IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | CR ESP | | | | | | Date: 2017-11-07 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Matthew Fischer | Broadcom |  |  | [Matthew.fischer@broadcom.com](mailto:Matthew.fischer@broadcom.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

Comment resolution with proposed changes to TGmd D0.1 for CIDs from the WG CC for TGmd related to Estimated Throughput.

The CID list is:

259 56 55 54 31 30 212 213 214 215 216 217

The proposed changes on this document are based on TGmd Draft 0.1.

**REVISION NOTES:**

**R0**:

initial

**R1**:

Add CID 212

Update resolution column DCN revision number

9.4.2.174 – slight modifications to the wording to address CID 212

ESTAirtimeFractionDir – slight modification to the wording to address CID212

**R2**:

6.3.103.2.2 change added

Update resolution column DCN revision number

**R3**:

6.3.103.2.2 Changes to inbound and outbound removed

9.4.2.174 – add ATF for outbound, requires identifying the last inbound field, which is per AC, using a bitmap for outbound airtime information present per AC

Update resolution column DCN revision number

**R4**:

Change references of TGax to TGmd (i.e. the editor)

Add a new note at the very end of R.7 for CID 213

**R5**:

Includes some comments from Mark Hamilton with some comment responses from Matthew Fischer, plus some changes, some of which were motivated by the comments from Mark Hamilton:

Various changes, mostly minor technical, except for:

expanded definition of new fields, old definitions were not sufficient

9.4.2.174 – Outbound Information field expanded – previously had only airtime fraction – now includes PPDU duration target field, so the field now expands from one octet per AC to two octets per AC

CID 215 – change from revise to reject based on a rereading that reveals that the equations are correct, as explained in the new rejection rationale for CID 215, also removed editing instructions that proposed to delete and modify the set of equations according to the suggestions given in CID 215

**R6**:

Backwards compatibility issue with ESP element resolved by creating a new separate element for the ESP Outbound

This means that changes to the ESP element are reverted in this version and a new element is defined

