**IEEE P802.11
Wireless LANs**

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| 11bn PDT MAC Dynamic Bandwidth Expansion (DBE) part 2 |
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 **Abstract**

This document contains Proposed Draft Text (PDT) for the Dynamic Bandwidth Expansion (DBE) feature of the proposed 11bn/UHR amendment to the 802.11 standard.

Baseline for this document is 11bn D0.3.

# Revision information

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Includes resolution to address following open items for DBE:* Indication of AP’s maximum supported BW for DBE
* Indication of a non-AP STA’s maximum supported BW for DBE
* Enable/disable/update for DBE mode from a non-AP STA
* Set of DBE parameters announced in the DBE critical update notification
* TPE (Transmit Power Envelop) information signaling for DBE BW
* Signaling DBE BW and CCF in UHR Operation when DBE Mode is enabled
* Rules for AP and STA’s selection of PPDU bandwidth for DBE operation when DBE mode is enabled
 |

**Introduction**

Interpretation of a Motion to Adopt.

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGbe Draft. The abstract, revision information, introduction, explanation of the proposed changes and references sections are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGbn Editor: Editing instructions preceded by “TGbn Editor” are instructions to the TGbn editor to modify existing material in the TGbn draft. As a result of adopting the changes, the TGbn editor will execute the instructions rather than copy them to the TGbn Draft.***

**Text to be adopted begins here.**

* UHR Operation Element

***TGbn editor: Please update UHR Operation element to add the DBE Operation Parameters field as shown below***

The format of the UHR Operation element is shown in Figure9-aa1 (UHR Operation element format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | UHR Operation Parameters | Basic UHR-MCS And NSS Set | UHR Operation Information | DPS Operation Parameters | DBE Operation Parameters |
| Octets: | 1 | 1 | 1 | TBD | TBD | TBD | 0 or TBD | 0 or 2  |
| * UHR Operation element format
 |  |

If the DBE Enabled field in the UHR Operation Parameters field is set to 1, a DBE Operation Parameters field is present in the UHR Operation element. If the DBE Enabled field is set to 0, the DBE Operation Parameters field is not present in the UHR Operation element. The format of the DBE Operation Parameters field is defined in Figure 9-xx1 (DBE Operation Parameters field format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 B7 | B8 B15 |
|  | DBE Bandwidth  | Reserved | DBE CCF |
| Bits: |  3 |  5 |  8 |

Figure 9-xx1 —DBE Operation Parameters field format

The DBE Bandwidth field indicates the expanded bandwidth for the DBE mode and is set as defined in Table 9-xx1 (Encoding of the DBE Bandwidth field).

Table 9-xx1 – Encoding of the DBE Bandwidth field

|  |  |
| --- | --- |
| Field | Encoding |
| DBE Bandwidth  | Value 0 is reserved.Set to 1 to indicate 40 MHz DBE bandwidth.Set to 2 to indicate 80 MHz DBE bandwidth.Set to 3 to indicate 160 MHz DBE bandwidth.Set to 4 to indicate 320 MHz DBE bandwidth.Values 5 to 7 are reserved. |

The DBE CCF field indicates the channel center frequency for the DBE bandwidth and is set to the channel number of the center frequency for the DBE bandwidth.

* UHR Capabilities element
* General
* UHR MAC Capabilities Information field

***TGbn editor: Please update UHR MAC Capabilities Information field to add the DBE Capability Parameters field as shown below***

The format of the UHR MAC Capabilities Information field is defined in ﻿Figure 9-aa5 (UHR MAC Capabilities Information field format).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B4 | B5 | B6 | B7 |
|  | DPS Support | DPS Assisting Support | Multi-Link Power Management | NPCA Supported | Enhanced BSR Support | Additional Mapped TID Support | EOTSP Support |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  | B8 | B9 | B10 | ... | ... | ... | By Bz |
|  | DSO Support | P-EDCA Support | DBE Support | ... | ... | DBE Capability Parameters | Reserved |
| Bits: | 1 | 1 | 1 | ... | ... | 0 or 8 or 32 or 56 | x |
| * UHR MAC Capabilities Information field format
 |

If the DBE Support field is set to 1, AP includes a DBE Capability Parameters field in the UHR MAC Capabilities Information field. If the DBE Support field is set to 0, AP does not include the DBE Capability Parameters field in the UHR MAC Capabilities Information field. A non-AP STA does not include the DBE Capability Parameters field in the UHR MAC Capabilities Information field.

