IEEE P802.11
Wireless LANs

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| Comment Resolutions on Clause 28.3.15 (SU-MIMO and DL MU-MIMO beamforming)  |
| Date: 2017-05-05 |
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Abstract

This submission proposes resolutions for the following 4 comments on 28.3.15 (SU-MIMO and DL MU-MIMO beamforming) of TGax D1.2 [1]:

7518, 9030, 9029, 10126

Revisions:

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 TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

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

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| **CID** | **Clause Number** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 7518 | 28.3.15.3 | 344.22 | The reference for CQI-only feedback is incorrect. | change "9.4.1.64" to "9.4.1.65". | Accept  |
| 9030 | 28.3.15.3 | 344.22 | Wrong reference: CQI-only feedback is described in 9.4.1.65. | Correct reference | Accept |
| 9029 | 28.3.15.2 | 344.13 | "SNR" should be "Delta SNR" | Correct | RevisedChanged to Delta SNR, also changed definition of phi and psi. |
| 10126 | 28.3.15.1 | 343.04 | add the definition of SU-MIMO and DL MU-MIMO beamforming to be consistent with 21.3.11.1 in 11ac.For example, SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs. | As in the comment. | Accepted —Placed 802.11ac definition at start of section but added text to indicate that this is RU based. SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL-MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU.  |

*Changes to D1.2*

***TGax Editor: Please make the following change on Pg 371, ln 46 (#9029):***

Upon receipt of an HE NDP PPDU, the beamformee computes a set of matrices for feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback Matrix V). The eligible beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the measured channel before computing a set of matrices for feedback to the beamformer.

The beamforming feedback matrix, *Vk,u*, found by the beamformee *u* for subcarrier *k* in RU *r* shall be compressed in the form of angles using the method described in 19.3.12.3.6 (Compressed beamforming feedback matrix). The angles, ϕ*(k,u ~~v~~)* (#9029)and ψ*(k,u)*, are quantized according to Table 9-68 (Quantization of angles). The number of bits for quantization is set by the beamformer, i.e., HE AP. The number of bits for quantization, tone grouping factor, and the number of columns in the HE Compressed beamforming feedback are set by the beamformee, i.e., non-AP STA, only if the NDP Announcement frame contains only one STA Info field. The compressed beamforming feedback matrix as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix) is the only Clause 28 beamforming feedback matrix defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (*Nr*) equal to the *NSTS* of the NDP.

After receiving the angle information, ϕ*(k,u ~~v~~)* (#9029)and ψ*(k,u)*, the beamformer reconstructs *Vk,u* using Equation (19-79). For SU-MIMO beamforming, the beamformer uses *Vk,0*, matrix to determine the steering matrix *Qk*. For MU-MIMO beamforming, the beamformer may calculate a steering matrix using *Vk,u* and Δ*SNRk,u* (0 ≤ *u* ≤*Nuser,r*-1) (#9209) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix *Qk* is implementation specific.

***TGax Editor: Please make the following change on Pg 372, ln 12 (#7518, #9030):***

Whenever the HE NDP Announcement frame is requesting a CQI-only feedback, upon receipt of the HE NDP, the beamformee computes HE CQI-only feedback as described in 9.4.1.65~~64~~. (#7518, #9030)

***TGax Editor: Please make the following change on Pg 371, ln 3 (#10126):***

**28.3.15.1 General**

SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL-MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU (#10126).

For SU-MIMO and DL MU-MIMO beamforming in RU *r*, the receive …

**References:**

1. **IEEE P802.11axTM/D1.2, April 2017.**