IEEE P802.11
Wireless LANs

|  |
| --- |
| SCS Procedure for EHT |
| Date: 2021-02-27 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Dibakar Das | Intel |  |  | Dibakar.das@intel.com |
| Dave Cavalcanti |  |  |  |
| Ganesh Venkatesan |  |  |  |
| Laurent Cariou |  |  |  |
| Cheng Chen |  |  |  |
| Po-kai Huang |  |  |  |
| Necati Canpolat |  |  |  |
| Duncan Ho | Qualcomm |  |  |  |
| Jarkko Kneckt | Apple |  |  |  |

Abstract

This submission resolves the following CID: 1977.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Page** | **Line** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1977 | 146 | 46 | 35.4.1 | There are complaints on UL MU operation for 11ax in the field, especially for the latency-sensive applications. It is beneficial to further enhance the MU operation in 11be. There is pratice in the industry in this direction. It is beneficial to bring the similar mechanisms for the whole industry by standarizing it at IEEE. | Refer to https://www.youtube.com/watch?v=uYlHpgZ6XTM; and DCN1006-r3 | **Revised.**We added TSPEC based signaling to provide parameters that describe traffic characteristics within the SCS procedure. With this addition the SCS protocol can be used by a non-AP STA to signal traffic flow QoS requirements (esp. the low latency parameters) which allows the AP to create an optimal schedule to meet those requirements. TGbe editor to make the changes with the CID tag (#1977) in doc.: IEEE 802.11-21/0340r3 |

**Discussion:**

To meet the low latency requirements in EHT as well as to increase the efficiency of the UL MU operation, what we need is a light-weight mechanism for a STA to inform the AP of its QoS requirements. There are quite a few procedures already defined in 802.11 that allow STAs to exchange QoS requirements. Among them the SCS mechanism provides an extremely light-weight way for a STA to inform the AP about what UP and EDCA transmit queue to be used for certain DL flows. What’s missing in SCS though is a way to provide detailed characteristics of a QoS traffic flow. As such in this document we propose to extend SCS to meet EHT QoS requirements as follows:

1. Include TSPEC in the SCS Request/Response frames to allow exchange of detailed traffic description in DL or UL and bidirectional flows.
2. Clarify that the traffic description is at MLD-level for DL and UL flows.

***TGbe editor: Revise the text in 6.3.82.3.2 of draft REVme 0.0 as:***

**6.3.82.3 MLME-SCS.confirm**

**6.3.82.3.2 Semantics of the service primitive** (#1977)

The primitive parameters are as follows:

MLME-SCS.confirm(

 PeerSTAAddress,

 DialogToken,

 SCSID,

 Status,

 SCS Descriptor,

 VendorSpecific Info)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| PeerSTAAddress | MAC address | Any valid individual MAC address | Specifies the address of thepeer MAC entity withwhich to perform the SCSprocess |
| Dialog Token | Integer | 1-255 | The dialog token to identifythe SCS request andresponse transaction |
| SCSID | Integer | 1–255 | Identifies the SCS streamthat is being classified |
| Status | Enumeration | See Table 9-50 (Statuscodes) | Indicates the result responseof the requested SCSID. SeeTable 9-50 (Status codes). |
| SCS Descriptor | SCS Descriptor element | SCS Descriptor | SCS Descriptor |
| VendorSpecificInfo | A set of elements | As defined in 9.4.2.25(Vendor Specific element) | Zero or more elements. |

***TGbe editor: Revise the text in 6.3.82.5.2 of draft REVme 0.0 as:***

**6.3.82.5 MLME-SCS.response**

**6.3.82.5.2 Semantics of the service primitive** (#1977)

The primitive parameters are as follows:

MLME-SCS.response(

PeerSTAAddress,

DialogToken,

SCSID,

Status,

 SCS Descriptor,

 VendorSpecificInfo

 )

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| PeerSTAAddress | MAC address | Any valid individual MAC address | Specifies the address of thepeer MAC entity withwhich to perform the SCSprocess |
| Dialog Token | Integer | 1-255 | The dialog token to identifythe SCS request andresponse transaction |
| SCSID | Integer | 1–255 | Identifies the SCS streamthat is being classified |
| Status | Enumeration | See Table 9-50 (Statuscodes) | Indicates the result responseof the requested SCSID. SeeTable 9-50 (Status codes). |
| SCS Descriptor | SCS Descriptor element | SCS Descriptor | SCS Descriptor |
| VendorSpecificInfo | A set of elements | As defined in 9.4.2.25(Vendor Specific element) | Zero or more elements. |

