IEEE P802.22
Wireless RANs

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| Multidimentional TCM for the IEEE 802.22b |
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Abstract

This document presents the proposed draft text on the multidimentional trellis coded modulation (MD-TCM) base on the PHY proposal from Niigata University (doc. IEEE 802.22-12-0091/r1). The contents of this document is potentially included into the IEEE 802.22b draft standard.

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*(Add new subclause after subclause 9.7.2.4)*

### 9.7.2.X Multidimensional Trellis Coded Modulation (MD-TCM) mode (optional)

**9.7.2.X.1 Overview of Multidimensional Trellis Coded Modulation (MD-TCM)**

Multidimensional trellis coded modulation (MD-TCM) is a combined coding and modulation for bandlimited channels by using multiple 2-dimentional (2D) symbols. In this subclause, MD-TCM base on [2] is applied to achieve additional higher data rate option and peak-to-average power ratio (PAPR) reduction at data mapping. The functional block of the MD-TCM encoder is illustrated in Figure xxx.1. Multidimensional trellis encoder contains the following functions:

1. Coset encoder,
2. Region encoder,
3. Symbol encoder.



Figure xxx.1: Structure of Multidimensional trellis encoder

**9.7.2.X.2 Coset encoder**

 Two bits enters the rate 2/3 convolutional encoder. This encoder generates three-bit output. With one additional bit, a total of four bits are used to choose a pair of signal points illustrated in Figure xxx.2 among the folloing pairs of signal points:

 (A, A), (A, B), (A, C), (A, D), (B, A), (B, B), (B, C), (B, D), (C, A), (C, B), (C, C), (C, D),

 (D, A), (D, B), (D, C), (D, D).

C

B

A

D

Fig. xxx.2 Signal constellation for Coset selection

**9.7.2.X.3 Region pair selection**

Three bits enter a Region pair selector to select a pair of regions over two 2-D symbols. Fig. xxx.3 illustrates the sketch of regions. One 2-D symbol contains three regions, say I0, I1, and O in Fig. xxx.3. According to the contents of entered three bits, one region pair (R1, R2) shall be chosen among the following region pairs:

 (I0, I0), (I0, I1), (I0, O), (I1, I0), (I0, I1), (I1, O), (O, I0), (O, I1),

I

Q

I0

I1

O

I1

I1

I1

Figure xxx.3 Sketch of “Region” in MD-TCM

**9.7.2.X.4 Symbol encoder**

 2-dimensional (2-D) symbol encoder contains QPSK mapper for MD-TCM 48QAM, and 16QAM mapper for MD-TCM 192QAM, respectively. 2x2 bits are used for 2 2-D symbols in the case of MD-TCM 48QAM, and 2x4bits are used for 2 2-D symbols in the case of MD-TCM 192QAM.

**References:**

1. Shigenobu Sasaki, et al., PHY/MAC Proposal for the IEEE 802.22b, IEEE 802.22-12-0091/r1, Nov. 2012
2. L. F. Wei, “Trellis-coded modulation with multidimensional constellations,” IEEE Trans. Info. Theory, vol. 33, No. 4, pp. 483-531, 1987