IEEE P802.11
Wireless LANs

|  |
| --- |
| 30.5.2 Transmitter Block Diagram for SC Mode |
| Date: 2017-05-07 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Artyom Lomayev | Intel | Turgeneva 30, Nizhny Novgorod 603024, Russia | +7 (831) 2969444 | artyom.lomayev@intel.com |
| Alexander Maltsev | Intel  |  |  | alexander.maltsev@intel.com |
| Miki Genossar | Intel |  |  | miki.genossar@intel.com |
| Claudio da Silva | Intel |  |  | claudio.da.silva@intel.com |
| Carlos Cordeiro | Intel  |  |  | carlos.cordeiro@intel.com |

Abstract

This document proposes specification text for subclause 30.5.2 of the spec describing transmitter block diagram for SC mode, [1], [2].

**30.5.2 Transmitter block diagram for SC mode**

**30.5.2.1 General**

EDMG and non-EDMG SC PPDU transmissions can be generated using a transmitter consisting of the following blocks:

1. *Scrambler* scrambles the data to reduce the probability of long sequences of 0s and 1s; see 20.3.9 (Scrambler).
2. *Stream parser* divides the output of scrambler into the groups of bits that are sent to different LDPC encoders and mapping devices. The sequence of the bits sent to different encoder is called a *spatial stream*; see 30.5.6.3 (Encoding).
3. *LDPC encoder* encodes the data to enable error correction. It makes bits padding to get an integer number of codewords and SC symbol blocks; see 30.5.6.3 (Encoding).
4. *Constellation mapper* maps the sequence of bits in each stream to constellation points (complex numbers); see 30.5.6.4 (Modulation mapping).
5. *Interleaver* performs interleaving inside a SC symbol block; see (30.5.6.4.4 Block interleaver)
6. *STBC* encoder spreads constellation points from *NSS* spatial streams into *NSTS* space-time streams using a space-time block code. SC mode defines single STBC scheme with *NSS* = 1 and *NSTS* = 2; see 30.5.6.4.3 (Space-time block coding).
7. *GI insertion* prepends the SC symbol block with guard interval defined as a π/2-BPSK modulated Golay sequence; see 30.5.6.2 (Symbol blocking and guard insertion).
8. *Golay builder* builds π/2-BPSK modulated Ga and Gb Golay sequences comprising the L-STF, L-CEF, EDMG-STF, EDMG-CEF, and TRN units; see 30.10 (Golay sequences).
9. *Spatial mapper* maps space-time streams to transmit chains. This may include one of the following:
	1. *Direct mapping*: Constellation points from each space-time stream are mapped directly into the transmit chains (one-to-one mapping).
	2. *Digital beamforming*: each vector of constellation points from all of the space-time streams is multiplied by a matrix of steering vectors to produce the input to the transmit chains.
10. *Cyclic shift (CSD)* insertion prevents the signal transmission from unintentional beamforming. A cyclic shift is specified per transmitter chain for non-EDMG duplicate PPDU transmission.
11. *Pulse shaping* performs convolution of constellation points with shape filter impulse response with possible sampling rate change. For duplicate channel transmission, pulse shaping may include a relative time delay between the primary and secondary channels. The exact definition of shape filter impulse response is out of scope of this standard and is implementation specific.

**30.5.2.2 Non-EDMG PPDU transmission**

Figure 1 shows the transmitter blocks used to generate the non-EDMG PPDU. The L-STF, L-CEF fields and TRN units of PPDU are generated using Golay builder block. The L-Header and data part of PPDU are generated using scrambler, LDPC encoder, constellation mapper, and GI insertion blocks. A single spatial stream is mapped to the *NTX* transmit chains applying relative cyclic shift over the chains as defined in 30.5.7.



Figure 1: Transmitter block diagram for non-EDMG PPDU transmission.

**30.5.2.3 EDMG PPDU transmission**

**30.5.2.3.1 Pre-EDMG portion of PPDU transmission**

Figure 1 shows the transmitter blocks used to generate the pre-EDMG modulated portion of EDMG PPDU preamble. The L-STF and L-CEF fields are generated using Golay builder block. The L-Header and EDMG-Header-A are generated using scrambler, LDPC encoder, constellation mapper, and GI insertion blocks. A single spatial stream is mapped to the *NTX* transmit chains applying relative cyclic shift over the chains as defined in 30.3.3.2.2.

**30.5.2.3.2 EDMG portion of SU PPDU transmission**

Figure 2 shows the transmitter blocks used to generate the EDMG portion of SU PPDU. The EDMG-STF and EDMG-CEF fields and TRN units are generated using Golay builder block. The data part of PPDU is generated using scrambler, LDPC encoder, constellation mapper, interleaver, and GI insertion blocks. If STBC encoder is applied, then a single spatial stream is mapped to two space-time streams as defined in 30.5.6.4.3. The *NSTS* space-time streams are further mapped to *NTX* transmit chains, where *NSTS* ≤ *NTX*.



Figure 2: SC transmitter block diagram for EDMG portion of SU PPDU transmission.

NOTE - interleaver is applied for 64QAM and 64NUC modulation only.

**30.5.2.3.3 EDMG portion of MU non-FDMA PPDU transmission**

Figure 3 shows the transmitter blocks used to generate the EDMG portion of MU non-FDMA PPDU. The EDMG-STF and EDMG-CEF fields and TRN units are generated using Golay builder block. The EDMG-Header-B and data part of PPDU are generated using scrambler, LDPC encoder, constellation mapper, interleaver, and GI insertion blocks. The PPDU encoding uses seed value defined in EDMG-Header-B and has independent flow per user. However, transmitter keeps the common space-time streams numeration over all users. If STBC encoder is applied, then a single spatial stream is mapped to two space-time streams as defined in 30.5.6.4.3. The *NSTS* space-time streams are further mapped to *NTX* transmit chains, where *NSTS* ≤ *NTX*.



Figure 3: SC transmitter block diagram for EDMG portion of MU non-FDMA PPDU transmission.

NOTE - interleaver is applied for 64QAM and 64NUC modulation only.

**30.5.2.3.4 EDMG portion of MU FDMA PPDU transmission**

TBD

**SP:**

Do you agree to include the definition of transmitter block diagram for SC mode proposed in (11-17-0752-02-00ay 30 5 2 Transmitter Block Diagram for SC Mode) into the spec draft?

**References:**

1. Draft P802.11ay\_D0.3
2. IEEE802.11-2016