***TGbe editor: Revise Figure 9-541 in 9.4.2.121 of draft REVme 0.0 as:***

**9.4.2.121 SCS Descriptor element** (#1977)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Element ID | Length | SCSID | Request Type | Intra-Access Category Priority element (optional)  | TCLAS Elements (optional) | TCLAS Processing Element (optional) | TSPEC Element (optional) | Optional Subelements |

Octets: 1 1 1 1 0 or 3 variable 0 or 3 0 or 57 variable

 **Figure 9-541—SCS Descriptor element format**

***TGbe editor: Add the following paragraph in 9.4.2.121 P1274L48 of draft REVme 0.0:***

The TSPEC Element field contains zero or one TSPEC element to describe the traffic characteristics and QoS expectations of traffic flows that belong to this SCS stream, as defined in 9.4.2.29 (TSPEC element). Zero or one TSPEC element is present when Request Type field is equal to “Add” or “Change” and no TSPEC element is present when Request Type field is equal to “Remove”.

***TGbe editor: Revise Figure 9-555 in 9.6.18.3 of draft REVme 0.0 as:***

**9.6.18.3 SCS Response frame format** (#1977)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | Robust Action | Dialog Token | SCS Status List | SCS Descriptor List |

Octets: 1 1 1 variable variable

 **Figure 9-955—SCS Response frame Action field format**

***TGbe editor: Add the following paragraph in 9. 6.18.3 P1624L21 of draft REVme 0.0:***

The SCS Descriptor List field contains zero or more SCS Descriptor elements, as defined in 9.4.2.121 (SCS
Descriptor element). If included, each SCS Descriptor element contains a TSPEC element to describe the traffic characteristics and QoS expectations of traffic flows that belong to this SCS stream. Zero or more SCS Descriptor elements are present when the Status Code field value is equal to “Success” and no SCS Descriptor element is

present otherwise.

**9.4.2.295b.2 Basic variant Multi-Link element**

***TGbe editor: Revise Figure 9-788ex and add an entry to MLD Capabilities field as:***

 B0 B3 B4 B5 B9 B10 B11 B15

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Maximum Number Of Simultaneous Links | SRS Support | Frequency Separation For STR | SCS Traffic Description Support | Reserved |

Bits: 4 1 5 1 5

**Figure 9-788ex- MLD Capabilities field format**

**Table 9-322an—Subfields of the MLD Capabilities field**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| SCS Traffic Description Support | Indicates support for transmission and reception of SCS Descriptor elements containing a TSPEC subelement.  | Set to 1 by an AP MLD that supports transmission of SCS Response frames containing SCS Descriptor element with a TSPEC subelement and reception of SCS Request frames containing SCS Descriptor element with a TSPEC subelement and dot11SCSActivated is true.Set to 1 by a non-AP MLD that supports transmission of SCS Request frames containing SCS Descriptor element with a TSPEC subelement and reception of SCS Response frames containing SCS Descriptor element with a TSPEC subelement and dot11SCSActivated is true.Set to 0 otherwise.  |

***TGbe editor: Revise the text in 11.25.2 of draft REVme 0.0 as:***

**11.25.2 SCS procedures** (#1977)

The stream classification service (SCS) is a service that may be provided either by anAP to its associated STAs that support SCS or by an AP MLD to non-AP MLDs that support SCS with which it has successfully performed multi-link setup. In SCS, the AP classifies incoming (M101) individually addressed MSDUs based upon parameters provided by the non-AP STA. Moreover, the SCS procedure can be used by a non-AP STA to describe its traffic characteristics and reserve resources within an AP.

The classification allows the UP, drop eligibility, and EDCA transmit queue to be selected for all MSDUs

matching the classification.

Implementation of SCS is optional for a STA. A STA that implements SCS shall set its dot11SCSImplemented to true. (#1121) A STA with dot11SCSActivated equal to true shall support stream classification and shall set to 1 the SCS field of the Extended Capabilities elements that it transmits. If dot11SCSActivated is true, dot11SCSImplemented shall be true. All STAs affiliated with an MLD shall set the SCS field of the Extended Capabilities element that they transmit to the same value.