Update resolution column DCN revision number

**END OF REVISION NOTES**

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

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

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

**CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 259 | Mark RISON |  | 11.46 | "When an MLME-ESTIMATED-THROUGHPUT.request primitive is received at the MLME, the MLME can use the parameters provided in the primitive plus the following information to create estimates of throughput per access category to deliver to the SME in the EstimatedThroughputOutbound parameter of the MLME-ESTIMATED-THROUGHPUT.confirm primitive:" -- OK, and how can the MLME determine the EstimatedThroughputInbound to deliver to the SME? | Add an equivalent para for EstimatedThroughputInbound | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 259 |
| 56 | Graham Smith | 2048.00 | 11.46 | This "Estimated Throughput" is intended to be useful for controlling traffic decisions. It does specify how a STA can inform another STA of traffic estimates but I am not convinced that this is of any use for what it supposed to address. By stating at L51 and L53 that these outside entities "need to know the current estimates" we are open to questions of accuracy and 'how to use'. I suggest that these statements are removed. | Delete "Entities outside the scope of this standard that might control the traffic steering decision of a device benefitby being able to predict the throughput that might be obtained through a link with a STA. Those same entities also need to know what the current estimate of throughput is for network selection purposes (by comparing an estimated throughout with existing throughout)." The commenter intends to bring a related presentation. | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 56 – slight modifications to the wording have been made to reduce the expressed level of certainty of the statements as opposed to the wholesale deletion proposed by the commenter, based on the fact that existing systems do use parameters similar to those listed to make the decisions described in the cited text. |
| 55 | Graham Smith | 2049.00 | 11.46 | Huge paragraph at P2049 L13 is in fact quite simple", but is repeated for each parameter and hence becomes diffivult to comprehend. If the MLME is incapable of determining a vale for EstimatedThroughput it simply returns a 0. If the AverageMSDU size in the MLME-ESTIMATED-THROUGHPUT.request primitive is -1, then the corresponding EstimatedThroughputin the MLME-ESTIMATED-THROUGHPUT.confirm primitive is 0. If the AverageMSDU size is 0, then the correspondoing EstimatedThroughput is calculated using any size but recommends 1500B. Can we try to write it simpler? | "If the MLME is incapable of determining a value for the EstimatedThroughputOutbound or EstimatedThroughputInbound parameter for any access category, then the MLME shall return a value of 0 for the value of that parameter for that access category in the MLME-ESTIMATEDTHROUGHPUT.confirm primitive. If the AverageMSDUSizeOutbound or AverageMSDUSizeInbound parameter for an access category is equal to -1 in the MLME-ESTIMATED-THROUGHPUT.request primitive, the STA shall include a value of 0 in the respective EstimatedThroughputOutbound or EstimatedThroughputInbound parameter for the corresponding access category in the MLME-ESTIMATED-THROUGHPUT.confirm primitive. If the AverageMSDUSizeOutbound or AverageMSDUSizeInbound parameter for an access category is equal to 0 in the MLME-ESTIMATED-THROUGHPUT.request primitive, the STA may use any value for the average MSDU size used in calculating the estimated throughput to be included in the corresponding access category in the respective EstimatedThroughputOutbound or EstimatedThroughputInbound parameter of the MLMEESTIMATED-THROUGHPUT.confirm primitive, but should use a value of 1500 octets. " | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 55 |
| 54 | Graham Smith | 2048.00 | 11.45 | Where did this "Beacon RSSI" come from (shame on me for missing it) ? What is it used for? I see no dirrect reference to using it anywhere, unless it is P2049L1, and if so why a seperate clause??. Also +/-5dB is useless, differing MCS EVM requirements are much tighter than 5dB, it needs to be +/-1dB. We need to tighten up on all these RSSI measurements, there is no reason why we need to stick to +/- 5dB we should be making a target of 1dB. As many will know I have been advocating the DSC mechanism that uses the Beacon RSSI. As such an algorithm for determining the Beacon RSSI has been presented that accounts for a mobile STA, missed beacons etc. but uses the Beacon RSSI to adjust effective CCA thresheld. This is a good use for Beacon RSSI but even if DSC is adopted there is still no need to have this seperate Clause. | Either change 5dB to 1dB, or delete this clause and all references to dot11BeaconRssi | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 54, commenter to see 11.45 Beacon RSSI. Accuracy value was agreed upon by discussion among PHY experts. Again, this parameter is already successfully used today in existing systems and while the accuracy might not be as high as desired, experts did not agree that a more accurate value was possible and useful output is generated in real systems with an accuracy estimated to be about 5dB. Commenter can review equation R-2 of Annex R.7 P3801 to see where RSSI is used, noting that in the earliest implementations, a simple comparison of RSSI is often employed rather than a calculation such as is described in R.7. |
