IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proposed Resolution for SB1 CID 6016 and more | | | | |
| Date: 2024-1-16 | | | | |
| Author: | | | | |
| Name | Affiliation | Address | Phone | Email |
| Emily Qi | Intel Corporation |  |  | Emily.h.qi@intel.com |
| Elad Oren | Intel Corporation |  |  | elad.oren@intel.com |
| Ilan Peer | Intel Corporation |  |  | ilan.peer@intel.com |
| Thomas Derham | Broadcom |  |  | thomas.derham@broadcom.com |
| Mark Rison | Samsung |  |  |  |
| Youhan Kim | Qualcomm Technologies, Inc. |  |  | youhank@qti.qualcomm.com |
|  |  |  |  |  |

Abstract

##### This submission provides proposed resolutions for CID 6016, 6017 and 6169.

##### The proposed changes are based on REVme D4.0.

##### Revision history:

##### R0 – initial version

R1 – incorporated some feedback from Mark R.

R2 – added a note in 11.21.15 per suggestions from Mark R and Thomas D.

R4:  
Changes from R2 to R4 are marked using the MS Word Track Change feature, except the addition of the MIB section (C.3) which does not use the MS Word Track Change feature (as it makes seeing ‘underline’ hard).  
Abstract of the changes from R2 to R4 are:

* The Channel Usage element with the Usage Mode field indicating Capability notification can be sent only during channel switch.
* If a non-AP STA does not include “X” Capabilities element, then it means that the non-AP STA does not support “X” (e.g., if HT Capabilities element is not included, then it means that the STA does not support HT).
* Both APs and non-AP STAs need to declare support for this new feature via the Capability Notification Support in the Extended Capabilities element.

R5: Added the HE 6 GHz Band Capabilities element.

R6: Updated during Jan. 16 TGme PM2 session.

| **CID** | **Page** | **Clause** | **Resn Status** | **Comment** | **Proposed Change** |
| --- | --- | --- | --- | --- | --- |
| 6017 | 1648 | 9.6.13.24 | 24 | When Channel Usage Request frame is used for channel switch request, the non-AP STA should indicate its new capabilities in a new band (e.g. VHT capabilities if originally associated with HE/HT only or HE capabilities) in the Channel Usage Request frame so that AP can non-AP STA's capabilities in the new band. | Add VHT or HE Capabilities element in the Channel Usage Request frame when the Usage Mode is set to "Noninfrastructure BSS channel switch request". Commenter will prepare a submission. |
| 6016 | 2503.16 | 11.9 |  | When AP uses Extended Channel Switch Announcement to switch to a new band (for example, from 2.4 to 5 GHz or from 2.4/5 GHz to 6 GHz ), AP may not know its associated STA’s capabilities in the new band (e.g., VHT capability, or HE capabilities in the new band). Normally the AP would know which capabilities the STA has enabled from the association request, however in this example the STA didn't’ send VHT Cap in the 2.4 Assoc request. IEEE 802.11 Std should provide a mechanism to allow non-AP STA to advertise its VHT capability for new band without reassociation. | Commenter will prepare a submission. |
| 6169 |  | 11.9 |  | Rules or at least guidance is needed for channel switch across bands, to cover information about operation in the new band that is not known in the old band | Emily QI expressed during a TGme session at the September F2F an intention to bring a contribution on this matter. This contribution should include a mechanism, such as use of BTM, to help STAs that are unable to operate in the new band |

**Background and Discussion**

In 11.38 VHT BSS operation, it states:

A STA for which dot11VHTOptionImplemented is true shall set dot11HighThroughputOptionImplemented to true.

In 26.17 HE BSS Operation, it states:

A STA operating in the 2.4 GHz band that sets dot11HEOptionImplemented to true shall set dot11HighThroughputOptionImplemented to true.

A STA operating in the 5 GHz or 6 GHz band that sets dot11HEOptionImplemented to true shall set both dot11VHTOptionImplemented and dot11HighThroughputOptionImplemented to true.

If dotxxxOptionImplemented is true, the xxx Capabilities element is included in the Association Request/Response frame.

According to those statements, my understandings are:

* If an HE STA operates in 2.4 GHz, it shall include HT/HE Capabilities elements in the Association Request/Response frame, but do not have VHT Capabilities element of its peer device.
* If an HE STA operates in 5 GHz or 6 GHz, it shall include all HT/VHT/HE Capabilities elements in the Association Request/Response frame.