A non-AP STA that supports SCS may request use of SCS by sending an SCS Request frame that includes an

SCS Descriptor element with the Request Type field set to “Add” or “Change.” The SCS Descriptor List field

in the SCS Descriptor element identifies how MSDUs are classified and the priority to assign to MSDUs that

match this classification. If the TCLAS Processing element is present in an SCS Descriptor element, the

Processing subfield shall have a value of 0 or 1. An AP shall decline any SCS Request frame where a TCLAS

Processing element is present, and the Processing subfield does not have a value of 0 or 1.

A non-AP STA with dot11SCSActivated equal to true that supports transmission of SCS Request frames containing SCS Descriptor element with a TSPEC subelement and reception of SCS Response frames containing SCS Descriptor element with a TSPEC subelement shall set value 1 to the SCS Traffic Description Support subfield in the Basic Variant Multi-Link element that it transmits. An AP STA with dot11SCSActivated equal to true that supports transmission of SCS Response frames containing SCS Descriptor element with a TSPEC subelement and reception of SCS Request frames containing SCS Descriptor element with a TSPEC subelement shall set value 1 to the SCS Traffic Description Support field of the Basic variant Multi-Link element that it transmits.

A non-AP STA may transmit an SCS Request frame with SCS Descriptor element(s) containing a TSPEC element with the Request Type field set to “Add” or “Change”. The TSPEC element describes the traffic characteristics of the requested SCS stream. A non-AP STA shall not transmit an SCS Request frame with SCS Descriptor element(s) containing a TSPEC element to an AP from which it has not received a Basic variant Multi-Link element with the SCS Traffic Description Support field equal to 1.

A non-AP STA shall not transmit an SCS Request frame with SCS Descriptor element(s) containing a TSPEC element to an AP in which the Direction subfield is equal to 3 (i.e., Bidirectional link).

An SCS Request frame sent by a non-AP STA affiliated with a non-AP MLD to the AP of an AP MLD that does not contain a TSPEC element in which the Direction subfield is equal to 1 (Direct Link) is interpreted as a request for creation of an SCS stream that applies at the MLD level.

Each SCS stream is identified by an SCSID. The SCSID is used by a non-AP STA to request creation,

modification, or deletion of an SCS stream. The SCSID is used by an AP to identify an SCS stream in SCS

responses.

The MLDs maintain SCSIDs in MLD level, i.e. the SCSID used by a STA affiliated with a non-AP MLD in an SCS Request frame transmitted to an AP affiliated with an AP MLD is unique across the non-AP MLD.

A non-AP STA should set the Minimum Service Interval and the Maximum Service Interval fields in any TSPEC element transmitted in an SCS Descriptor element to the minimum and maximum interval respectively, in microseconds, in which it requests to be scheduled for UL traffic (if the Direction subfield in the TSPEC element is equal to 0) or DL traffic (if the Direction subfield in the TSPEC element is equal to 2) or Direct link traffic (if the Direction subfield in the TSPEC element is equal to 1).

Upon receipt of an SCS Request frame from an associated non-AP STA, the AP shall respond with a corresponding SCS Response frame. A value of (#4282)SUCCESS shall be set in the corresponding Status field of the SCS Status duple in the SCS Response frame when the AP accepts the SCS request for the requested SCSID. A value of REQUEST\_DECLINED, REQUESTED\_TCLAS\_NOT\_SUPPORTED\_BY\_AP, REJECTED\_WITH\_SUGGESTED\_CHANGES, or INSUFFICIENT\_TCLAS\_PROCESSING\_RESOURCES shall be set in the corresponding SCS Status field of

the SCS Status duple in the SCS Response frame when the AP denies the SCS request for the requested SCSID.

If the AP declines a request to change a previously accepted SCSID, the previously accepted classification for

this SCSID continues to operate.

If the requested SCS is accepted by the AP and the SCS Descriptor element either did not contain a TSPEC element or contained a TSPEC element in which the Direction subfield is equal to 2 (i.e., Downlink), the AP shall process subsequent incoming (M101)individually addressed MSDUs from the DS or WM that match the TCLAS elements and optional TCLAS Processing element classifier specified in the SCS Descriptor element.

