IEEE P802.11
Wireless LANs

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| CID 5110 Comment resolution |
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Abstract

 This document discusses CID 5110 and proposes a resolution.

## Comment:

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 5110 | 165.10 | 22.2.2 | Improve definition of EXPANSION\_MAT | The third column states that this parameter contains "compressed beamforming feedback matrices". This looks like a copy-paste error from "CHAN\_MAT". In fact, it should contain either a spatial mapping matrix, a BF steering matrix or a MU steering matrix. These matrices are all implementation specific.Change defintion accordingly. | Revised  |

## Discussion

This CID was originally addressed in 802.11-12/0340. The proposal was to revise and only delete the note under the text.

During discussion of the CID, two possible interpretations of EXPANSION\_MAT were offered:

1. EXPANSION\_MAT contains the spatial mapping/beamforming matrices that will be applied in the spatial mapping block in the PHY
2. EXPANSION\_MAT contains the channel information as provided by the beamformee. The PHY uses this as input to determine the values of the matrices that will be applied in the spatial mapping block in the PHY

The note in Table 22-1 is consistent with the first interpretation, but the main text is not. The second interpretation is problematic when no beamforming is applied.

Note that the term EXPANSION\_MAT appears once in draft 2.0 of the 11ac Amendment, so its exact interpretation is not clear from the Amendment.

The term appears in Revmb\_D12.0 in the following places:

**9.2.28 Link adaptation using the HT Control field**

If a beamformer transmits a PPDU with the TXVECTOR EXPANSION\_MAT\_TYPE set to either COMPRESSED\_SV or NON\_COMPRESSED\_SV, it should use the recommended MCS associated with those matrices reported in a Noncompressed Beamforming frame or a Compressed Beamforming frame.

Comments: no such language in 11ac. This provision is exclusively for HT.

**9.29.1 General**

An HT STA shall not transmit a PPDU with the TXVECTOR EXPANSION\_MAT parameter present if dot11BeamFormingOptionActivated is false.

Comments: no such language in 11ac. Should we make this consistent with HT behavior? It’s true that each VHT STA is an HT STA, but further clarification is still desirable.

**Table 20-1**

In Table 20-1, the line corresponding to EXPANSION\_MAT\_TYPE has an additional condition “EXPANSION\_MAT is present”. This is not the case for VHT. If EXPANSION\_MAT is only present for beamformed frames, this should be modified in the 11ac Amendment.

**Table 20-3: mapping of HT parameters to non-HT**

Not relevant for current discussion

**20.3.4 Overview of the PPDU encoding process**

Determine spatial mapping to be used for HT-STF and HT-LTFs in HT-mixed format frame and HT-GF-STF and HT-LTFs in HT-greenfield format frame from the EXPANSION\_MAT parameter of the TXVECTOR.

AND:

(…) Otherwise, a spatial mapping matrix associated with each OFDM subcarrier, as indicated by the EXPANSION\_MAT parameter of the TXVECTOR, is used to perform a linear transformation on the vector of N\_STS complex numbers associated with each subcarrier in each OFDM symbol. This spatial mapping matrix maps the vector of N\_STS complex numbers in each subcarrier into a vector of N\_TX complex numbers in each subcarrier.

Comment: the two instances of EXPANSION\_MAT in 20.3.4 do not unambiguously support either interpretation 1 or interpretation 2. The first occurrence may be used to support interpretation 2, while the second occurrence seems to favor interpretation 2

**Table 20-28—List of parameters for PMD primitives**

Not relevant for current discussion

## Proposal:

Make VHT consistent with HT and add some clarification on interpretation of EXPANSION\_MAT. Specifically, the following changes are proposed:

1. Modify sentence in 9.29.1:

An HT or VHT STA shall not transmit a PPDU with the TXVECTOR EXPANSION\_MAT parameter present if dot11BeamFormingOptionActivated is false.
2. Modify Table 22-1

Add condition to EXPANSION\_MAT\_TYPE: “if EXPANSION\_MAT is present” (similar to Table 20-1 in Revmb)
3. Modify text for EXPANSION\_MAT in Table 22-1

Contains a set of compressed beamforming feedback matrices as defined in 22.3.11.2 (Beamforming Feedback Matrix V). The number of elements depends on the number of space-time streams and the number of users.

~~Note that implementations are not restricted to the spatial mapping matrix examples listed in 20.3.11.11.2 (Spatial mapping). For MU packets, it is the MU-MIMO steering matrix which is implementation specific.~~

1. In section 22.3.10.11, modify text as follows:

$Q\_{k}^{(iseg)}$ is a spatial mapping matrix with *NTX* rows and *NSTS,total* columns for subcarrier *k* in frequency segment. $Q\_{k}^{(iseg)}$ may be frequency dependent. Refer to the examples of $Q\_{k}^{}$ listed in 20.3.11.11.2 (Spatial mapping) for examples of $Q\_{k}^{(iseg)}$ that could be used for SU PPDUs. Note that implementations are not restricted to the spatial mapping matrix examples listed in Section 20.3.11.11.2 (Spatial mapping) and the number of transmit chains *NTX* could be up to 8. For SU PPDUs that apply beamforming, $Q\_{k}^{(iseg)}$ is a beamforming steering matrix and is derived from the field EXPANSION\_MAT in TXVECTOR. For MU PPDUs, $Q\_{k}^{(iseg)}$ is the MU-MIMO steering matrix and is derived from the field EXPANSION\_MAT in TXVECTOR. Beamforming steering matrices and MU-MIMO steering matrices are ~~which is~~ implementation specific.