**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.

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# 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
 |
| 1 | Edits based on feedback received during TGbn call and offline feedback* Updates to UHR Operation element for DBE
* Added text to indicate that AP accepts DBE enable/disable/update from STA even when DBE mode is not enabled.
* Added Note that STA is recommended to enable/disable/update DBE even before DBE mode is enabled to avoid gold rush of such updates after DBE modes becomes enabled.
* Added Note that STA does not need to enable/disable/update DBE every time AP enables /disables DBE mode.
* Clarified that the DBE BW provided in the OMP enable/update by a non-AP STA is its currently supported DBE BW.
* Clarified that the TPE information is included for DBE BW (if any) per baseline clause 11.7.5 (Specification of regulatory and local maximum transmit power levels).
 |
| 2 | Edits based on offline feedback:* Added updates for DBE mode on top of 25/882 for enable/disable/update for DBE from a non-AP STA
* Added updates for DBE mode on top of 25/1091 for DBE critical update notification
* Removed changes related to OMN/OMI. UHR OMP request is used to provide DBE BW for non-AP STA.
* Removed changes related to TPE information signaling for DBE.
* Changes to UHR Operation element to include DBE Operation Parameters, that will be included in Probe Response and (Re)Association Response.
* Other clarificatory changes to the text.
 |

**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 3  |
| * UHR Operation element format
 |  |

If the DBE Enabled field in the UHR Operation Parameters field is set to 1, the DBE Operation Parameters field is included in the Probe Response and (Re)Association Response frames, otherwise the DBE Operation Parameters field is not included in the Probe Response and (Re)Association Response frames. The DBE Operation Parameters field is not included in the Beacon frames.

The format of the DBE Operation Parameters field is defined in Figure 9-xx1 (DBE Operation Parameters field format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 B7 | B8 B23 |
|  | DBE Bandwidth  | Reserved | DBE Disabled Subchannel Bitmap |
| Bits: |  3 |  5 |  16 |

Figure 9-xx1 —DBE Operation Parameters field format

The DBE Bandwidth field is set to indicate expanded bandwidth for DBE mode 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 320-1 MHz DBE bandwidth.Set to 5 to indicate 320-2 MHz DBE bandwidth.Values 6 to 7 are reserved. |

The DBE Disabled Subchannel Bitmap field is set to indicate disabled 20 MHz subchannels within 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 | … | ... | variable | x |
| * UHR MAC Capabilities Information field format
 |

If the DBE Support field is set to 1, an AP includes a DBE Capability Parameters field in the UHR MAC Capabilities Information field. If the DBE Support field is set to 0, an AP does not include the DBE Capability Parameters 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 is 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 is defined in ﻿9.4.2.323.4 (Supported EHT-MCS And NSS Set field).

**(changes on top of DCN 25/882)**

**9.4.2.X UHR Mode Change element**

***TGbn editor: please modify this clause in 25/882 for DBE mode as shown below***

The Mode ID field contains the identifier for the UHR mode associated with the mode tuple. The encoding of this field is defined in Table 9-XYZ4 (Encoding of the Mode ID field).

 **Table 9-XYZ4 --- Encoding of the Mode ID field**

|  |  |
| --- | --- |
| **Value** | **Mode** |
| 0 | DPS |
| 1 | NPCA |
| 2 | DUO |
| 3 | DSO |
| 4 | P-EDCA |
| 5 | ELR Reception |
| 6 | AOM |
| 7 | LLI |
| 8 | Co-BF |
| 9 | Co-SR |
| 10 | EMLSR |
| 11 | DBE |
| 12-63 | Reserved |

**9.4.2.X.3 Mode Specific Parameters for DBE**

When the value of the Mode ID field is 11,

* the Mode Tuple field corresponds to DBE, and
* the Mode Specific Control field is reserved, and
* the Mode Specific Parameters field carries the parameters for DBE

The Mode Specific Parameters field for DBE is defined in Figure 9-aaxN (Mode Specific Parameters field for DBE).

|  |  |  |
| --- | --- | --- |
|  | B0 B2 | B3 B7 |
|  | Non-AP STA Current DBE Bandwidth | Reserved |
| Bits: | 3 | 5 |

**Figure 9-aaxN --- Mode Specific Parameters field for DBE**

The Non-AP STA Current DBE Bandwidth field indicates the bandwidth that the non-AP STA currently supports for DBE.