A match of the classifier is defined as follows:

— When the Processing subfield of the TCLAS Processing element is 0, the classifier matches all of the parameters in the TCLAS elements in the SCS Descriptor element.

— When the Processing subfield of the TCLAS Processing element is 1 or the TCLAS Processing element is not present, the classifier matches if the parameters match at least one of the TCLAS elements in the SCS Descriptor element.

The processing of matching MSDUs depends upon the access policy assigned to the MSDU:

— For matching MSDUs that are not part of a TS (as described in 11.4 (TS operation)), the User

Priority subfield of the Intra-Access Category Priority element is used as the UP of these MSDUs.

— For matching MSDUs that are part of a TS (as described in 11.4 (TS operation)), the TID and UP

classification of these MSDUs shall follow the rules specified in 11.4.8 (Data transfer).

— If dot11AlternateEDCAActivated is true, for matching MSDUs that are not part of a TS (as

described in 11.4 (TS operation)) or for MSDUs that are part of a TS that uses EDCA or HEMM as

the access policy, the Alternate Queue subfield of the Intra-Access Category Priority element is used

to select whether the primary EDCA transmit queue or alternate EDCA transmit queue is used for

these MSDUs.

— All matching MSDUs have their DEI set using the value from the Drop Eligibility subfield of the

Intra-Access Category Priority element in the DEI subfield of the HT Control field, as defined in

9.2.4.6 (HT Control field).

If the requested SCS is accepted by an AP MLD and the SCS Descriptor element in the corresponding SCS Request frame contained a TSPEC element, an AP of the AP MLD shall include an SCS Descriptor element containing a TSPEC element in the SCS Response frame signaling the accepted TSPEC parameters for this SCS stream. The SCS Descriptor element shall not contain any Intra-Access Category Priority element, TCLAS Elements or TCLAS Processing Element. The Request Type field value in the SCS Descriptor element is reserved. The AP should set the Minimum Service Interval and the Maximum Service Interval fields in the TSPEC element transmitted to the minimum and maximum interval respectively, in microseconds, in which it is expected to schedule UL traffic (if the Direction subfield in the TSPEC element is equal to 0) or DL traffic (if the Direction subfield in the TSPEC element is equal to 2) or Direct link traffic (if the Direction subfield in the TSPEC element is equal to 1).

If the requested SCS is accepted by the AP of an AP MLD and the SCS Descriptor element in the corresponding SCS Request frame contains a TSPEC element, the AP MLD should use techniques or mechanisms available to it (e.g., configuring appropriate EDCA parameters, scheduling the non-AP STA, setting up one or more Restricted TWT service periods (rTWT) on its enabled links) to meet the QoS requirements (e.g., meeting the delay bound) described in the TSPEC element sent in the SCS Response frame.

A non-AP STA may request the termination of an accepted SCS stream by sending an SCS Request frame with

the Request Type field set to “Remove” and the requested SCSIDs in the SCS Descriptor element. The Length

field of the SCS Descriptor element is set to 0; and no Intra-Access Priority, TCLAS, or TCLAS Processing

elements shall be included in the SCS Descriptor element.

Upon reception of a request to terminate a previously accepted SCS stream, the AP shall cease to apply the

classifier related to this SCSID. The AP shall send an SCS Response frame to confirm the termination of the

SCS stream identified by the SCSID, by including the SCSID and a value of “Terminate” in the Status field of

an SCS Status duple in an SCS Response frame and the dialog token in the SCS Response frame set to the

value from the SCS Request frame that requested termination. Such an SCS Response frame shall not contain a TSPEC element.

The AP may send an unsolicited SCS Response frame at any time to cancel a granted SCS stream identified by

the SCSID, by including the SCSID and a value of “Terminate” in the Status field of an SCS Status duple in an

SCS Response frame and the dialog token in the SCS Response frame set to 0. Such an SCS Response frame shall not contain a TSPEC element.

The AP may send an unsolicited SCS Response frame at any time to update the Minimum Service Interval, Service Start Time and Maximum Service Interval parameters for a granted SCS stream identified by the SCSID, by including the SCSID and a value of “Success” in the Status field of an SCS Status duple in an SCS Response frame. The SCS Response frame shall contain a TSPEC element and the Dialog Token field shall be set to 0.