| 31 | Graham Smith | 1189.00 | 9.4.2.174 | "The Estimated Air Time Fraction subfield is 8 bits in length and contains an unsigned integer that represents the predicted percentage of time, linearly scaled with 255 representing 100%, that a new STA joining the BSS will be allocated for PPDUs that contain only MPDUs with the Type subfield equal to Data of the corresponding access category for that STA." "Allocated"? So the STA is using HCCA, or EDCA Admission Control? What scheme is in use here that we have allocation of BW to specific STAs, and traffic? In addition, what is %, the fraction of all traffic or fraction of just that AC traffic? This is unclear, but why have this for every AC and how is this to be interpreted? Also unclear how an AP would even measure this. I am generally unhappy with this, I might make a presentation. | Replace cited with "The Estimated Air Time Fraction subfield is 8 bits in length and contains an unsigned integer that represents the predicted percentage of time, linearly scaled with 255 representing 100%, not used by PPDUs that contain only MPDUs with the Type subfield equal to Data, of the corresponding access category." | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 31 |
| 30 | Graham Smith | 1189.00 | 9.4.2.174 | "A-MPDU aggregation is expected to be performed for MPDUs with the Type subfield equal to Data for the corresponding AC, but A-MSDU aggregation is not expected to be performed for MSDUs for the corresponding AC". Seems to be missing something. | Change cited text after the comma to "but A-MSDU aggregation is not expected to be performed for MSDUs with the Type subfield not equal to Data for the corresponding AC ." | Reject – nothing is missing. MPDUs are aggregated into AMPDUs, and MPDUs have a MAC header with a type and subtype and TID. A-MSDUs are built from MSDUs which do not have a MAC header and therefore do not have type or subtype but by definition will eventually be placed into an MPDU of some sort with a type of DATA and any of various subtypes. |
| 212 | Mark RISON |  | *9.4.2.174* | "The Estimated Air Time Fraction subfield is 8 bits in length and contains an unsigned integer that represents  the predicted percentage of time, linearly scaled with 255 representing 100%, that a new STA joining the  BSS will be allocated for PPDUs carrying Data of the corresponding AC for that STA." -- if you look at R.7 it turns out that this is exactly the time for the PPDUs, not including any contention/IFS time. This is a very subtle point (and differs from e.g. admission control) | Change the cited text to "The Estimated Air Time Fraction subfield is 8 bits in length and contains an unsigned integer that represents  the predicted percentage of air time (so not including interframe space), linearly scaled with 255 representing 100%, that a new STA joining the  BSS will be allocated for PPDUs carrying Data of the corresponding AC for that STA (so not including any Management or Control frames)." | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 212 |
| 213 | Mark RISON |  | R.7 | The equation for PPDU\_Dur extremely pedantically accounts for symbol rounding ... and then completely fails to account for A-MPDU delimiters. It also includes the PHY header but not the PHY trailer (e.g. signal extension) | At the end of the referenced subclause add a "NOTE---The equations above do not account for e.g. A-MPDU delimiters and signal extension." | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 213, which adds a minimum delimiter count of 4 octets to the PPDUDur equation, and adds a note that indicates that signal extension is not accounted for. |
| 214 | Mark RISON |  | R.7 | The equation for PPDU\_Dur assumes A-MSDUs can be included in A-MPDUs, but this will only happen if both sides support it | At the end of the referenced subclause add a "NOTE---The equations above assume that A-MSDUs are included in A-MPDUs." | Reject – there is a definition above the equation for A\_MSDU\_B which is based on a minimum function to determine the maximum mutual support for AMSDU. |
| 215 | Mark RISON |  | R.7 | PPDU\_Dur "is the expected duration of a single PPDU, in seconds". DPDUR "is the Data PPDU duration target of the transmitter of the PPDUs containing MPDUs with the Type subfield equal to Data, in seconds". Given the equation, PPDU\_Dur is also only for PPDUs with Data MPDUs. So PPDU\_Dur is the same thing as DPDUR | Delete the definition of PPDU\_Dur and then change PPDU\_Dur to DPDUR throughout the referenced subclause | Reject – PPDU\_Dur and DPDUR are not the same thing. DPDUR is the target duration, but PPDU\_Dur is the actual duration which can be limited at high data rates by aggregation limits, for example. |
| 216 | Mark RISON |  | R.7 | "Note that some of the parameters of Equation (R-2) have values that are AC dependent." -- er, which? None of them have any dependency on the AC | Delete the cited sentence | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 216, noting that the correct fix for the cited problem is to change the equation number. |
| 217 | Mark Rison |  | R.7 | It is claimed that one can determine "EstimatedThroughputInbound and EstimatedThroughputOutbound for each AC of a current or potential link to another STA using Equation (R-1)", but Equation (R-1) refers to EST\_AirtimeFraction, which is defined as " the estimated portion of airtime that is available for outbound transmissions", so does not work for inbound traffic | Delete "EstimatedThroughputInbound and" in R.7. At the end of R.7 add a para "The mechanism by which ESP STAs determine values for EstimatedThroughputInbound is outside the scope of the standard." | Revise – TGmd editor to make changes as shown in 11-17/1192r6 that are marked with CID 217, which generally agree with the nature of the comment, but resolve it by adding language for Inbound describing a method for estimating the inbound traffic. |

