Proposal for IEEE 802.16m Synchronization Channel

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Venue:

IEEE 802.16m-08/016r1, “Call for Contributions on Project 802.16m System Description Document (SDD)”,
On topic of “Preambles.”

Base Contribution:

None

Purpose:

To be discussed and adopted by TGm for use in 802.16m SDD

Notice:

Release:

Patent Policy:

Proposal for IEEE 802.16m Synchronization Channel

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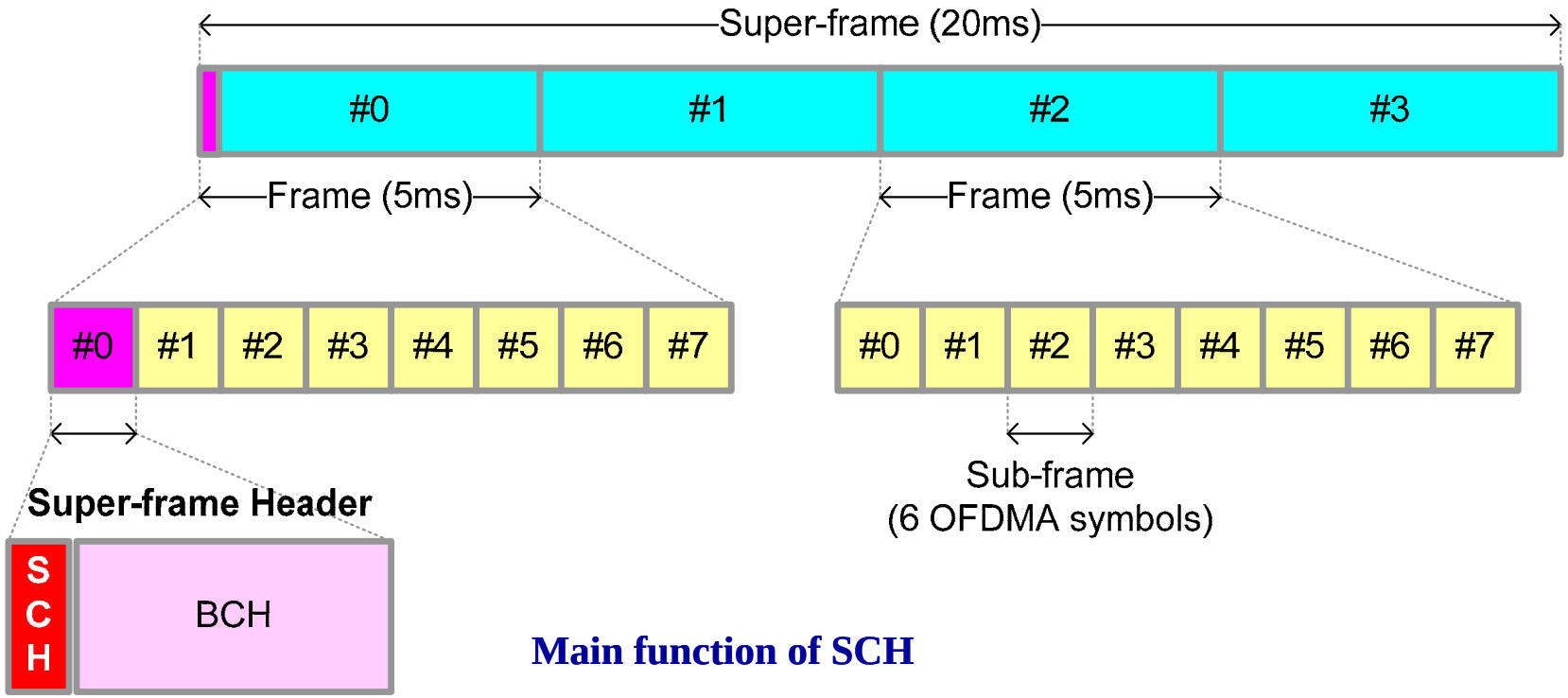
About This Contribution

