Proposal for Preamble Design

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Re:
IEEE 802.16m-08/016r1: Call for Contributions on Project 802.16m System Description Document (SDD), **Preambles.**

Abstract:
To propose preamble design robust to frequency-selectivity but taking advantage of frequency-diversity in IEEE 802.16m systems

Purpose:
For discussion and approval in TGm.

Roles of Preamble (Synchronization Channel)

- Synchronization channel =

  Primary Synchronization channel

  + Secondary Synchronization channel
- Primary Synchronization channel is used for
  - Frame timing synchronization,
  - Frequency synchronization.
- Secondary Synchronization channel is used for
  - Cell ID search,
  - Band-specific channel quality measurement.

Structure of Synchronization Channels

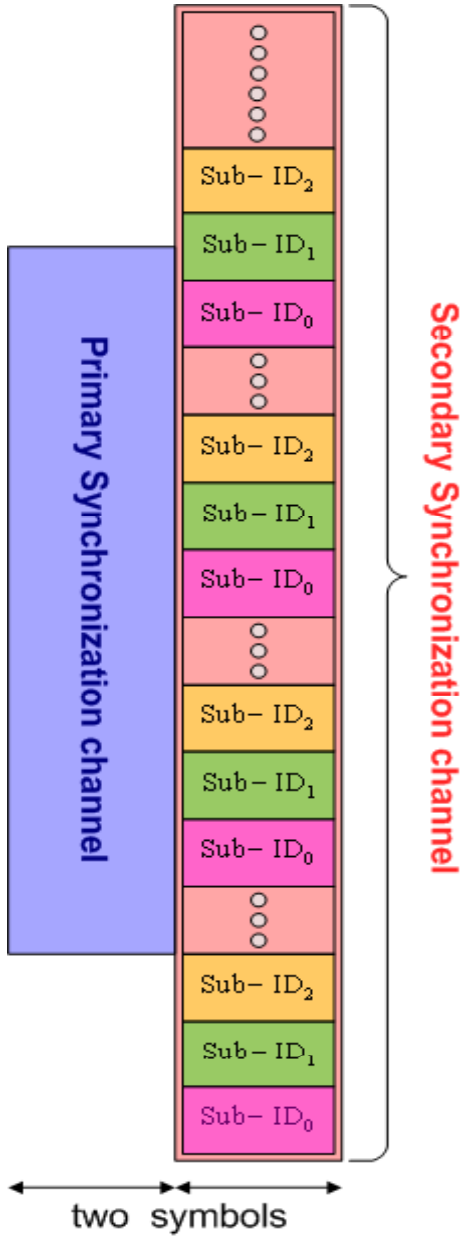


Fig. 1 Structure of synchronization channels

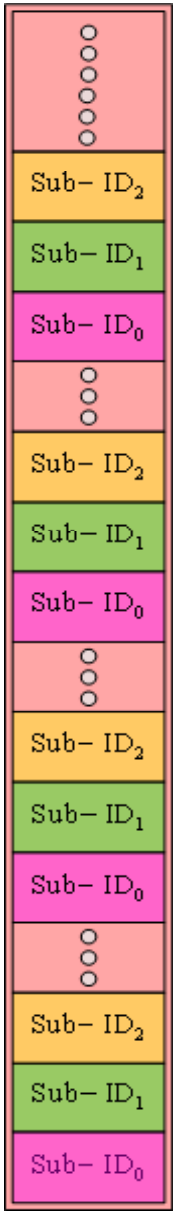
Primary Synchronization Channel

- All cells use the same pattern of Primary Synchronization channel.
- Primary Synchronization channel may occupy only a small part (not whole) of the minimum nominal channel bandwidth (i.e., 5 MHz).
  - since reducing the occupied bandwidth can mitigate the negative effect of frequency-selectivity on the synchronization performance.

