### IEEE P802.11 Wireless LANs

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| PDT MAC for Dynamic Subband Operation (DSO), Follow Up | | | | |
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Abstract

This document contains Proposed Draft Text (PDT) for the Dynamic Subband Operation (DSO) feature of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

# Revision information

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

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial revision on this doc based on the precious PDT doc (11-25/0454) |
| 1 | Editorial changes and adding text for DSO mode enablement procedure |
| 2 | Editorial changes for MIB and added more CIDs |
| 3 |  |
| 4 |  |

# 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 TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes, discussion and references sections are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbn 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.***

## Explanation of the proposed changes:

The proposed changes to the 802.11 TGbn draft within this document are based on the following motions adopted by the TGbn task group:

### Relevant passed motions and pending SPs:

**[Motion 332, doc 11-25/0014r13] Do you support that TGbn will define a mechanism where a non-AP STA can be allocated frequency resources dynamically (i.e., on a per-TXOP basis) outside of the non-AP STA's current operating bandwidth and within the associated AP's BSS bandwidth?**

**[Motion 388, doc 11-25/0014r16] Do you support the following for DSO**

* For a non-AP STA, the channel with bandwidth equaling its operating bandwidth and including the BSS primary channel is referred to as primary sub-band
* For a non-AP STA, a channel with the bandwidth equaling its operating bandwidth outside of its primary sub-band where it can be allocated resources by the AP is referred to as DSO sub-band for that non-AP STA
* A non-AP STA that supports this mechanism is referred to as a DSO STA

**[SP#1] Do you support that:**

* only 80MHz UHR STAs and 160MHz UHR STAs can be DSO STAs
* the DSO ICF-ICR exchange and the PPDUs that follows it shall only be between UHR STAs
* one 80MHz subband in 320MHz BSS can be a DSO subband
* whether more than one 80MHz subband can be a DSO subband in 320MHz BSS TBD
* Secondary 80MHz in 160MHz BSS can be a DSO subband
* Secondary 160MHz in 320MHz BSS can be a DSO subband

*Supporting document: 11-24/1588*

**[SP#2] Do you support that in the DSO ICF, the AP indicates to a DSO STA to switch to a DSO sub-band**

* Upon reception of the DSO ICF, the DSO STA shall
* transition to the DSO sub-band,
* transmit the response in the DSO sub-band a SIFS after the end of the DSO ICF
* And receive frames or be triggered to transmit frames, subject to its spatial stream capabilities and operation mode, in the DSO sub-band (derived from the DSO ICF), a SIFS after the end of the response frame
* The baseline rules for CS required are followed.

*Supporting document: 11-24/1553*

**[SP#3] Do you support that if no non-AP STA that is assigned resources in the primary 20 MHz responds to the initial Control frame and there is at least one response on other channels, the AP shall do one of the following:**

* Terminate the frame exchange sequence with all non-AP STAs, or
* Continue the frame exchange sequence by ensuring that the primary 20 MHz is occupied

*Supporting document: 11-24/1553*

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| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **line** | **Comment** | **Proposed Change** | **Resolution** |
| 1240 | 37 |  |  | Define the DSO Capabilities for UHR STA | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1240 tag in this document. |
| 1241 | 37 |  |  | Define a procedure to enable/disable DSO mode. Also define the signaling for enabling/disabling the mode | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1241 tag in this document. |
| 1243 | 37 |  |  | Define the signaling for DSO STA to indicate its switching delay between the Primary subband and DSO subband and vice versa | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1243 tag in this document. |
| 1244 | 37 |  |  | Define the DSO frame exchange procedure | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1244 tag in this document. |
| 1245 | 37 |  |  | Define the DSO subband BWs and what is the location of the secondary channels BW within BSS BW | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1245 tag in this document. |
| 1246 | 37 |  |  | Define the ICF for the DSO and the limitation on the ICF and ICR | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1246 tag in this document. |
| 1247 | 37 |  |  | Define the inclusion of the intermediate FCS in DSO ICF | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1247 tag in this document. |
| 1248 | 37 |  |  | Define the switch back rule for determining the end of DSO TXOP for DSO STA so that DSO STA can switch back from DSO subband to DSO Primary subband. In general, the rule follows the same as the EMLSR switch back rules defined in 11be | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1248 tag in this document. |
| 1249 | 37 |  |  | Define the AP's behavior for the DSO frame exchange when no non-AP STA respond to the DSO ICF on primary 20MHz | Please define the request in comment as specified in submission 11-24-2054. | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1249 tag in this document. |
| 1251 | 37 |  |  | Define the required MIB variables for DSO feature | As in comment | Revised  Discussion: agree with the commenter in general.  TGbn editor: please make the change with #1251 tag in this document. |