**Discussion:**

See comments within the proposed resolutions.

**Proposed Changes to Draft Text of TGmd D0.4:**

**CID 259, 56, 55, 54, 31, 213, 216, 217, 212:**

**6.3.103.2.2 Semantics of the service primitive**

***TGmd editor: within the table in subclause 6.3.103.2.2 Semantics of the service primitive, modify the text as described herein:***

Change “to the wireless medium” to “over the wireless medium” in two locations in the table.

**9.4.2.1 General**

***TGmd editor: add a new element to Table 9-88 Element IDs as shown, noting that the column headings are shown for convenience and are not to be added:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Element ID** | **Element ID Extension** | **Extensible** | **Fragmentable** |
| Estimated Service Parameters Outbound (see 9.4.2.216a (Estimated Service Parameters Outbound element)) | 255 | <ANA> | Yes | No |

**9.4.2.174 Estimated service parameters element**

***TGmd editor: modify the first paragraph as shown:***

The Estimated Service Parameters element is used by a STA to provide information to another STA which can then use the information as input to an algorithm to generate an estimate of inbound throughput between the two STAs.

***TGmd editor: modify Figure 9-588 – ESP Information field format as follows:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 B4 | B5 B7 | B8 B15 | B16 B23 |
|  | Access Category | Reserved | Data Format | BA Window Size | Estimated Inbound Air Time Fraction | Data PPDU Duration Target |
| Bits: | 2 | 1 | 2 | 3 | 8 | 8 |

**Figure 9-588 – ESP Information field format**

***TGmd editor: modify the following text as shown:***

The Estimated Inbound Air Time Fraction subfield is 8 bits in length and contains an unsigned integer that represents the predicted percentage of time, linearly scaled with 255 representing 100% and 0 representing 0% , that a new STA joining the BSS can expect to be available for the transmission of PPDUs to that STA, including overhead, where such PPDUs contain MPDUs with the Type subfield equal to Data that belong to the access category indicated in the Access Category subfield of the corresponding ESP Information field and any other MPDUs in the PPDU are considered to be overhead.**(#31)(#212)(#217)**

The Data PPDU Duration Target field is 8 bits in length and is an unsigned integer that indicates the expected target duration of PPDUs transmitted to the STA that contain MPDUs with the Type subfield equal to Data that belong to the access category indicated in the Access Category subfield of the corresponding ESP Information field for the corresponding access category in units of 50 μs.

***TGmd editor: insert a new subclause 9.4.2.216a Estimated service parameters outbound element to appear after subclause 9.4.2.216 MAD element (11ah) as shown:* (#217)**

**9.4.2.216a Estimated service parameters outbound element**

The Estimated Service Parameters Outbound element is used by a STA to provide information to another STA which can then use the information as input to an algorithm to generate an estimate of outbound throughput between the two STAs.

The format of the Estimated Service Parameters outbound element is shown in Figure 9-712a (Estimated Service Parameters Outbound element format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Outbound Air Time Bitmap | Outbound Air Time List |
| Octets: | 1 | 1 | 1 | 1 | 0, 1, 2, 3 or 4 |

**Figure 9-712a – Estimated Service Parameters Outbound element format**

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The Outbound Air Time Bitmap field contains a bitmap indicating the presence or absence of an Outbound Air Time Information field for each of the four EDCA Access Categories. The format of the Outbound Air Time Bitmap field is shown in Figure 9-712b Outbound Air Time Bitmap field format.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 B7 |
|  | AC\_BK Outbound Information Present | AC\_BE Outbound Information Present | AC\_VI Outbound Information Present | AC\_VO Outbound Information Present | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 4 |

**Figure 9-712b – Outbound Airtime Bitmap field format**

The Outbound Air Time List field contains from 0 to 4 Outbound Information fields, each corresponding to an access category for which estimated air time information and PPDU duration target information for outbound traffic is provided. The format of the Outbound Information field is shown in Figure 9-712c Outbound Air Time List field format.

