IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Spatial Mapping for HE Ranging | | | | | | Date: 2024-5-3 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Youhan Kim | Qualcomm Technologies, Inc. |  |  | [youhank@qti.qualcomm.com](mailto:youhank@qti.qualcomm.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

This submission proposes resolutions for the following CIDs from SB2 on REVme D5.0:

7016, 7017, 7018, 7020

NOTE – Set the Track Changes Viewing Option in the MS Word to “All Markup” to clearly see the proposed text edits.

**Revision History:**

R0: Initial version.

R1: Updated per discussion during TGme Ad Hoc on 4/16/2024.

R2: Updated the discussion section per offline feedback. No changes are made to the proposed resolution or the proposed text update relative to R1.

R3: Two options provided for the resolution – one using the identity matrix and another using the permutation matrix.

# CID 7016, 7017

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| **CID**  **Clause**  **Page.Line** | **Comment** | **Proposed Change** |
| 7016  27.3.19.1  4387.1 | Firstly, since how to assign indices to antenna chains is implementation dependent, the Q matrix doesn't have to be an Identity matrix. Requiring the Q matrix to be a binary unitary matrix of size N\_TX x N\_TX (elements restricted to 0 or 1) should be sufficient.  Secondly, the sentence "the Q matrix shall be based on an antenna selection matrix with no antenna swapping" is not clear. Both "antenna selection matrix" and "antenna swapping" are not defined anywhere in the spec draft. | Change the paragraph to "For transmission of HE-STFs and HE-LTFs, if NSTS = N\_TX, the Q matrix shall be a binary unitary matrix of size N\_TX x N\_TX, and if NSTS < NTx, the Q matrix shall become a binary unitary matrix of size NSTS x NSTS after rows with all 0s are removed. The Q matrix shall not be changed during HE Ranging NDP transmissions." Define "binary unitary matrix" in Clause 3.1 as "unitary matrix with the values of elements restricted to 0 or 1." |
| 7017  27.3.19.2  4389.39 | Firstly, since how to assign indices to antenna chains is implementation dependent, the Q matrix doesn't have to be an Identity matrix. Requiring the Q matrix to be a binary unitary matrix of size N\_TX x N\_TX should be sufficient.  Secondly, the sentence "the Q matrix shall be based on an antenna selection matrix with no antenna swapping" is not clear. Both "antenna selection matrix" and "antenna swapping" are not defined anywhere in the spec draft. | Change the paragraph to "For transmission of HE-STFs and HE-LTFs, if NSTS = N\_TX, the Q matrix shall be a binary unitary matrix of size N\_TX x N\_TX , and if NSTS < NTx, the Q matrix shall become a binary unitary matrix of size NSTS x NSTS after rows with all 0s are removed. The Q matrix shall not be changed during HE TB Ranging NDP transmissions." |

## Proposed Resolution: CID 7016

**REVISED**

**Instruction to TGme Editor:**

Implement the proposed text updates option X for CID 7016 in <https://mentor.ieee.org/802.11/dcn/24/11-24-0698-03-000m-spatial-mapping-for-he-ranging.docx>

## Proposed Resolution: CID 7017

**REVISED**

**Instruction to TGme Editor:**

Implement the proposed text updates option X for CID 7017 in <https://mentor.ieee.org/802.11/dcn/24/11-24-0698-03-000m-spatial-mapping-for-he-ranging.docx>

## Proposed Text Update: CID 7016

**Option A:**

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| **27.3.19.1 HE Ranging NDP**  …  *Instruction to TGme Editor: Update REVme D5.0 P4387L1 as shown below.*   * For the HE-STF and HE-LTF fields, if *NSTS* = *NTX*, the spatial mapping matrix *Q* shall be an identity matrix; if *NSTS* < *NTX*, *Q* shall be a *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

**Option B:**

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| **27.3.19.1 HE Ranging NDP**  …  *Instruction to TGme Editor: Update REVme D5.0 P4387L1 as shown below.*   * For the HE-STF and HE-LTF fields, if *NSTS* = *NTX*, the spatial mapping matrix *Q* shall be an *NTX* × *NTX* permutation matrix; if *NSTS* < *NTX*, *Q* shall be *P* × *D* where *P* is an *NTX* × *NTX* permutation matrix and *D* is an *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix.   NOTE – A permutation matrix has exactly one entry of 1 in each row and each column with all other entries 0. |