# Text to be adopted begins here:

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

***TGbn editor: Please update the following subclause in 802.11bn D0.2: (#1240)***

The format of the UHR MAC Capabilities Information field is defined in Figure9-aa5 (UHR MAC Capabilities Information field format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B4 | B5 | B6 | B7 | B8 Bx |
|  | DPS Support | DPS Assisting Support | Multi-Link Power Management | NPCA Supported | BSR Enhancement Support | Additional  Mapped  TID  Support | DSO Support | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 | x |
| * UHR MAC Capabilities Information field format | | | | | | | | |

|  |  |  |
| --- | --- | --- |
| * Subfields of the UHR MAC Capabilities Information field (continued) | | |
| Subfield | Definition | Encoding |
| … | … | … |
| DSO Support | Indicates whether or not the DSO operation is supported | Set to 1 if dot11DSOOptionImplemented is equal to true (see 37.19 (Dynamic Subband Operation)).  Set to 0 otherwise. |

***TGbn editor: Please update the following subclause 37.19 Dynamic Subband Operation in 802.11bn D0.2:***

37. Ultra High Reliability (UHR) MAC specification

**37.19 Dynamic Subband Operation [M#332]**

A non-AP STA that [#1251]has dot11DSOOptionImplemented set to true is called a dynamic subband operation (DSO) non-AP STA and shall set the DSO Support subfield of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1; otherwise, the non-AP STA shall set the DSO Support subfield to 0. An AP that has dot11DSOOptionImplemented set to true is called a DSO AP and shall set the DSO Support subfield of the UHR MAC Capabilities Information field of the UHR Capabilities element to 1; otherwise, the AP shall set the DSO Support subfield to 0.

DSO is a mechanism where a DSO non-AP STA that has an operating bandwidth narrower than the DSO AP can dynamically be allocated frequency resources outside of its current operating bandwidth within the DSO AP’s BSS bandwidth, on a per-TXOP basis.

[M#338]For a DSO non-AP STA, the channel with bandwidth equal to the STA’s operating bandwidth which includes the BSS primary channel, is referred to as the primary subband. For a DSO non-AP STA, a channel with bandwidth equal to the STA’s operating bandwidth which lies outside of the STA’s primary subband but within the BSS bandwidth, where it can be allocated resources by the DSO AP during a DSO frame exchange (i.e. TXOP initiated by an ICF for DSO), is referred to as a DSO subband for that non-AP STA.

[#1245][SP#1]Only 80 MHz and 160 MHz operating bandwidth UHR STAs can be DSO non-AP STAs. The DSO ICF-ICR exchange and the PPDUs that follow it, shall only be between UHR STAs. In a 160 MHz BSS, the secondary 80 MHz subband can be a DSO subband for an 80 MHz DSO non-AP STA. In a 320 MHz BSS, one of the secondary 80 MHz subbands can be a DSO subband for an 80 MHz DSO non-AP STA; it is TBD whether more than one secondary 80 MHz subband can be a DSO subband. In a 320 MHz BSS, the secondary 160 MHz subband can be a DSO subband for a 160 MHz DSO non-AP STA.