|  |  |  |
| --- | --- | --- |
|  | B0 B7 | B8 B15 |
|  | Estimated Outbound Air Time Fraction | Outbound Data PPDU Duration Target |
| Octets: | 1 | 1 |

**Figure 9-712c – Outbound Air Time List field format**

The Estimated Outbound Air Time Fraction subfield of the Outbound Information field is 8 bits in length and contains an unsigned integer that represents the predicted percentage of time, linearly scaled with 255 representing 100% and 0 representing 0%, that a new STA joining the BSS can expect to be available for the reception of PPDUs to that STA, including overhead, where such PPDUs contain MPDUs with the Type subfield equal to Data that belong to the access category corresponding to the position of the Outbound Information field Outbound Airtime Bitmap field and any other MPDUs in the PPDU are considered to be overhead.

The Outbound Data PPDU Duration Target field is 8 bits in length and is an unsigned integer that indicates the expected target duration of PPDUs received by the STA that contain MPDUs with the Type subfield equal to Data that belong to the access category indicated in the Access Category subfield of the corresponding Outbound Information field for the corresponding access category in units of 50 μs.

***TGmd editor: modify the following text as shown:***

**11.45 Beacon RSSI**

Upon receiving a Beacon frame, a STA measures the received signal strength of the Beacon frame and may store the result in dot11BeaconRssi. If the Beacon frame is received using multiple receive chains, the Beacon RSSI is averaged in linear domain over all active receive chains. The Beacon RSSI is reported in dBm. When operating in frequency bands below 6 GHz, the Beacon RSSI has an accuracy of ± 5 dB (95% confidence interval) within the specified dynamic range of the receiver. Beacon RSSI may be averaged over time using a vendor specific smoothing function.**(#54)**

**11.46 Estimated throughput**

A STA that has a value of true for dot11EstimatedServiceParametersOptionImplemented is an estimated service parameters (ESP) STA.

Entities outside the scope of this standard that control the traffic steering decision of a device might benefit by being able to predict the throughput that might be obtained through a link with a STA. Those same entities might also benefit from having the current estimate of throughput for network selection purposes (e.g. to allow comparison of an estimated throughout with existing throughout). The MLME-ESTIMATEDTHROUGHPUT.request and MLME-ESTIMATED-THROUGHPUT.confirm primitives together provide an interface to allow such entities, operating through the SME, to obtain estimates of throughput for MSDUs sent between the STA that corresponds to the PeerMACAddress indicated in the parameter list of the MLME-ESTIMATED-THROUGHPUT.request primitive and this STA.**(#56)**

When an MLME-ESTIMATED-THROUGHPUT.request primitive is received at the MLME, the MLME can use the parameters provided in the primitive plus the following information to create estimates of throughput per access category to deliver to the SME in the EstimatedThroughputOutbound and EstimatedThroughputInbound parameters of the MLME-ESTIMATED-THROUGHPUT.confirm primitive:**(#259)**

— RSSI measured during reception of Beacon or Probe Response frames transmitted by the STA that corresponds to the MAC entity with the MAC address equal to the PeerMACAddress in the MLMEESTIMATED-THROUGHPUT.request primitive to this STA

— Number of spatial streams that is expected to be supported on the link between this STA and the STA

— Channel bandwidth

— Estimated air time fraction

— Block ack window size

If the MLME is incapable of determining a value for the EstimatedThroughputOutbound or EstimatedThroughputInbound parameter for any access category, then the MLME shall return a value of 0 for the value of that parameter for that access category in the MLME-ESTIMATEDTHROUGHPUT.confirm primitive.

If the AverageMSDUSizeOutbound parameter for an access category is equal to 0 in the MLME-ESTIMATED-THROUGHPUT.request primitive, the STA shall include a value of 0 in the EstimatedThroughputOutbound parameter for the corresponding access category in the MLMEESTIMATED-THROUGHPUT.confirm primitive.

