following text at the beginning of Clause 8.3.2.2.1***

There are four variations of the A-MSDU format. If the transmitter is a GLK STA, the CBA-MSDU format or Short CBA-MSDU format is used as specified in 4.3.2.3. If the transmitter is a non-GLK STA, the A-MSDU or Short A-MSDU format is used as described in the remainder of this clause.

***Delete new clause 8.3.2.3:***

#### Control Block (CB) A-MSDU (CBA-MSDU) format

### Management frames

#### Format of Management frames

#### Beacon frame format

***Add to Table 8-35 – Beacon frame body as the next to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 66 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

#### Association Request frame format

***Add to Table 8-37 – Association Reqeust frame body as the next to the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 24 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |

#### Associaton Response frame format

***Add to Table 8-38 – Association Response frame body as the next to the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 30 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |

#### Reassociation Request frame format

***Add to Table 8-39 – Reassociation Requst frame body as the next to the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 29 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |

#### Reassociation Response frame format

***Add to Table 8-40 – Reassociation Response frame body as the next to the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 34 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |

#### Probe Request frame format

***Add to Table 8-41 – Probe Request frame body as the next to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 18 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

#### Probe Response frame format

***Add to Table 8-42 – Probe Response frame body as the third to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 68 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

### Extension frames

#### DMG Beacon

***Add to Table 8-49 – DMG Beacon frame body as the third to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 15 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

## Management and Extension frame body components

### Fields that are not elements

#### Authentication Algorithm Number field

#### Authentication Transaction Sequence Number field

#### Beacon Interval field

#### Capability Information field

***Change Figure 8-65—Capability Information field (non-DMG STA) and Figure 8-66—Capability Information field (DMG STA) as follows:***

ESS

 B0 B1 B2 B3 B4 B5 B6 B7

 **Figure 8-65—Capability Information field (non-DMG STA)**

CF Pollable

CF-Poll Request

Short Preamble

Reserved

IBSS

Privacy

Reserved

Spectrum Management

 B8 B9 B10 B11 B12 B13 B14 B15

QoS

Radio Measurement

EPD ~~GLK~~

APSD

Delayed Block Ack

Short Slot Time

Immediate Block Ack

DMG Parameters

 B0 B7 B8 B9 B11 B12 B13 B14 B15

Reserved

EPD ~~GLK~~

Reserved

Spectrum Management

Radio Measurement

 **Figure 8-66—Capability Information field (DMG STA)**

***Update the following in the 2nd to last paragraph of Clause 8.4.1.4:***

A STA sets the ~~GLK~~EPD sub-field in the Capabilities Information field to 1 when dot11~~GeneralLink~~EPDImplemented is true and sets it to 0 otherwise.

### Elements

#### General

***Add the following to Table 8-62 – Element IDs maintaining order by Element ID number:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | GLK Capabilities (see 8.4.2.171 (GLK Capabilities element)) | <ANA> |   |  |
|  |  |  |  |  |

#### SSID element

***Rename the Supported Rates element:***

#### Supported Rates and BSS Membership Selectors element

***Replace all occurances of “Supported Rates element” with “Supported Rates and BSS Membership Selectors element”.***

***Add the following two new entries at the end of Table 8-86 BSS membership selector value encoding:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | **Value**  | **Feature**  | **Interpretation**  |  |
|  | 125 | GLK | Support for the mandatory features of Clause TBD is required in order to join the BSS that was the source of the Supported Rates and BSS Membership Selectors element or Extended Supported Rates and BSS Membership Selectors element containing this value.  |  |
|  | 124 | EPD | Support for EPD is required in order to join the BSS that was the source of the Supported Rates and BSS Membership Selectors element or Extended Supported Rates and BSS Membership Selectors element containing this value.  |  |
|  |  |  |  |  |

***Change the name of clause 8.4.2.12 as follows:***

#### Extended Supported Rates and BSS Membership Selectors element

***Replace all occurances of “Extended Supported Rates element” with “Extended Supported Rates and BSS Membership Selectors element”.***

#### DMG Capabilities element

##### General

##### DMG STA Information Capability element

***Change Figure 8-499 as follows:***

Reverse Direction

 B0 B1 B2 B3 B4 B5 B6 B7 B13

**Figure 8-499—DMG STA Capability Information field format**

TPC

SPSH and Interference Mitigation

Fast Link Adaptation

Total Number of Sectors

Higher Layer Timer Synchronization

Number of RX DMG Antennas

RXSS Length

B14 B19 B20 B21 B26 B27 B28 B51 B52 B53

DMG Antenna Reciprocity

Supported MCS Set

BA with Flow Control

DTP Supported

A-MPDU Parameters

A-PPDU Supported

 B54 B55 B56 B57 B59 B60 B61 B62 B63

Heartbeat

Antenna Pattern Reciprocity

EPD ~~GLK~~

Supports Other\_AID

Heartbeat Elapsed Indication

RXSSTx- Rate Supported

Bit: 1 1 1 1 2 1 7

Bit: 6 1 6 1 24 1 1

Grant Ack Supported

Reserved

Bit: 1 1 1 3 1 1 1 1

***Change at the end of Clause 8.4.2.127.2:***

A DMG STA sets the ~~GLK~~EPD sub-field in the DMG Capabilities Information field to 1 when dot11G~~eneralLink~~EPDImplemented is true and sets it to 0 otherwise.