[#1241]A DSO non-AP STA to enable DSO mode with its associated DSO AP:

* The non-AP STA shall transmit to the AP a Link Reconfiguration Request frame with the DSO Mode subfield in the frame set to 1 for the corresponding enabled link.
  + The non-AP STA shall indicate its DSO switch delay value in the DSO Switch Delay subfield and DSO switch back delay value in the DSO Switch Back Delay subfield in DSO Parameters field of the Link Reconfiguration Request frame when enabling the DSO mode. A non-AP STA may update its DSO related paramters after enablement.
* The associated AP shall accept the request and shall transmit a Link Reconfiguration Notify frame by setting the DSO Mode subfield in the frame to 1, after the AP is ready to serve the non-AP STA in DSO operation, as a response to the received Link Reconfiguration Request frame, to the non-AP STA.

[#1241]A DSO non-AP STA to disable DSO mode with its associated DSO AP:

* The non-AP STA shall transmit to the AP a Link Reconfiguration Request frame with the DSO Mode subfield in the frame set to 0 for the corresponding enabled link.
* The associated AP shall accept the request and shall transmit a Link Reconfiguration Notify frame by setting the DSO Mode subfield in the frame to 0, after the AP is no longer serving the non-AP STA in the DUO mode, as a response to the received Link Reconfiguration Request frame, to the non-AP STA.

If a DSO AP and a DSO non-AP STA operate in DSO mode, the following apply:

[#1246]1) A DSO AP that initiates a DSO frame exchange that includes neither group addressed Data nor group addressed Management frames and requires the DSO non-AP STA(s) to switch to the DSO subband shall begin the frame exchanges by transmitting a BSRP as the DSO ICF to the DSO non-AP STA with the following limitations:

* The DSO ICF shall be sent in the non-HT duplicate PPDU format using a rate of 6 Mb/s, 12 Mb/s, or 24 Mb/s.
* The DSO AP shall set the length of the Padding field of the DSO ICF according to the rules in 37.15 (Padding for an Initial Control frame), such that the MAC padding duration following the intermediate FCS if required by the DSO non-AP STA is greater than or equal to the [#1243] DSO switch delay, most recently indicated by the DSO non-AP STA in the DSO Switch Delay field of the Link Reconfiguration Request frame. The MAC padding duration in DSO ICF shall also meet any additional requirements associated with other mechanisms the non-AP STA is engaged in (e.g., EMLSR, DPS).
* The number of spatial streams in response to the BSRP Trigger frame as the DSO ICF shall be limited to one for all the scheduled DSO non-AP STAs and it shall be indicated in the BSRP Trigger frame.
* In the DSO ICF, the AID12 subfield of a User Info field shall be set to the AID of the DSO non-AP STA and the RU Allocation subfield shall be set to an RU assigned to the DSO non-AP STA that is contained in a single DSO subband.
* [#1247]A DSO AP shall include an intermediate FCS in the DSO ICF if needed by a DSO non-AP STA that is an intended recipient of the DSO ICF.

NOTE—An intermediate FCS might not be needed, e.g., if the DSO non-AP STA requires no padding.

[#1244][SP#2]2) If a DSO non-AP STA receives a DSO ICF from its DSO AP, where the allocated RU to the DSO non-AP STA is contained in a DSO subband, the DSO non-AP STA shall transition to the indicated DSO subband and transmit the corresponding ICR on the allocated RU a SIFS after the end of the PPDU carrying the DSO ICF. A DSO non-AP STA shall follow the CS mechanism defined in 35.5.2.4 (UL MU CS mechanism for EHT STAs) before transmitting the ICR. A DSO non-AP STA that switches to the DSO subband shall be able to receive frames or be triggered to transmit frames, subject to its spatial stream capabilities and operation mode, in the DSO subband, a SIFS after the end of the PPDU carrying the ICR.