Secondary Synchronization Channel

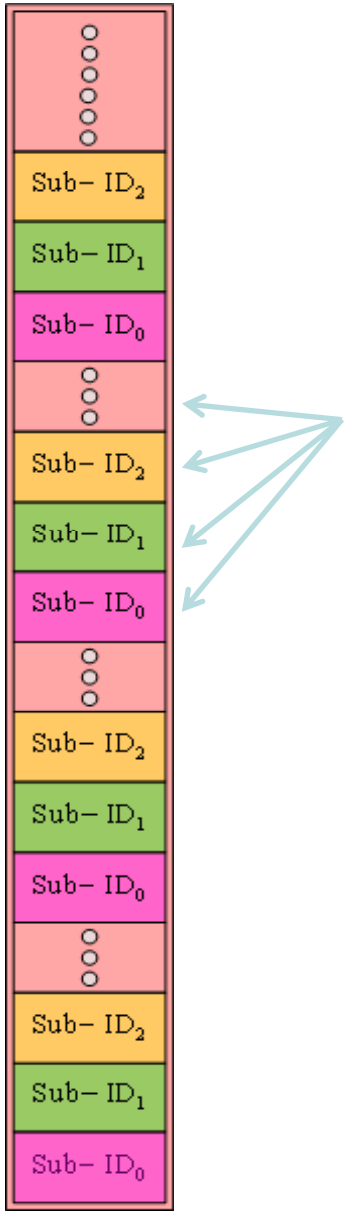
- Secondary synchronization channel will be detected by a non-coherent manner, since
  - channel estimation using the primary synchronization channel is not well-performing when signal of primary synchronization channel from other cells interferes; or
  - primary synchronization channel may not occupy the whole bandwidth which, on the other hand, is occupied by the Secondary Synchronization channel.

Secondary Synchronization Channel (Cont'd)



- A Secondary Synchronization channel is partitioned into many small sub-blocks in frequency domain.
  - which helps mitigate the negative effect of frequency-selectivity on correlation-based synchronization performance.
- Secondary Synchronization channels occupy the whole available bandwidth to
  - improve the synchronization performance;
  - enable band-specific channel quality measurement with preamble.

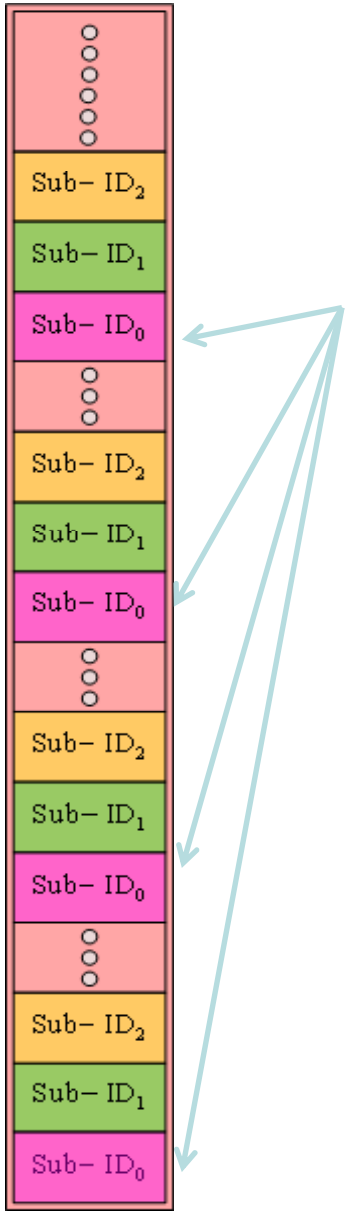
Secondary Synchronization Channel (Cont'd)



- Each sub-block has a Sub-ID identified by a sequence whose length is the sub-block size.
- Each cell ID is specified by a combination of sub-IDs

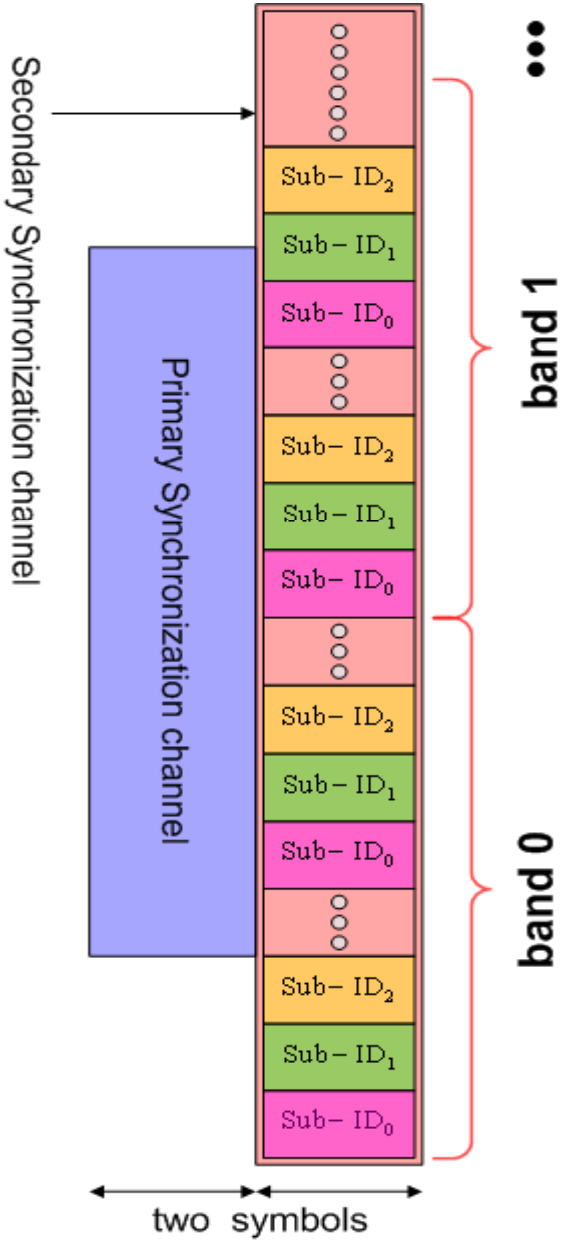
  (Sub-ID_0, Sub-ID_1, Sub-ID_2, ···).
- Such combination makes it easy to obtain sufficient number of cell IDs.

