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Title	**Processing Times for Transmission and Reception in HARQ Process (AWD – 15.2.14.2.2)**
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Re:	"802.16m amendment working document": IEEE 802.16m-09/0028r1, "Call for Comments and Contributions on Project 802.16m Amendment Content". Target topic: "15.2.14.2.2 A-MAP relevance and HARQ timing".
Abstract	The contribution proposes to separate a single HARQ processing time parameter T_{proc}, which is defined in the current 802.16m AWD, into multiple parameters according to the applied case.
Purpose	To be discussed and adopted by TGm.
Notice	
Release	
Patent Policy	

Processing Times for Transmission and Reception in HARQ Process (AWD – 15.2.14.2.2)

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1. Introduction

This contribution proposes a change to the HARQ timing defined in the current 802.16m AWD [1]. In the current HARQ timing structure, when deciding DL HARQ feedback offset, UL HARQ transmission offset, and UL HARQ feedback offset, a single processing time is applied to all cases. I.e. a single T_{proc} parameter is used. However, each processing requires different functions, as listed below:

- Rx processing of DL HARQ burst at MS includes,
  - DL A-MAP decoding, Data burst decoding, ACK/NACK encoding
- Tx processing of UL HARQ burst at MS includes,
  - UL MAP or ACK/NACK decoding, Scheduling, Data burst encoding
- Rx processing of UL HARQ burst at BS includes,
  - ACK/NCACK decoding, Scheduling, UL A-MAP or ACK/NACK encoding, Data burst encoding

In addition, processing powers of BS and MS are not the same. So, it is reasonable to apply different processing time to each case. In this contribution, we propose to separate the single processing time parameter T_{proc}, which is defined in the current AWD, into three parameters according to the applied case: I.e. $T_{DL\_MS\_Rx\_proc}$ for MS Rx processing time of DL HARQ, $T_{UL\_MS\_Tx\_proc}$ for MS Tx processing time of UL HARQ, and $T_{UL\_BS\_Rx\_proc}$ for BS Rx processing time of UL HARQ.

2. References

[1] IEEE 802.16m-09/0010r2, "IEEE 802.16m Amendment Working Document (AWD)", 2009-06-01.

3. Proposed Text Changes

[Remedy1: Modify the text and equation, line 10~19, page 78]

DL HARQ feedback offset z shall be set to 1 only if a time gap from completion of the HARQ subpacket transmission to its feedback time derived with z = 0 is shorter than ~~the data burst processing time T_{proc}~~ MS Rx processing time for DL HARQ $T_{DL\_MS\_Rx\_proc}$. Otherwise, z shall be set to 0. This rule shall be also applied to the long TTI transmission:

$$z = \begin{cases} 0, & \text{if } ((ceil(F/2) - N_{TTI}) \geq ~~T_{proc}~~ T_{DL\_MS\_Rx\_proc}) \\ 1, & \text{else} \end{cases}$$

[Remedy2: Modify the text, line 46~49, page 78]

Figure 409— shows an example of the timing relationship between a DL Basic Assignment A-MAP IE with $N_{A\text{-}MAP} = 1$, a DL HARQ subpacket with the default TTI, corresponding HARQ feedback, and retransmission in FDD frame structure, for 5, 10 and 20 MHz channel bandwidths. In this example, ~~T_{proc}~~ $T_{DL\_MS\_Rx\_proc}$ is 3.

[Remedy3: Modify the text and equation, line 29~44, page 79]

UL HARQ transmission offset v shall be set to 1 only if a time gap from completion of the UL Basic Assignment A-MAP IE transmission to the HARQ subpacket transmission time derived with $v = 0$ is shorter than ~~the data burst processing time T_{proc}~~ MS Tx processing time for UL HARQ $T_{UL\_MS\_Tx\_proc}$. Otherwise, v shall be set to 0:

$$v = \begin{cases} 0, & \text{if } ((ceil(F/2) - 1) \geq ~~T_{proc}~~ T_{UL\_MS\_Tx\_proc}) \\ 1, & \text{else} \end{cases}$$

UL HARQ feedback offset w shall be set to 1 only if a time gap from completion of the HARQ subpacket transmission to its feedback time derived with $w = 0$ is shorter than ~~the data burst processing time T_{proc}~~ BS Rx processing time for UL HARQ $T_{UL\_BS\_Rx\_proc}$. Otherwise, w shall be set to 0. This rule shall be also applied to the long TTI transmission

$$w = \begin{cases} 0, & \text{if } ((floor(F/2) - N_{TTI}) \geq ~~T_{proc}~~ T_{UL\_BS\_Rx\_proc}) \\ 1, & \text{else} \end{cases}$$

[Remedy4: Modify the text, line 3~6, page 80]

Figure 410— shows an example of the timing relationship between a UL Basic Assignment A-MAP IE with $N_{A\text{-}MAP} = 1$, a UL HARQ subpacket with the default *TTI*, corresponding HARQ feedback, and retransmission in FDD frame structure, for 5, 10 and 20 MHz channel bandwidths. In this example, ~~T_{proc}~~ $T_{UL\_MS\_Tx\_proc}$ and $T_{UL\_BS\_Rx\_proc}$ are ~~is~~ 3.