[#1244]3)ADSO AP shall follow the following rules after the ICF/ICR exchange and until the DSO non-AP STA switches back from the DSO subband to the primary subband:

* indicate the RU allocations for the DSO non-AP STA with reference to the BSS primary channel in all triggering frames, and
* indicate the RU allocations for the DSO non-AP STA to be within the DSO subband to which the DSO non-AP STA has switched in all triggering frames and DL MU PPDUs, and
* not use the MU-RTS as the trigger frame.

[#1248]5) The DSO non-AP STA shall switch back from the DSO subband to the primary subband no later than [#1243] DSO switch back delay, indicated by the DSO non-AP STA in the most recent successfully transmitted Link Reconfiguration Request frame, as measured from the end of the DSO frame exchange, which occurs when any of the following conditions is met:

* The DSO non-AP STA does not receive a PHY-RXSTART.indication primitive during a timeout interval of aSIFSTime + aSlotTime + 20 μs starting at the end of the PPDU transmitted by the DSO non-AP STA as a response to the most recently received frame from the DSO AP or starting at the end of the reception of the PPDU containing a frame for the DSO non-AP STA from the DSO AP that does not require immediate acknowledgement.
  + NOTE—20 μs value is derived from aRxPHYStartDelay duration
* The DSO non-AP STA receives a PHY-RXSTART.indication primitive during a timeout interval of aSIFSTime + aSlotTime + 20 μs starting at the end of the PPDU transmitted by the DSO non-AP STA as a response to the most recently received frame from the DSO AP or starting at the end of the reception of the PPDU containing a frame for the DSO non-AP STA from the DSO AP that does not require immediate acknowledgement, and the DSO non-AP STA does not detect within the PPDU corresponding to the PHY-RXSTART.indication any of the following frames:
  + An individually addressed frame with the RA equal to the MAC address of the DSO non-AP STA
  + A Trigger frame that has one of the User Info fields addressed to the DSO non-AP STA
  + A CTS-to-self frame with the RA equal to the MAC address of the DSO AP
  + A Multi-STA BlockAck frame that has one of the Per AID TID Info fields addressed to the DSO non-AP STA
  + An NDP Announcement frame that has one of the STA Info fields addressed to the DSO non-AP STA, followed by a sounding NDP
* The DSO non-AP STA does not respond to the most recently received frame from the DSO AP within the DSO frame exchange that requires an immediate response after a SIFS.

[#1249][SP#3]6) If no non-AP STA that is assigned resources in the primary 20 MHz subband responds to the DSO ICF and there is at least one response to the DSO ICF from a DSO non-AP STA on any other subband, the AP shall do one of the following:

* Terminate the DSO frame exchange sequence with all non-AP STAs
* Continue the DSO frame exchange sequence by ensuring that the primary 20 MHz is occupied

**Annex C**

**C.3 MIB Detail**

***TGbn editor: Please Update the following paragraph as follows:***

Dot11UHRStationConfigEntry ::=

SEQUENCE {

dot11CoRTWTOptionImplemented TruthValue,

dot11NPCAOptionImplemented TruthValue,

dot11DUOOptionImplemented TruthValue,

dot11UHRBSROptionImplemented TruthValue,

dot11DSOOptionImplemented TruthValue}

***TGbn editor: Please add the following MIB to this subclause***

dot11DSOOptionImplemented OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

This attribute, when true, indicates that the station implementation is capable of supporting DSO operation.

DEFVAL { ana }

"::= { dot11UHRStationConfigEntry <ana> }

# Text to be adopted ends here.

**SP: Do you agree** **to incorporate the proposed text changes for DSO in 11-25/0713r0 to the latest TGbn draft?**

**References:**

1. 11-24-0171r21: 11-24-0171-21-00bn-tgbn-motions-list-part-1, Alfred Asterjadhi (Qualcomm Inc.)