If the AverageMSDUSizeOutbound parameter for an access category is equal to -1in the MLME-ESTIMATED-THROUGHPUT.request primitive, the STA may use any value for the average MSDU size used in calculating the estimated throughput to be included in the corresponding access category in the EstimatedThroughputOutbound parameter of the MLMEESTIMATED-THROUGHPUT.confirm primitive, but should use a value of 1500 octets.

If the AverageMSDUSizeInbound parameter for an access category is equal to 0 in the MLME-ESTIMATEDTHROUGHPUT.request primitive, the STA shall include a value of 0 in the EstimatedThroughputInbound parameter for the corresponding access category in the MLME-ESTIMATED-THROUGHPUT.confirm primitive.

If the AverageMSDUSizeInbound parameter for an access category is equal to -1 in the MLMEESTIMATED-THROUGHPUT.request primitive, the STA may use any value for the average MSDU size used in calculating the estimated throughput to be included in the corresponding access category in the EstimatedThroughputInbound parameter of the MLME-ESTIMATED-THROUGHPUT.confirm primitive, but should use a value of 1500 octets.**(#55)**

An ESP STA should determine a value for EstimatedThroughputOutbound and EstimatedThroughputInbound for each AC of a current or potential link with a STA using the equation found in R.7.**(#259)**

An ESP STA or a mesh STA may include a Request element that includes the element ID of the Estimated Service Parameters element in transmitted Probe Requests.

An ESP STA that is an AP or a mesh STA shall include the Estimated Service Parameters element within Probe Response frames transmitted in response to a Probe Request frame that included a Request element that includes the element ID of the Estimated Service Parameters element. An ESP STA that is not an AP may include the Estimated Service Parameters element within Probe Response frames transmitted in response to a Probe Request frame that included a Request element that includes the element ID of the Estimated Service Parameters element. An ESP STA may include the Estimated Service Parameters element within Probe Response frames transmitted in response to a Probe Request frame that did not include a Request element, or included a Request element that did not include the element ID of the Estimated Service Parameters element.

An ESP STA that is an AP or a mesh STA shall include the Estimated Service Parameters element within Beacon frames. An ESP STA that is not an AP may include the Estimated Service Parameters element within Beacon frames.

**R.7 Calculating Estimated Throughput**

***TGmd editor: in equation (R-1), modify the first term of the RHS “ESTAirtimeFraction” by changing it to “ESTAirtimeFractionDir”* (#217)**

***TGmd editor: in the definition for ESTAirtimeFraction, change the description as follows:***

***ESTAirtimeFractionDir*** is dimensionless. It is the estimated portion of airtime that is available for inbound or outbound transmissions for this link when calculating EstimatedThroughput for inbound and outbound directions, respectively. The value of this parameter is based on the value of the Estimated Inbound Air Time Fraction or Estimated Outbound Air Time Fraction subfield, respectively, of the Estimated Service Parameters element received from the STA with the MAC address that matches the PeerMacAddress in the MLME-ESTIMATED-THROUGHPUT.request primitive, using a method that is beyond the scope of this standard but that should include some efficiency scaling.**(#217)(#212)**

***TGmd editor: add an equation number to the equation for MPDU\_pA\_MPDU, swap the order of the definition of MPDU\_pA\_MPDU and the equation and modify the definition of MPDU\_pA\_MPDU as shown, with an appropriate replacement of the dummy equation number “R-xx” with a valid equation number corresponding to the number assigned to the equation for MPDU\_pA\_MPDU:***

*MPDU\_pA\_MPDU* is dimensionless, and is calculated as shown in equation (R-xx)

***TGmd editor: within the equation for MPDU\_pA\_MPDU add the value “4” to the second denominator term to yield the term (MACHdr + A\_MSDU\_B + 4)* (#213)**

***TGmd editor: change the last sentence of the subclauase R.7 Calculating Estimated Throughput as shown:***

Note that some of the parameters of Equation (R-1) have values that are AC dependent.**(#216)**

***TGmd editor: add the following text at the end of the subclause:***

NOTE – The equations above do not account for signal extension. **(#213)**

**End of proposed changes.**