The format of the DBE Capability Parameters field is defined in Figure 9-aaX (DBE Capability Parameters field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B2 |  B3 |  B4 | B5 B7  | B8 B31 | B32 B55 |
|  | DBE Maximum Supported Bandwidth | EHT-MCS Map (BW=160 MHz) Present | EHT-MCS Map (BW=320 MHz) Present | Reserved | EHT-MCS Map (BW=160 MHz) | EHT-MCS Map (BW=320 MHz) |
| Bits: | 3 | 1 | 1 | 3 | 0 or 24  | 0 or 24  |
|  Figure 9-aaX DBE Capability Parameters field format |  |  |

The DBE Maximum Supported Bandwidth field indicates the maximum bandwidth that the AP supports for DBE operation and is set as defined in Table 9-xx2 (Encoding of the DBE Maximum Supported Bandwidth field).

 Table 9-xx2 – Encoding of the DBE Maximum Supported Bandwidth field

|  |  |
| --- | --- |
| Field | Encoding |
| DBE Maximum Supported Bandwidth | Value 0 is reserved.Set to 1 to indicate 40 MHz as the maximum supported bandwidth for DBE.Set to 2 to indicate 80 MHz as the maximum supported bandwidth for DBE.Set to 3 to indicate 160 MHz as the maximum supported bandwidth for DBE.Set to 4 to indicate 320 MHz as the maximum supported bandwidth for DBE.Values 5 to 7 are reserved. |

The EHT-MCS Map (BW=160 MHz) Present field indicates whether the EHT-MCS Map (BW=160 MHz) field is present in the DBE Capability Parameters field. This field is set to 1 if the EHT-MCS Map (BW=160 MHz) field is present in the DBE Capability Parameters field. Otherwise, this field is set to 0.

The EHT-MCS Map (BW=320 MHz) Present field indicates whether the EHT-MCS Map (BW=320 MHz) field is present in the DBE Capability Parameters field. This field is set to 1 if the EHT-MCS Map (BW=320 MHz) field is included in the DBE Capability Parameters field. Otherwise, this field is set to 0.

The EHT-MCS Map (BW=160 MHz) field indicates the ﻿combinations of EHT-MCS 0–13, and number of spatial streams NSS, that the AP supports for reception and the combinations that it supports for transmission for 160 MHz DBE bandwidth. This field has the same definition as defined in ﻿9.4.2.323.4 (Supported EHT-MCS And NSS Set field).

The EHT-MCS Map (BW=320 MHz) field indicates the ﻿combinations of EHT-MCS 0–13, and number of spatial streams NSS, that the AP supports for reception and the combinations that it supports for transmission for 320 MHz DBE bandwidth. This field has the same definition as defined in ﻿9.4.2.323.4 (Supported EHT-MCS And NSS Set field).

***TGbn editor: Please update the subclause 37.26 Dynamic Bandwidth Expansion (DBE) to the 802.11bn draft as shown below***

37. Ultra-high reliability (UHR) MAC specification

﻿**37.26 Dynamic bandwidth expansion (DBE)**

﻿(#3942)Dynamic bandwidth expansion (DBE) is a mode of operation that allows a UHR AP to dynamically

enable operation with an expanded bandwidth that is greater than the BSS bandwidth and up to the AP's

maximum supported bandwidth for DBE, for UHR non-AP STAs that support DBE mode. When DBE mode

is enabled, the AP is operating with an expanded operating bandwidth which is referred to as the DBE

bandwidth. When DBE mode becomes disabled, the AP no longer operates with a bandwidth greater than

the BSS bandwidth.