However, even though the HT or HE Capabilities element are always included in the Association Request/Response frames, the parameters of HT or HE Capabilities element may have different configurations for different bands. For example,

* STA may not support 40 MHz on 2.4 GHz band but support 40 MHz for 5GHz band. 40 MHz related fields in the HT Capabilities element may be configured differently with different band.
* the PPE Thresholds field of the HE Capabilities element might be different between bands.

Therefore, following capabilities elements need to be communicated from STA to AP when switching band:

* VHT Capabilities element when switching from 2.4 GHz band to 5 GHz band (because it was not included in the original association frames)
* HT or HE Capabilities element when switching between bands (because they might have different configurations.)

In today’s implementation, in those scenarios, STAs do reassociation procedure after switching to a new band.

This submission is to provide a way for non-AP STA to communicate its HT/VHT/HE Capabilities for the new band to avoid reassociation procedure for the case that the security configuration is same between bands. However, if the security configurations are different between bands, the STA may have to do reassociation.

**Proposed Resolutions for CID 6016, 6017 and 6169:**

Revised. Incorporate changes in this document under “Proposed Changes”.

**Proposed Changes:**

**9.4.2.25 Extended Capabilities element**

***TGm editor: Please insert a new row in Table 9-190 (Extended Capabilities field) in this subclause as shown below:***

|  |  |  |
| --- | --- | --- |
| ANA | Capability Notification Support | In an AP, set to 1 to indicate the AP supports reception of a Channel Usage Request frame that includes capabilities elements. Set to 0 otherwise.  In a non-AP STA, set to 1 to indicate the STA supports transmission of a Channel Usage Request frame that includes capabilities elements. Set to 0 otherwise. |

**9.4.2.85 Channel Usage element**

***TGm editor: Please modify Table 9-266 in this subclause as shown below:***

|  |  |
| --- | --- |
| * Usage Mode definitions | |
| Value | Usage Mode |
| 0 | Noninfrastructure BSS |
| 1 | Off-channel TDLS direct link |
| 2 | Noninfrastructure BSS in which none of the APs belonging to the same ESS operate on the channels identified by the Channel Entry field |
| 3 | Peer-to-peer link indication |
| 4 | Noninfrastructure BSS channel switch request |
| <ANA> | Capability notification |
| <ANA> +1 –254 | Reserved |
| 255 | Unknown request |

* Channel Usage Request frame format

***TGm editor: Please insert three new fields in Figure 9-1174 (******Channel Usage Request frame Action field format) as shown below:***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Category | WNM Action | Dialog Token | Channel Usage Elements | Supported Operating Classes Element | TWT Elements (optional) | Timeout Interval Element (optional) |
| Octets: | 1 | 1 | 1 | variable | variable | variable | 0 or 7 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | HT Capabilities Element (optional) | VHT Capabilities Element (optional) | HE Capabilities Element (optional) | HE 6 GHz Band Capabilities Element (optional) |
| Octets: | variable | variable | variable | variable |

**Figure 9-1174 - Channel Usage Request frame Action field format**

***TGm editor: change the following paragraph in 9.6.13.24 as follows:***

The Channel Usage Elements field includes one or more Channel Usage elements described in 9.4.2.84 (Channel Usage element) to identify the request channel usage. If the Usage Mode field in a Channel Usage element indicates Noninfrastructure BSS channel switch request or Capability notification, no other Channel Usage element is included in the Channel Usage Request frame.

The Supported Operating Classes Element field contains a Supported Operating Classes element to indicate the supported operating classes for the requested network type, consistent with the Country element advertised by the AP. The Supported Operating Classes is described in 9.4.2.52 (Supported Operating Classes element). This field is not present if the Usage Mode field in the Channel Usage element is Capability notification.

***TGm editor: insert the following paragraphs at the end of 9.6.13.24:***

The HT Capabilities Element field, if present, contains an HT Capabilities element. It specifies the HT capabilities of the STA in the operating class and channel specified in the Channel Entry field of the Channel Usage element. It is optionally present when the Usage Mode field in the Channel Usage element indicates Noninfrastructure BSS channel switch request or Capability notification; not present otherwise.

The VHT Capabilities Element field, if present, contains a VHT Capabilities element. It specifies the VHT capabilities of the STA for the operating class and channel specified in the Channel Entry field of the

Channel Usage element. It is optionally present when the Usage Mode field in the Channel Usage element indicates Noninfrastructure BSS channel switch request or Capability notification; not present otherwise.