## Proposed Text Update: CID 7017

**Option A:**

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| **27.3.19.1 HE Ranging NDP**  …  *Instruction to TGme Editor: Update REVme D5.0 P4389L39 as shown below.*   * For the HE-STF and HE-LTF fields, if *NSTS* = *NTX*, the spatial mapping matrix *Q* shall be an identity matrix; if *NSTS* < *NTX*, *Q* shall be an *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

**Option B:**

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| **27.3.19.1 HE Ranging NDP**  …  *Instruction to TGme Editor: Update REVme D5.0 P4389L39 as shown below.*   * For the HE-STF and HE-LTF fields, if *NSTS* = *NTX*, the spatial mapping matrix *Q* shall be an *NTX* × *NTX* permutation matrix; if *NSTS* < *NTX*, *Q* shall be *P* × *D* where *P* is an *NTX* × *NTX* permutation matrix and *D* is a *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

# CID 7018

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| **CID**  **Clause**  **Page.Line** | **Comment** | **Proposed Change** |
| 7018  27.3.20.1  4390.34 | Since identity matrix is always square, there is no need to include "square". Also, if the purpose is to avoid beamforming, Q matrix just needs to be a binary unitary matrix. | Change the sentence to "No beamforming is applied; Q is a binary unitary matrix" |

## Background

REVme D5.0 P4390:

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## Proposed Resolution: CID 7018

**REVISED**

**Instruction to TGme Editor:**

Implement the proposed text updates option X for CID 7018 in <https://mentor.ieee.org/802.11/dcn/24/11-24-0698-03-000m-spatial-mapping-for-he-ranging.docx>

## Proposed Text Update: CID 7018

**Option A:**

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| **27.3.20.1 Introduction**  …  *Instruction to TGme Editor: Update REVme D5.0 P4390L34 as shown below.*   * No beamforming is applied. If *NSTS* = *NTX*, the spatial mapping matrix *Q* is an identity matrix. If *NSTS* < *NTX*, *Q* is an *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

**Option B:**

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| **27.3.20.1 Introduction**  …  *Instruction to TGme Editor: Update REVme D5.0 P4390L34 as shown below.*   * No beamforming is applied. If *NSTS* = *NTX*, the spatial mapping matrix *Q* is an *NTX* × *NTX* permutation matrix. If *NSTS* < *NTX*, *Q* is *P* × *D* where *P* is an *NTX* × *NTX* permutation matrix and *D* is a *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

# CID 7020

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| **CID**  **Clause**  **Page.Line** | **Comment** | **Proposed Change** |
| 7020  27.3.20.6  4401.40 | No need to include "block" in the sentence. Making Q matrix to be a binary unitary matrix is sufficient. | Change the sentence to "There is no spatial mapping. The Q matrix shall be a binary unitary matrix" |

## Background

REVme D5.0 P4401:

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## Proposed Resolution: CID 7020

**REVISED**

**Instruction to TGme Editor:**

Implement the proposed text updates option X for CID 7020 in <https://mentor.ieee.org/802.11/dcn/24/11-24-0698-03-000m-spatial-mapping-for-he-ranging.docx>

## Proposed Text Update: CID 7020

**Option A:**

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| **27.3.20.6 Construction of secure HE-LTF symbols**…  *Instruction to TGme Editor: Update REVme D5.0 P4401L40 as shown below.*   * There is no spatial mapping. If *NSTS* = *NTX*, the spatial mapping matrix *Q* is an identity matrix. If *NSTS* < *NTX*, *Q* is an *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

**Option B:**

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| **27.3.20.6 Construction of secure HE-LTF symbols**…  *Instruction to TGme Editor: Update REVme D5.0 P4401L40 as shown below.*   * . If *NSTS* = *NTX*, the spatial mapping matrix *Q* is an *NTX* × *NTX* permutation matrix. If *NSTS* < *NTX*, *Q* is *P* × *D* where *P* is an *NTX* × *NTX* permutation matrix and *D* is a *NTX* × *NSTS* matrix where the first *NSTS* rows make up an identity matrix and the remaining rows make up a zero matrix. |

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