IEEE P802.11
Wireless LANs

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| CID3309 ESTTHROUGHPUT SAPs |
| Date: 2014-07-03 |
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Abstract

This document proposes a resolution for CID 3309 of LB202, the comment on TGm Draft 3.0 suggesting the addition of a set of SAPs for providing an estimated throughput for a proposed or existing association.

**REVISION NOTES:**

R0: initial

R1:

R2:

R3:

R4:

R5: Removed accuracy values for pre- and post-association.

 Fixed some typos.

R6: corrected a few syntax errors

 Modified several statements to indicate that estimated throughput value is calculated for one direction of the existing or potential association between the PeerMACAddress and this STA (direction indicated is from PeerMACAddress STA to this STA)

 Added an example equation that can be used to create a throughput estimate

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 TGmc Draft. This introduction is not part of the adopted material.

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

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

**CID LIST:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3309 | Matthew Fischer | 143.50 | 6.3 | Sometimes, it is an outside entity that needs to make a decision as to which BSS to choose for association. Those external entities would benefit by knowing the expected throughput of a possible association. Provide a hook for this information to be communicated through the MLME SAP. | Add a SAP called:MLME-ESTTHROUGHPUT.requestwith parameter list:PeerSTAAddresswith a valid range of "Any valid MAC address" and a description of "Specifies the address of the peer MAC entity with which to estimate throughput."Add a SAP called:MLME-ESTTHROUGHPUT.confirmwith parameter list:PeerSTAAddresswith a valid range of "Any valid MAC address" and a description of "Specifies the address of the peer MAC entity with which an estimate of throughput was calculated."Estimated Throughputwith a valid range of "either -1, or a floating point value [0,infinite]"and a description of "Specifies the estimated throughput that is possible between this STA and the peer STA if an association is established." | Revise - generally agree with commenter, TGmc editor to execute proposed changes from 11-14-0792r6 found under all headings which include CID3309 |

**Discussion:**

Many external entities wishing to control the association decision of a device desire to know what the association will deliver in terms of throughput and quality of service before making the decision to associate. While it is conceivable that the external entity can gather information from existing Service Access Primitives to attempt to make a fully informed decision on association, the most important elements and parameters that would allow the external entity to make a reasonable estimate of throughput of the potential association are missing from the existing SAPs. Specifically, while parameters such as utilization, number of associations, QoS admissions, available admission capacity, link quality, BSS load and others provide a good amount of information on the current profile of traffic and associated STAs within a candidate BSS, none of the existing parametes provides any insight into the specific behaviour of the STA. It is much simpler to provide a single parameter which combines the effects of all of the hidden algorithms within the STA entity. Estimated throughput is just such a parameter.

Even if the estimated throughput is not terribly accurate, one can assume that whatever process was used to generate an estimate for one potential or current connection is the same process that is used to evaluate the potential estimate for another potential or current connection, so that a traffic steering entity or network selection entity will at least have a relative comparison available between various possible connections, with the caveat that the comparison of an estimate for a current connection versus a potential connection might have different degrees of accuracy.

Previously, 802.11 provided the following response to 3GPP:

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| --- | --- |
| Question 3: Does IEEE 802.11 WG consider any other WLAN signal metric more suitable for the above described mechanism? | Understanding that the objective of the mechanism is to select the network that provides the best match to the QoS and/or throughput requirements of the system, the consideration of RNSI/RCPI is not sufficient on its own to efficiently estimate the available throughput and QoS that will be experienced in the IEEE 802.11 WLAN. Other metrics should be taken into account, especially channel bandwidth, operating band, number of spatial streams, BSS load, and WAN metrics, see also the attached Table 1. Comparing only the RSNI/RCPI, as is, to thresholds presents some risks of poor decisions. Ideally, a single parameter, such as estimated available throughput, which combines all of the above parameters, would be determined inside of the WLAN modem and then delivered to the upper layers. |

The authors of this proposal believe that this proposal is a linear continuation of the previous communication with 3GPP.

**Proposed changes**

The proposed changes create a new set of SAPs which allows the SME to request and receive an estimate of the throughput that the STA expects to achieve if it were associated with a specified BSS.

**CID 3309**

***TGmc editor: add a new SAP as shown, noting that the subclause numbering is prospective and that the editor should include the new SAP in the appropriate location with appropriate subclause numbering:***

**6.3.102a Estimated Throughput (ESTT)**

**6.3.102a.1 General**

The following set of MLME primitives support the transport of an estimate of the throughput for a potential or existing association between the STA and an AP.

**6.3.102a.2 MLME-ESTIMATED-THROUGHPUT.request**

**6.3.102a.2.1 Function**

This primitive is generated by the SME to request that the MLME provide an estimated throughput for a potential or existing association.

**6.3.102a.2.2 Semantics of the service primitive**

The primitive parameters are as follows:

MLME-ESTIMATED-THROUGHPUT.request(

 PeerMACAddress,

 AverageMSDUSize

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| PeerMACAddress | MACAddress | Any valid individual MAC address | Specifies the MAC address of the STA for which throughput is to be estimated assuming an association to that STA if an association with that STA does not currently exist. |
| AverageMSDUSize | Set of Integers | -1 - 7920 (for each integer in the set) | A set of integers providing an estimate of the expected average MSDU size to be delivered to the wireless medium by the STA corresponding to the PeerMACAddress to this STA, specified per access category. A value of 0 means that the size is unspecified, a value of -1 means that no MSDUs are expected to be delivered for this access category. |

**6.3.102a.2.3 When generated**

This primitive is generated by the SME to request that the MLME provide an estimate of throughput for MSDUs sent from the STA which corresponds to the PeerMACAddress provided in the parameter list to this STA.