The HE Capabilities Element field, if present, contains an HE Capabilities element. It specifies the HE capabilities of the STA for the operating class and channel specified in the Channel Entry field of the Channel Usage element. It is optionally present when the Usage Mode field in the Channel Usage element indicates Noninfrastructure BSS channel switch request or Capability notification; not present otherwise.

The HE 6 GHz Band Capabilities Element field, if present, contains an HE 6 GHz Band Capabilities element. It specifies the HE capabilities of the STA for the operating class and channel in the 6 GHz band that is specified in the Channel Entry field of the Channel Usage element. It is optionally present when the Usage Mode field in the Channel Usage element indicates Noninfrastructure BSS channel switch request or Capability notification; not present otherwise.

**11.21.15 Channel usage procedures**

***TGm editor: please change the following paragraphs as shown below:***

A non-AP STA that is operating in a noninfrastructure BSS may send a Channel Usage Request frame with a Channel Usage element that carries a Usage Mode field indicating Noninfrastructure BSS channel switch request to a peer STA to indicate that it prefers to switch the operating channel of the noninfrastructure BSS to another channel. A non-AP STA may indicate the preferred operating channels by including one or more Operating class and Channel fields in the Channel Entry field of the Channel Usage element carried in the corresponding Channel Usage Request frame. To provide the parameters in the HT Capabilities element, VHT Capabilities element, HE Capabilities element and/or HE 6 GHz Band Capabilities element for the preferred operating channel, the non-AP STA shall include the corresponding capabilities element(s) in the Channel Usage Request frame; otherwise, capabilities element(s) shall not be included. When the Usage Mode field indicates Noninfrastructure BSS channel switch request and any capabilities elements are included in the Channel Usage Request frame, the Channel Entry field shall include an Operating Class and Channel field that indicates the operating class and channel that the capability notification applies to.

Upon receiving a Channel Usage Request frame with a Channel Usage element that carries a Usage Mode field indicating Noninfrastructure BSS channel switch request, a STA that supports noninfrastructure BSS channel switch requests and is operating in a noninfrastructure BSS should consider switching the operating channel of the noninfrastructure BSS to a new channel that is one of the preferred channels indicated in the received Channel Entry field of the Channel Usage element, if present. The STA shall transmit a Channel Usage Response frame in response to the reception of a Channel Usage Request frame with the Usage Mode field equal to 4 that includes a Channel Usage element with the Usage Mode field set to 4. If the channel switch request is accepted, the STA shall include the target operating class and channel in the Channel Entry field of the Channel Usage element in the Channel Usage Response frame. Otherwise, no Channel Entry field shall be included. ~~When the Channel Usage element is carried in a Probe Request or Probe Response frame, the Usage Mode field shall not be set to 4.~~

***TGm editor: please insert the following paragraphs before the last paragraph of 11.21.15:***

A STA for which dot11ChannelUsageCapabilityNotificationImplemented is true shall set the Capability Notification Support field to 1 in the Extended Capabilities elements that it transmits. A STA for which dot11ChannelUsageCapabilityNotificationImplemented is not true shall set the Capability Notification Support field to 0 in the Extended Capabilities elements that it transmits.

If an AP has the Capability Notification Support field set to 1 in the Extended Capabilities element, an associated non-AP STA for which dot11ChannelUsageCapabilityNotificationImplemented is true may send a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element to the AP after the non-AP STA receives an Extended Channel Switch Announcement element or an Extended Channel Switch Announcement frame from the AP. When the Usage Mode field indicates Capability notification, the Channel Entry field shall include an Operating Class and Channel field that indicates the operating class and channel that the capability notification applies to.If an AP has the Capability Notification Support field set to 1 in the Extended Capabilities element, an associated non-AP STA for which dot11ChannelUsageCapabilityNotificationImplemented is true shall send a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element to the AP after the non-AP STA has received an Extended Channel Switch Announcement element or an Extended Channel Switch Announcement frame from the AP if the HT, VHT and/or HE capabilities of the STA are different before and after the channel switch except for the following cases:

* The STA is a STA 5G before the channel switch and a STA 6G after the channel switch, and the only difference in the capabilities before and after the channel switch is that HT and VHT are not supported after the channel switch.
* The STA is a non-HE STA that is a STA 5G before the channel switch and a STA 2G4 after the channel switch, and the only difference in the capabilities before and after the channel switch is that VHT is not supported after the channel switch.