When DBE mode is enabled, the DBE bandwidth can be changed to another DBE bandwidth that is greater

than the BSS bandwidth. The BSS primary channel does not change when DBE mode is enabled, the DBE

bandwidth is changed or DBE mode is disabled. When an AP has DBE mode enabled, the non-AP STAs that

do not support DBE mode continue to operate with the BSS bandwidth.

﻿A STA that supports DBE mode has dot11DBEOptionActivated equal to true, is called a DBE STA and shall

set the DBE Support field of the UHR MAC Capabilities Information field of the UHR Capabilities element ﻿to 1.

A UHR AP that supports DBE operation is called a DBE AP. A UHR non-AP STA that supports DBE

operation is called a DBE non-AP STA.

A DBE AP shall include the DBE Capability Parameters field in the UHR MAC Capabilities Information field in the UHR Capabilities element. The DBE AP shall set the DBE Maximum Supported Bandwidth field to indicate its maximum supported bandwidth for DBE. If the DBE AP supports 160 MHz bandwidth for DBE and is not providing EHT-MCS Map (BW=160 MHz) field in the EHT Capabilities element, then the DBE AP shall set the EHT-MCS Map (BW=160 MHz) Present field to and shall include the EHT-MCS Map (BW=160 MHz) field in the DBE Capability Parameters field. If the DBE AP supports 320 MHz bandwidth for DBE and is not providing EHT-MCS Map (BW=320 MHz) field in the EHT Capabilities element, then the DBE AP shall set the EHT-MCS Map (BW=320 MHz) Present field to 1 and shall include the EHT-MCS Map (BW=320 MHz) field in the DBE Capability Parameters field.

A DBE non-AP STA shall indicate support for 40 MHz, 80 MHz, 160 MHz and/or 320 MHz as supported bandwidth for DBE by setting the corresponding bandwidth capability field(s) in the VHT, HE and/or EHT Capabilities element. For a DBE non-AP STA, the maximum supported bandwidth for DBE shall be the maximum bandwidth capability indicated by the non-AP STA in the VHT/HE/EHT Capabilities element. The DBE non-AP STA shall include subfields in the Supported EHT-MCS and NSS Set field in the EHT Capabilities element to provide EHT MCS Map information for all its supported bandwidths for DBE.

In the (Re)Association Response frame send to a DBE non-AP STA, a DBE AP shall include one or more Transmit Power Envelop elements (see ﻿9.4.2.160 (Transmit Power Envelope element)) to provide local or regulatory maximum transmit powers for its maximum support bandwidth for DBE.

A DBE non-AP STA that intends to enable, disable or update the parameters for DBE mode shall follow the procedure defined in 37.27 (Procedure for operating mode and parameter updates). The associated AP shall accept the request and follow the procedure defined in 37.27 (Procedure for operating mode and parameter updates). In the OMP request sent to enable or update the parameters of the DBE mode, the DBE non-AP STA may include a DBE Maximum Supported Bandwidth field to update its maximum supported bandwidth for DBE.

NOTE – For a non-AP STA to enable the DBE mode, the associated AP must support DBE (see 37.27 (Procedure for operating mode and parameter updates)).

If a DBE non-AP STA uses the OMN procedure as described in 11.40 (﻿Notification of operating mode changes) or OMI procedure as describe in 26.9 (﻿Operating mode indication) or 35.9 (﻿Operating mode indication) to update its operating bandwidth to be smaller than its previously indicated maximum supported bandwidth for DBE, then the smaller bandwidth indicated in the OMN or OMI shall be the maximum supported bandwidth for DBE for that non-AP STA, starting from the subsequent TxOP.