#### Relay Capabilities element

***Change Figure 8-537 as follows:***

Relay Supportability

Bits: 1 1 1 1 1 1 1 1 1

 **Figure 8-537—Relay Capability Information field format**

Relay Usability

A/C Power

Cooperation

Reserved

 B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 B15

Relay Permission

Relay Preference

Duplex

EPD ~~GLK~~

***Change the following text at the end of Clause 8.4.2.147:***

A DMG STA sets the ~~GLK~~EPD sub-field in the Relay Capabilities Information field to 1 when dot11~~GeneralLink~~EPDImplemented is true and sets it to 0 otherwise.

***Add new clause 8.4.2.171 as follows:***

#### GLK Capabilities element

The presence of the GLK Capabilities element, as shown in Figure 8-575a, in a Beacon, Probe, Probe Response, Associate, Association Response, Re-Associate, Reassociation Response, Mesh Peering Open, or Mesh Peering Confirm indicates that the transmitting STA is a GLK STA and indicates what additional GLK capabilities it may have if any.

 Element ID Length GLK Capability Flags

Octets: 1 1 1

 **Figure 8-575a – GLK Capabilities element format**

The Element ID and Length fields are defined in 8.4.2.1.

The Length field for this element is 1.

The flag bits are as show in Figure 8-575b.

DNSB

Bits: 1 1 1 5

 **Figure 8-575b — GLK Capability Flags field format**

DNSU

Reserved

 B0 B1 B2 B3 B7

DNSM

If the DNSB flag is set to 1, the transmitting station is requesting that data MSDUs with a broadcast DA not be sent to it.

If the DNSU flag is set to 1, the transmitting station is requesting that data MPDUs with a individual address DA not be sent to it unless that MAC address has been registered by MMRP from the transmitting station.

If the DNSM flag is set to 1, the transmitting station is requesting that data MPDUs with a non-broadcast group address DA (multicast DA) not be sent to it unless that MAC address has been registered by MMRP from the transmitting station.

## Fields used in Management and Extension frame bodies and Control frames

## Action frame format details

### Public Action details

#### TDLS Discovery Response frame format

***Add to Table 8-303 – Information for TDLS Discovery Response frame as the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 18 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

### TDLS Action field formats

#### TDLS Setup Request Action field format

***Add to Table 8-327—Information for TDLS Setup Request Action field as the last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 21 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |

***Make the parallel change to that above to Table 8-328 in Clause 8.6.13.3***

### Self-protected Action frame details

#### Self-protected Action fields

#### Mesh Peering Open frame format

##### Mesh Peering Open frame self-protection

##### Mesh Peering Open frame details

***Add to Table 8-350 – Mesh Peering Open frame Action field format as the third to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 22 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

#### Mesh Peering Confirm frame format

##### Mesh Peering Confirm frame self-protection

##### Mesh Peering Confirm frame details

***Add to Table 8-351 – Mesh Peering Confirm frame Action field format as the third to last row:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 18 | GLK Capabilities | The GLK Capabilities element is present if dot11GeneralLinkImplemented is true. |  |
|  |  |  |  |  |

# MAC sublayer functional description

# MLME

***Change the name of clause 10.45 as follows:***

## GLK ~~BSS~~ Operation

***Replace clause 10.45 with the following:***

GLK STAs advertise the GLK Capabilities information element (see 8.4.2.171.2). For a GLK STA, dot11GeneralLinkImplemented is true. For a non-GLK STA, dot11GeneralLinkImplemented is false or absent.

The Supported Rates and BSS Membership Selectors or Extended Supported Rates and BSS Membership Selectors IEs shall include the GLK selector if dot11GLKRequired is true.

***Add a new clause as follows:***

## EPD Operation

EPD STAs set the EPD bit in the Capability Information, DMG Capability Information, and Relay Capabilities IEs. For an EPD STA, dot11EPDImplemented is true. For a non-EPD STA, dot11GeneralLinkImplemented is false or absent.

The Supported Rates and BSS Membership Selectors or Extended Supported Rates and BSS Membership Selectors IEs shall include the EPD selector if dot11EPDRequired is true.

# MLME Mesh procedures

## Mesh Interworking ~~with the DS~~

### Overview of Mesh Interworking between a mesh BSS and a DS

***Change the first paragraph of clause 13.11.1 as follows:***

A mesh STA that has access to a DS is called a mesh gate. Mesh STAs in an MBSS access the DS via the mesh gate. ~~An MBSS functions like an IEEE 802 LAN segment that is compatible with IEEE Std 802.1D if the MBSS is composed of non-GLK mesh STAs and compatible with IEEE Std 802.1Q if the MBSS is composed of GLK mesh STAs.~~ The MBSS appears as a single access domain.

# Annex C, ASN.1 encoding of the MAC and PHY MIB

***Change entry being added at the end of the* dot11StationConfigEntry SEQUENCE*:***

dot11GeneralLinkImplemented TruthValue

dot11GeneralLinkRequired TruthValue

dot11EPDImplemented TruthValue

dot11EPDRequired TruthValue