When an associated non-AP STA chooses to send a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element to the AP, the STA shall wait a random delay uniformly distributed in the range between 0 and 5000 µs, and then transmit the Channel Usage Request frame once any applicable conditions for transmitting are met (e.g., channel access procedures, DFS or enablement procedures). The Channel Usage Request frame shall be sent no later than 5 beacon periods after the expected time of the first Beacon frame in the new channel.

NOTE 7—The Channel Usage Request frame indicating Capability notification might be transmitted before or after a channel switch. In either case, the Operating Class and Channel field unambiguously identifies the channel for which the notification applies.

NOTE 8 – For example, if an AP included the Max Channel Switch Time element in the frame containing the Extended Channel Switch Announcement element, then the non-AP STA cannot send a Channel Usage Request frame with the Usage Mode field indicating Capability notification to the AP if the time elapsed since the last Beacon frame in the channel prior to the channel switch is greater than *T*MCST + 5 \* *T*BP, where *T*MCST is the switch time indicated in the Switch Time field in the Max Channel Switch Time element and *T*BP is the beacon period.

NOTE 9 – An AP knows if there are associated non-AP STAs for which dot11ChannelUsageCapabilityNotificationImplemented is false from the Capability Notification Support field in the Extended Capabilities elements transmitted by the associated non-AP STAs. How the AP determines the capabilities of the non-AP STAs for which dot11ChannelUsageCapabilityNotificationImplemented is false after a channel switch is implementation specific. For example, an AP might choose not to perform a channel switch to a different band if there are many associated non-AP STAs for which the Capability Notification Support field is 0 in the Extended Capabilities elements.

A non-AP STA that is associated to an AP shall not send a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element to the AP if any of the following conditions are true:

* The non-AP STA has dot11ChannelUsageCapabilityNotificationImplemented equal to false.
* The Capability Notification Support field is equal to 0 in the Extended Capabilities element transmitted by the AP.
* The non-AP STA has received neither an Extended Channel Switch Announcement element nor an Extended Channel Switch Announcement frame from the AP.

NOTE 10 - If the STA has not transmitted the Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element within a reasonable time, the AP might ignore the frame or disassociate the STA.

* If a non-AP STA sends a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element because of channel switch from channel A to channel B, then:The STA shall include the HT Capabilities element if the STA supports HT in channel B even if the HT capabilities have not changed between the channels A and B.
* The STA shall include the VHT Capabilities element if the STA supports VHT in channel B even if the VHT capabilities have not changed between channels A and B.
* If channel B is in the 2.4 or 5 GHz band, the STA shall include the HE Capabilities element if the STA supports HE in the channel B even if the HE capabilities have not changed between channels A and B.
* If channel B is in the 6 GHz band, the STA shall include the HE Capabilities element and the HE 6 GHz Band Capabilities element if the STA supports HE in channel B even if the HE capabilities have not changed between the channels A and B.

If a non-AP STA transmits a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element during channel switch from channel A to channel B, then:

* The STA is indicating that it does not support HT in the channel B if the Channel Usage Request frame does not include the HT Capabilities element.
* The STA is indicating that it does not support VHT in the channel B if the Channel Usage Request frame does not include the VHT Capabilities element.
* The STA is indicating that it does not support HE in the channel B if the Channel Usage Request frame does not include the HE Capabilities element.

NOTE 11 – Consider the case, for example, an HE non-AP STA that is a STA 6G receives from its associated AP an Extended Channel Switch Announcement element indicating a channel switch to the 2.4 GHz band. The non-AP STA sends a Channel Usage Request frame with the Usage Mode field indicating Capability notification in the Channel Usage element including only the HT Capabilities element. This means that the non-AP STA is a non-HE HT STA after the channel switch.

When the Channel Usage element is carried in a Probe Request or Probe Response frame, the Usage Mode field shall not indicate Noninfrastructure BSS channel switch request or Capability notification.

**C.3 MIB detail**

***TGm editor: Please update REVme D4.2 P5269L42 as follows.***

Dot11WirelessMgmtOptionsEntry ::=

SEQUENCE {

…

dot11PhaseShiftFeedbackImplemented TruthValue

dot11ChannelUsageCapabilityNotificationImplemented TruthValue

}

***TGm editor: Please add the following at REVme D4.2 P5284L30.***

dot11ChannelUsageCapabilityNotificationImplemented OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by STA capabilities.

This attribute in an AP, when true, indicates that the AP supports reception of a Channel Usage Request frame that includes capabilities elements.

This attribute in a non-AP STA, when true, indicates that the STA supports transmission of a Channel Usage Request frame that includes capabilities elements."

::= { dot11WirelessMgmtOptionsEntry 66 }