[Remedy5: Modify the text and equation, line 55~62, page 80]

DL HARQ feedback offset z shall be set to 1 only if a time gap from completion of the HARQ subpacket transmission to its feedback time derived with $z = 0$ is shorter than ~~the data burst processing time T_{proc}~~ MS Rx processing time for DL HARQ $T_{DL\_MS\_Rx\_proc}$. Otherwise, z shall be set to 0. This rule shall be also applied to the long TTI transmission:

$$z = \begin{cases} 0, & \text{if } ((D - m - N_{TTI} - n) \geq \sout{T_{proc}}\ T_{DL\_MS\_Rx\_proc}) \\ 1, & \text{else} \end{cases}$$

[Remedy6: Modify the text, line 22~25, page 81]

Figure 411— shows an example of the timing relationship between a DL Basic Assignment A-MAP IE with $N_{A\text{-}MAP} = 1$, a DL HARQ subpacket with the default TTI, corresponding HARQ feedback, and retransmission in TDD frame structure, for 5, 10 and 20 MHz channel bandwidths. In this example, ~~T_{proc}~~ $T_{DL\_MS\_Rx\_proc}$ is 3.

[Remedy7: Modify the text and equation, line 26~44, page 82]

UL HARQ transmission offset v shall be set to 1 only if a time gap from completion of the UL Assignment A-MAP IE transmission to the HARQ subpacket transmission time derived with $v = 0$ is shorter than ~~the data burst processing time T_{proc}~~ MS Tx processing time for UL HARQ $T_{UL\_MS\_Tx\_proc}$. Otherwise, v shall be set to 0:

$$v = \begin{cases} 0, & \text{if } ((D - l - 1 + m) \geq \sout{T_{proc}}\ T_{UL\_MS\_Tx\_proc}) \\ 1, & \text{else} \end{cases}$$

UL HARQ feedback offset w shall be set to 1 only if a time gap from completion of the HARQ subpacket transmission to its feedback time derived with $w = 0$ is shorter than ~~the data burst processing time T_{proc}~~ BS Rx processing time for UL HARQ $T_{UL\_BS\_Rx\_proc}$. Otherwise, w shall be set to 0. This rule shall be also applied to the long TTI transmission

$$w = \begin{cases} 0, & \text{if } ((U - m - N_{TTI} + l) \geq \sout{T_{proc}}\ T_{UL\_BS\_Rx\_proc}) \\ 1, & \text{else} \end{cases}$$

[Remedy8: Modify the text, line 21~24, page 83]

Figure 412— shows an example of the timing relationship between a UL Basic Assignment A-MAP IE with $N_{A\text{-}MAP} = 1$, a UL HARQ subpacket with the default *TTI*, corresponding HARQ feedback, and retransmission in TDD frame structure, for 5, 10 and 20 MHz channel bandwidths. In this example, ~~T_{proc}~~ $T_{UL\_MS\_Tx\_proc}$ and $T_{UL\_BS\_Rx\_proc}$ are ~~is~~ 3.

[Remedy9: Modify the equations, line 1~17, page 84]

$$z = \begin{cases} 0, & \text{if } ((D' - m' - N_{TTI}' - n') \geq \sout{T_{proc}}\ \underline{T_{DL\_MS\_Rx\_proc}}\ ) \\ 1, & \text{else} \end{cases}$$

$$v = \begin{cases} 0, & \text{if } ((D' - l' - 1 + m') \geq \sout{T_{proc}}\ \underline{T_{UL\_MS\_Tx\_proc}}\ ) \\ 1, & \text{else} \end{cases}$$

$$w = \begin{cases} 0, & \text{if } ((U' - m' - N_{TTI}' + l') \geq \sout{T_{proc}}\ \underline{T_{UL\_BS\_Rx\_proc}}\ ) \\ 1, & \text{else} \end{cases}$$

[Remedy10: Modify the text, line 61, page 84 ~ line 3, page 85]

Figure 414— and Figure 415—show examples of the DL and UL timing relationships between a Assignment A-MAP IE with $N_{A\text{-}MAP} = 1$, a HARQ subpacket with the default *TTI*, corresponding HARQ feedback and retransmission, for 5, 10 and 20 MHz channel bandwidths. The ratio of whole DL subframes to whole UL subframes, *D'*:*U'* is 5:3. In this example, FRAME_OFFSET is 2, UL subframes of the WirelessMAN-OFDMA and the Advanced Air Interface are frequency-division multiplexed, the ratio of DL to UL subframes for the Advanced Air Interface, *D*:*U* is 3:3, and ~~T_{proc}~~ $T_{DL\_MS\_Rx\_proc}$, $T_{UL\_MS\_Tx\_proc}$ and $T_{UL\_BS\_Rx\_proc}$ are ~~is~~ 3.