Baseline Proposal for Burst Markers in EPoC

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Introduction

- Burst markers are used to
  - indicate the start and end of each burst.
  - indicate the profile of a burst.

- There are N unique burst marker sequences, one for each of the N, bitloading profiles.

Burst Marker Sequences

- Burst marker is a predefined sequence of elements called *burst marker elements*.
- There are three types of *burst marker elements*, 1's, -1's and 0's. Where +1's and -1's represent BPSK modulated symbols, and 0's represent nulls (i.e. no energy being transmitted).
- Tables 1 & 2 in the document rahman_syed_3bn_01_1113.pdf gives the burst marker sequences.

Power boosting options

- If *marker_power* = 0/1/2 then the average transmit power of the burst marker will be 0/3/6 dB higher than the average transmit power of the data.

Burst Marker sequence inclusion options

- The two bit parameter *marker_incl* defines the burst marker inclusion options
- *marker_incl = 0* : The Transmitter does not transmit any burst marker .
- *marker_incl = 1* : The transmitter transmits a burst marker at the beginning of each burst.
- *marker_incl = 2* : The transmitter transmits a burst marker at the end of each burst.
- *marker_incl = 3* : The transmitter transmits the same burst marker twice for each burst. Once at the beginning of the burst and once at the end of the same burst.

Length of the Burst Marker Sequence

- The length, L, of the Burst Marker sequence is configurable through the parameter *marker_length* .
- *marker_length* value of 0/1/2/3/4/5/6 corresponds to sequence length,L, of 16/24/32/40/48/56/64 elements respectively.

Interleaving Burst Markers with Data/pilots

- Interleaving Burst Marker sequence with data and/or pilots spreads the burst marker sequence across more sub-carriers.
- This provides immunity for the burst marker sequence against narrow band ingress.
- The 1^{st}, 3^{rd}, 5^{th},…. resource elements are mapped with the burst marker sequence and the 2^{nd}, 4^{th}, 6^{th},… resource elements are mapped with the data and/or pilots. Where the 1^{st} resource element corresponds to the starting location of the burst marker sequence of the burst. .

Simulation Suite

- **AWGN** = 15 dB
- **Multipath profile** :

  delay = [0.5 1 1.5 2 3 4.5]*1e-6;

  pwr_db = [-16 -22 -29 -35 -42 -51];
- **Carrier frequency offset** = 30 Hz
- **Burst Noise:**
- Duration = 16 micro seconds, Signal_to_burst_noise_ratio = 5 dB; repetition rate = 100 Hz (100 events of burst noise per second);
- Case 1: burst noise overlaps one OFDM symbols (excluding CP)
- Case 2: burst noise overlaps two OFDM symbols

Simulation Suite

- **Narrowband Ingress:**

  signal_to_ingress_noise_ratio = 0 dB;

  16 burst markers are hit by ingress in each upstream frame.

  Case1: Ingress width = 50 KHz,

  Case2: Ingress width = 100 KHz;

  case 3 : ingress width = 150 KHz;

  Case 4: Ingress width = 200 KHz

  Case 5: Ingress width = 250 KHz,

  Case 6: Ingress width = 300 KHz.

Simulation Suite

- **Resource Block Sizes**:

  Case1: 1 Sub-carrier by 8 OFDM symbols.

  Case2: 4 Sub-carriers by 8 OFDM symbols.

  Case3: 8 Sub-carriers by 8 OFDM symbols.

Summary

- All the above impairments were added simultaneously in the simulations.
- Requirement for Net burst marker detection error (unable to detect valid burst + false detection of invalid burst) < 1E-6
- The baseline proposal meets/exceeds the Net burst marker detection error rate requirement.

Motion:

Move to adopt rahman_syed_3bn_01_1113.pdf as the base line proposal for the burst markers.

Yes:

No:

Abstain:

Thank you

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