**(changes on top of DCN 25/1091)**

**9.4.2.X UHR Parameters Update element**

**…**

**9.4.2.X.5 Mode Specific Parameters for DBE**

When the value of the Mode ID field is 4, the Mode Specific Parameters field carries the parameters for DBE.

***TGbn editor: Please update this clause in DCN 25/1091 to update Mode Specific Parameters field for DBE as shown below.***

The Mode Specific Parameters field for DBE is as defined in Figure 9-aax6 (Mode Specific Parameters field for DBE format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 B7 | B8 B23 |
|  | DBE Bandwidth | Reserved | DBE Disabled Subchannel Bitmap |
| Bits: | 3 | 5 | 16 |

**Figure 9-aax13 --- Mode Specific Parameters field for DBE format**

The encoding of fields in the Mode Specific Parameters field for DBE is the same as the encoding of the corresponding fields in the DBE Operation Parameters field as defined in 9.4.2.aa1 (UHR Operation element).

***TGbn editor: Please update the subclause 37.26 Dynamic Bandwidth Expansion (DBE 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 does not include 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 1 and 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 does not include 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 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 (see ﻿9.4.2.323.4 (Supported EHT-MCS And NSS Set field)) to provide EHT-MCS Map information for all its supported bandwidths 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 DBE AP shall accept the request and follow the procedure defined in 37.27 (Procedure for operating mode and parameter updates). In the UHR OMP request sent to enable or update the parameters of the DBE mode, a DBE non-AP STA shall include a Non-AP STA Current DBE Bandwidth field to indicate non-AP STA’s bandwidth that it currently supports for DBE.

A DBE AP shall support receiving enable/disable/update for DBE mode from a DBE non-AP STA using procedures defined in 37.27 (Procedure for operating mode and parameter updates) both when DBE mode is not enabled and when DBE mode is enabled.

NOTE 1 – It is recommended that a DBE non-AP STA performs enable/disable/update for DBE mode using procedures defined in 37.27 (Procedure for operating mode and parameter updates) even before DBE mode is enabled by the AP, to avoid large number of requests from non-AP STAs for DBE mode updates after DBE mode is enabled by the DBE AP.

NOTE 2 – A DBE non-AP STA does not need to enable/disable/update DBE mode using procedures defined in 37.27 (Procedure for operating mode and parameter updates) every time DBE mode is enabled/disabled/updated by the DBE AP.

﻿A DBE AP shall announce an upcoming enablement of DBE mode, updates to the DBE parameters (for already enabled DBE mode) or disablement of DBE mode in Beacon, Probe Response and (Re)Association Response frames using the procedure defined in 37.28 (Enhanced BSS parameter critical update procedure). DBE mode

enablement, the DBE parameters 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 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 advance notification of critical update to enable DBE mode or to change the DBE parameters for already enabled DBE mode, the DBE AP shall:

* Set the Mode Enable field to indicate enabled state for DBE mode.
* Set the Mode Update field to 1 if the AP is updating DBE parameters.
* Set the DBE Bandwidth field to the DBE bandwidth for the DBE mode.
* Set the DBE Disabled Subchannel Bitmap field to indicate disabled 20 MHz subchannels within the DBE bandwidth. The DBE Disabled Subchannel Bitmap field shall satisfy following conditions:
	+ Not disable the primary 20 MHz channel.
	+ Disable any 20 MHz subchannel(s) that are indicated as disabled for the BSS bandwidth in the ﻿Disabled Subchannel Bitmap field in the EHT Operation element.
	+ Not disable any 20 MHz subchannel(s) that are not indicated as disabled for the BSS bandwidth in the Disabled Subchannel Bitmap in the EHT Operation element.

In the advance notification of critical update to disable DBE mode, the DBE AP shall set the Mode Enable field to 0 to indicate disabled state for DBE mode. The DBE AP shall not include any other DBE parameters in the advance notification of critical update 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 by a DBE AP (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. In this case, the AP shall include the DBE Operation Parameters field in the UHR Operation element in the 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. In this case, the AP shall not include the DBE Operation Parameters field in the UHR Operation element in the Probe Response and (Re)Association Response frames.

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 DBE bandwidth provided in OMP request.
* The maximum PPDU bandwidth in UL for non-trigger based PPDU used by 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 DBE bandwidth provided in OMP request.

**Text to be adopted ends here.**