Secondary Synchronization Channel (Cont'd)



- Several different sub-blocks convey the same sub-ID information
  - To support for reliable detection of each sub-ID.
- Sub-blocks of the same sub-ID are distributed
  - to take advantage of frequency diversity.

Secondary Synchronization Channel (Cont'd)



Channel quality for each band can be easily estimated by grouping adjacent sub-blocks into a band.

Fig. 2 Grouping of secondary synchronization channel sub-blocks into each band for band-specific channel quality measurement.

For Multi-FA Operation

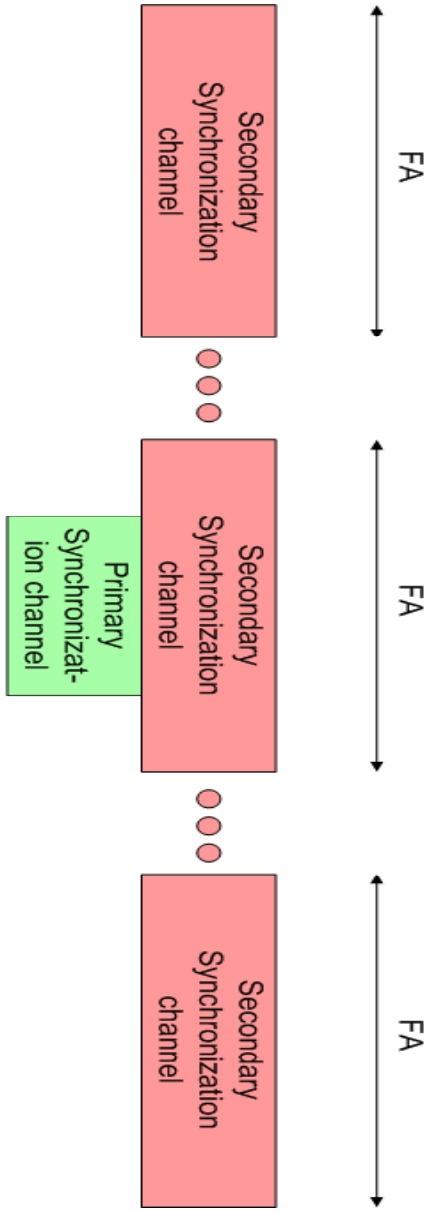


Fig. 3 Structure of synchronization channels for multi-FA operation.