**6.3.102a.2.4 Effect of receipt**

On receipt of this primitive, the MLME generates an estimate of throughput for MSDUs sent from the STA which corresponds to the PeerMACAddress provided in the parameter list to this STA.

**6.3.102a.3 MLME-ESTIMATED-THROUGHPUT.confirm**

**6.3.102a.3.1 Function**

This primitive reports the result of a request to provide estimated throughput for a potential or existing association.

**6.3.102a.3.2 Semantics of the service primitive**

The primitive uses the following parameters:

MLME-ESTIMATED-THROUGHPUT.confirm(

 PeerMACAddress,

 EstimatedThroughputDownlink

)

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| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| PeerMACAddress | MACAddress | Any valid individual MAC address | Specifies the MAC address of the STA for which throughput is to be estimated assuming an association to that STA if an association with that STA does not currently exist. |
| EstimatedThroughputDownlink | A set of Real Numbers | Non-negative real numbers. | The estimated throughput in the direction from the STA corresponding to the PeerMACAddress to this STA for an association between this STA and the STA with the MAC address PeerMACAddress with units of bits per second, specified per access category. A value of 0 means no estimate is available. |

**6.3.102a.3.3 When generated**

This primitive is generated by the MLME to provide an estimate of throughput for MSDUs sent from the STA which corresponds to the PeerMACAddress indicated in the parameter list to this STA.

**6.3.102a.3.4 Effect of receipt**

On receipt of this primitive, the SME may use the reported estimate.

***TGmc editor: add the following new subclause with the appropriate numbering:***

**10.44a Estimated throughput**

Many external entities wishing to control the traffic steering decision of a device will benefit by being able to predict the throughput that can be obtained through an association with a peer STA. Those same entities also need to know what the current expectation for throughput is for network selection purposes. The MLME-ESTIMATED-THROUGHPUT.request and MLME-ESTIMATED-THROUGHPUT.confirm SAPs together provide an interface to allow such external entities, operating through the SME, to obtain an estimate of throughput for MSDUs sent from the STA which corresponds to the PeerMACAddress indicated in the parameter list of the MLME-ESTIMATED-THROUGHPUT.request to this STA.

When an MLME-ESTIMATED-THROUGHPUT.request is received at the MLME, the MLME can use the parameters provided in the SAP plus the following information to create estimates of throughput per access category to deliver to the SME in the EstimatedThroughput parameter of the MLME-ESTIMATED-THROUGHPUT.confirm:

* Averaged RSSI measured during receptions of PPDUs transmitted by the STA that corresponds to the MAC entity with the MAC address equal to the PeerMACAddress in the MLME-ESTIMATED-THROUGHPUT.request
* Number of spatial streams that is expected to be supported on the link between this STA and the peer STA
* Channel bandwidth
* BSS Load information known by this STA or obtained from the peer STA
* Block Ack Window size

An estimated MCS should be determined (PHY datarate) using the first three parameters listed above. The PHY datarate may be scaled, for example, by the BSS Load parameter to determine the estimated throughput. The following additional parameters may be used to refine the throughput estimate:

* Channel Utilization
* Number of associations at the peer STA if the peer STA is an AP
* QoS admissions at the peer STA if the peer STA is an AP
* Available admission capacity at the peer STA if the peer STA is an AP
* STA AMSDU QoS admissions at the peer STA if the peer STA is an AP
* Power Save operation

If the MLME is incapable of determining a value for the EstimatedThroughput parameter for any access category, then the MLME shall return the value of 0 for the EstimatedThroughput parameter for that access category in the MLME-ESTIMATED-THROUGHPUT.confirm primitive. If the AverageMSDUSize parameter for an access category is equal to -1 in the MLME-ESTIMATED-THROUGHPUT.request, the STA shall include a value of 0 in the EstimatedThroughput parameter for the corresponding access category in the MLME-ESTIMATED-THROUGHPUT.confirm. If the AverageMSDUSize parameter for an access category is equal to 0 in the MLME-ESTIMATED-THROUGHPUT.request, the STA may assume any value for the average MSDU size used in calculating an estimated throughput to be included in the corresponding access category in the MLME-ESTIMATED-THROUGHPUT.confirm, but should use a value of 1500.

An example of an initial estimate for MSDU throughput is shown in the following equation:

$$EstimatedThroughput= \frac{8\sum\_{i=1}^{X}Y\_{i}L\left(1-P\_{b}\right)^{C\_{4}^{i}}}{C\_{1}+TSym\*ceil\left(\frac{\sum\_{i=1}^{X}C\_{4}^{i}+22}{BitsPerSym\*R}\right)}$$

where,

L = averageMSDUSize

R = PHY bit rate

X = the estimated average number of MPDU frames in an A-MPDU, with an upper bound equal to the Block ACK window size

P*b* = bit error probability

Yi = the estimated average number of MSDUs in MPDU number *i* of an A-MPDU

C1 = AIFS + Average\_Backoff + Preamble\_duration + SIFS + BA\_duration

*TSym* = duration of one PHY symbol on the air

*BitsPerSym* = number of bits per PHY symbol on the air

$$C\_{4}^{i}=8\*4 \*ceil\left(\frac{C\_{2}+C\_{3}^{i}}{4}\right)$$

C2 = MacDelimiter\_bytes + MacHeader\_bytes + FCS\_bytes

$$C\_{3}^{i}=Y\_{i}\*4\*ceil\left(\frac{L+14}{4}\right)$$

$$C\_{3}^{i}=Y\_{i}\*L^{'}$$

$$L^{'}=4\*ceil\left(\frac{L+14}{4}\right)$$

The estimated throughput calculated with the above equation can be further refined by applying scaling factors to account for the estimated air time available for this STA.

**References:**