﻿A DBE AP shall announce an upcoming enablement of DBE mode, changes to the DBE bandwidth or

disablement of DBE mode in Beacon and Probe Response frames using the advance notification mechanism

for UHR critical updates (see 37.y (UHR BSS parameter critical update procedure)). DBE mode

enablement, the DBE bandwidth change, or DBE mode disablement should be announced sufficiently in

advance for multiple beacon intervals so that all associated non-AP STAs, including those in the power save

mode, have the opportunity to receive at least one successful indication of the update before the update takes

effect. After the DBE mode is enabled or the DBE bandwidth is changed, the DBE AP shall continue

operating with its DBE bandwidth until a subsequent change to its DBE bandwidth takes effect, or DBE

mode disablement takes effect.

﻿In the critical update announcement to enable DBE mode or to change the DBE bandwidth for already enabled DBE mode,

the DBE AP shall include following:

* A DBE Enabled field that is set to 1 to indicate enabled state for DBE mode.
* A DBE Bandwidth field that indicates the DBE bandwidth for the DBE mode.
* A DBE CCF field that indicates the channel center frequency for the DBE bandwidth and is set to the channel number of the center frequency for the DBE bandwidth.
* A DBE Disabled Subchannel Bitmap field only if the set of disabled 20 MHz subchannels within the DBE Bandwidth is different than the disabled subchannels indicated in the Disabled Subchannel Bitmap in the EHT Operation element. This field indicates disabled 20 MHz subchannels within the DBE Bandwidth. The DBE Disabled Subchannel Bitmap field shall not disable the 20 MHz subchannel corresponding to the primary 20 MHz channel and shall disable any 20 MHz subchannel(s) that are indicated as disabled for the BSS bandwidth in the ﻿Disabled Subchannel Bitmap in the EHT Operation element.
* One or more DBE Transmit Power Envelop subelement to provide TPE information for the DBE bandwidth, only if the TPE information for the DBE bandwidth has been updated after sending the (Re)association Response for at least one associated STA. The DBE Transmit Power Envelop subelement has the same format as the Transmit Power Envelope element (see ﻿9.4.2.160 (Transmit Power Envelope element)).

In the critical update announcement to disable DBE mode, the DBE AP shall include a DBE Enabled field that is set to 0 to indicate disabled state for the DBE mode. The DBE AP shall not include any other DBE parameters in the critical update announcement to disable DBE mode.

NOTE—The time when DBE mode enablement, the DBE bandwidth change, or DBE mode disablement takes effect is

indicated as part of the advance notification mechanism for UHR critical updates (see 37.y (UHR BSS parameter critical

update procedure)).

When a DBE mode becomes enabled (i.e. the AP starts operating with an expanded DBE bandwidth), the

AP shall set the DBE Enabled field to 1 in the UHR Operation element in Beacon, Probe Response and (Re)Association Response frames. When a DBE mode becomes disabled (i.e. the AP stops operating with an expanded bandwidth for DBE), then the AP shall set the DBE Enabled field to 0 in the UHR Operation element in Beacon, Probe Response and (Re)Association Response frames.

When the DBE Enabled field is set to 1 in the UHR Operation element, the DBE AP shall include a DBE Operation Parameters field in the UHR Operation element and shall indicate its DBE bandwidth in the DBE Bandwidth field and the center frequency for the DBE bandwidth in the DBE CCF field.

When a DBE AP is operating with DBE mode enabled, the following applies:

* The maximum PPDU bandwidth used by the AP in DL and trigger-based UL for a DBE non-AP STA shall not be more than the minimum of the following bandwidth values:
* AP’s DBE bandwidth, and
* non-AP STA’s maximum supported bandwidth for DBE.
* The maximum PPDU bandwidth in UL used by a DBE non-AP STA shall not be more than the minimum of the following bandwidth values:
* AP’s DBE bandwidth, and
* the non-AP STA’s maximum supported bandwidth for DBE.

NOTE: If a DBE non-AP STA uses OMN or OMI procedure to update its operating bandwidth to be smaller than its previously indicated maximum supported bandwidth for DBE, then the smaller bandwidth indicated in the OMN or OMI becomes the maximum supported bandwidth for DBE for that non-AP STA.

**Text to be adopted ends here.**