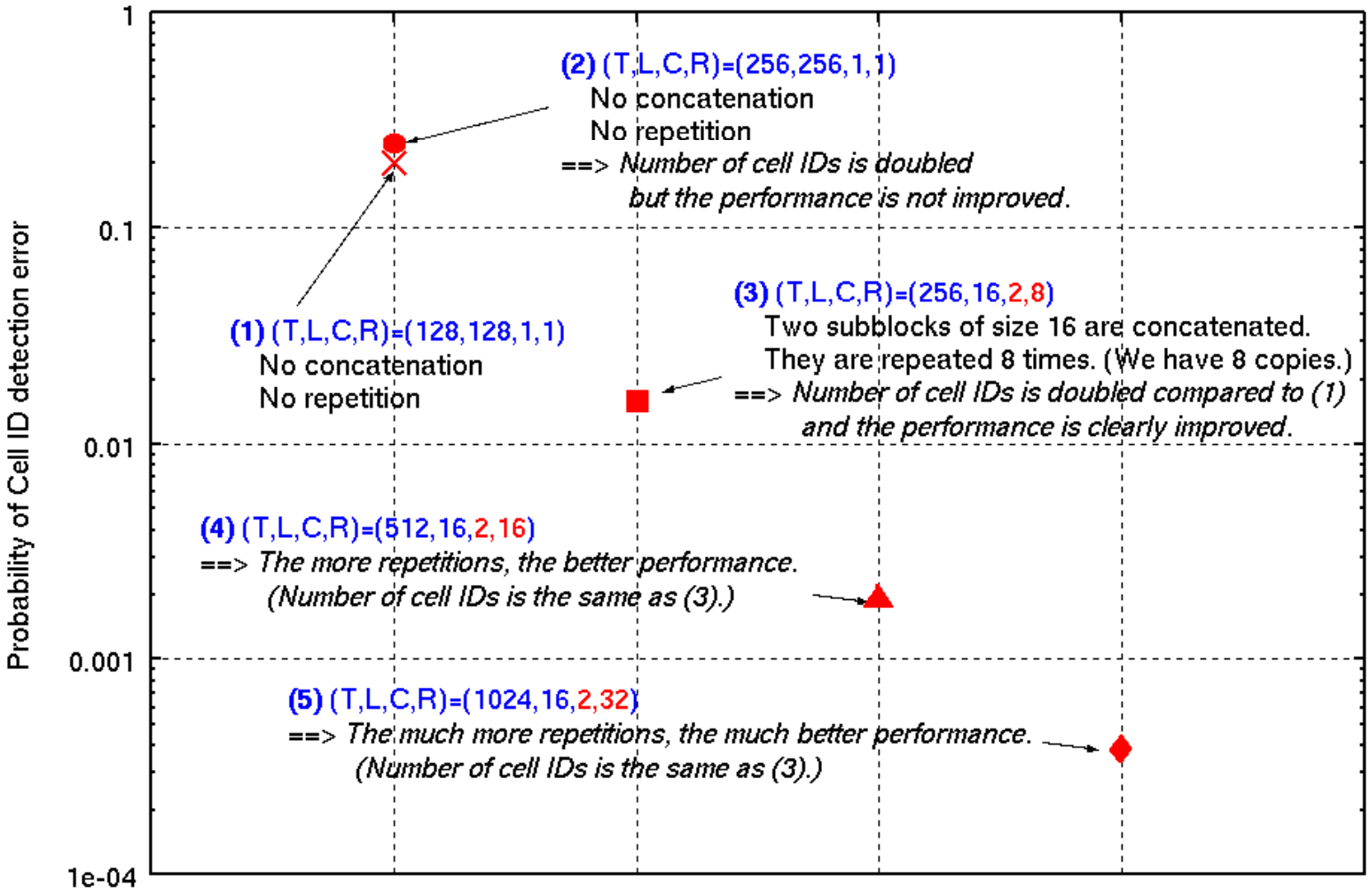
Performance Experiment

- Cell ID detection error probabilities are evaluated for
  - Secondary SCH of size 128 and 256 with no partitioning
  - Secondary SCH of size 256, 512, and 1024 with partitioning
- Single cell scenario considered.
- Walsh sequence (for example) employed.
- Combined non-coherent detection
  - Squared magnitudes of correlation for sub-blocks with the same sub-ID are summed for each sub-ID detection.
- Definition of “cell ID detection error”
  - One cell ID is assumed to be transmitted.
  - It is declared that a cell ID detection error occurs if at least one of sub-IDs to be concatenated is wrongly detected.

Performance Experiment (Cont'd)

Ped. B
Subcarrier spacing: 9.765625 kHz
SNR: 3 dB

T: Total length of secondary SCH (number of used subcarriers)
L: Length of a subblock
C: Number of concatenated subblocks
R: Number of repetitions



Proposed Texts into SDD

X.y Preamble (Synchronization Channels)

Synchronization channels (preamble) are comprised of a primary synchronization channel and a secondary synchronization channel as shown in Fig. 1. (*include Fig. 1*)

X.y.1 Primary Synchronization Channel

- The same pattern of primary synchronization channel is used by all cells.
- …….

X.y.2 Secondary Synchronization Channel

- A Secondary Synchronization channel is partitioned into many small sub-blocks in frequency domain. Each sub-block has a Sub-ID identified by a sequence whose length is the sub-block size. Each cell ID is specified by a combination of the sub-IDs.

Proposed Texts into SDD (Cont'd)

- Several different sub-blocks convey the same sub-ID information and they are distributed to take advantage of frequency diversity for reliable detection of each sub-ID.
- Secondary synchronization channel sub-blocks are grouped into each band to enable band-specific channel quality measurement, as shown in Fig. 2. (*include Fig. 2*)

X.y.3 For Multi-FA Operation

- Secondary synchronization channels are available in all FAs for improving synchronization performance and enabling band-specific channel quality measurement as shown in Fig. 3. (*include Fig. 3*)