- Goal and scope of this contribution
  - Propose a synchronization channel(SCH) design for 802.16m
- Issue to be addressed in this contribution
  - Transmit period of SCH
  - Number of SCH symbol per super-frame
  - Number of cell ID
  - Timing synchronization method
  - Bandwidth of SCH

Requirements

- Simple timing/frequency synchronization
  - Low computational complexity for power saving
  - Low implementation complexity
- More number of cell ID than 802.16e
  - Support femto cell
- Low overhead
  - No overdesign
- Support channel estimation
  - Flat frequency spectrum
- Low PAPR for power boosting

SCH Structure



Main function of SCH

- Provide reference of time/frequency synch, and BS identification

SCH structure

- 1 symbol in Super-frame header

SCH Features

Attribute			Value
Channel Structure	Tx Period		20ms
	Bandwidth		5MHz, 10MHz
	Position	Time	Within super-frame header
		Freq	Center of FFT BW
Symbol Structure	Num of cell IDs		1024
	Num of Symbols		1
	Time Sync method		2x time repetition (Schmidl & Cox)
	Fast Cell Search		2 sets are interlaced in frequency domain
	Sequence		BPSK modulated Frequency Domain Sequence
Other functions than Sync	NBR Cell Search for Handover		Common Pilot (DL Ref. Signal, 5ms Tx period)
	Additional function/Information		TBD

SCH and Common Pilot Operation

- SCH [20ms Tx period]
  - Time/freq synchronization + cell ID detection
- Common Pilot (DL reference signal) [5ms Tx period]
  - Common (or predetermined cell-specific) time/freq position among cells
  - Covered by a cell-specific code
  - Provide reference signal for each antenna to support MIMO

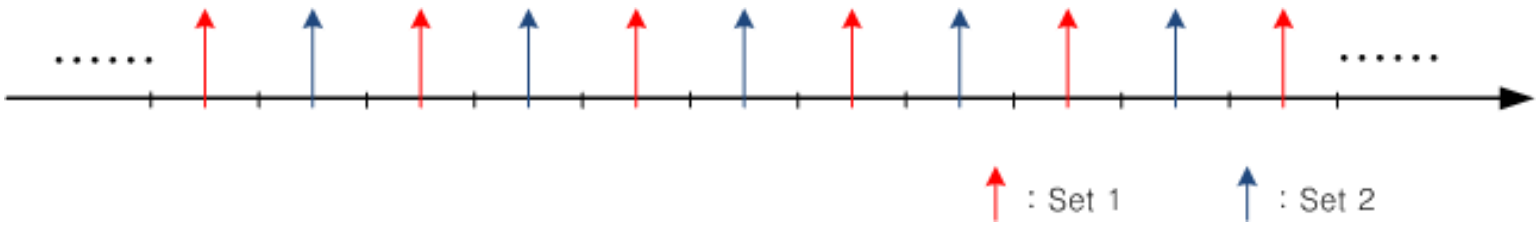
Function	Update period	Channel
Time sync.	20ms	SCH
Freq sync.	20ms	SCH
Cell ID detection	20ms	SCH
CQI measure (per Ant)	5ms	Common Pilot (DL Ref. Signal)
RSSI measure	5ms	Common Pilot (DL Ref. Signal)
NBR cell measure	5ms	Common Pilot (DL Ref. Signal)

SCH Symbol Structure

- Number of cell ID = 1024
- 1 symbol used for time/freq synch & BS identification
- Time Synchronization by Schmidl & Cox using 2x time repetition
- Low computational/implementation complexity
  - Two sets are interlaced in frequency domain
  - Each set has 32 sequences (32 x 32 = 1024)

	5 MHz	10 MHz
FFT size	512	1024
Sequence Length	108	216

- BPSK modulated frequency domain sequence with low PAPR and good correlation properties
  - Low complexity at terminal



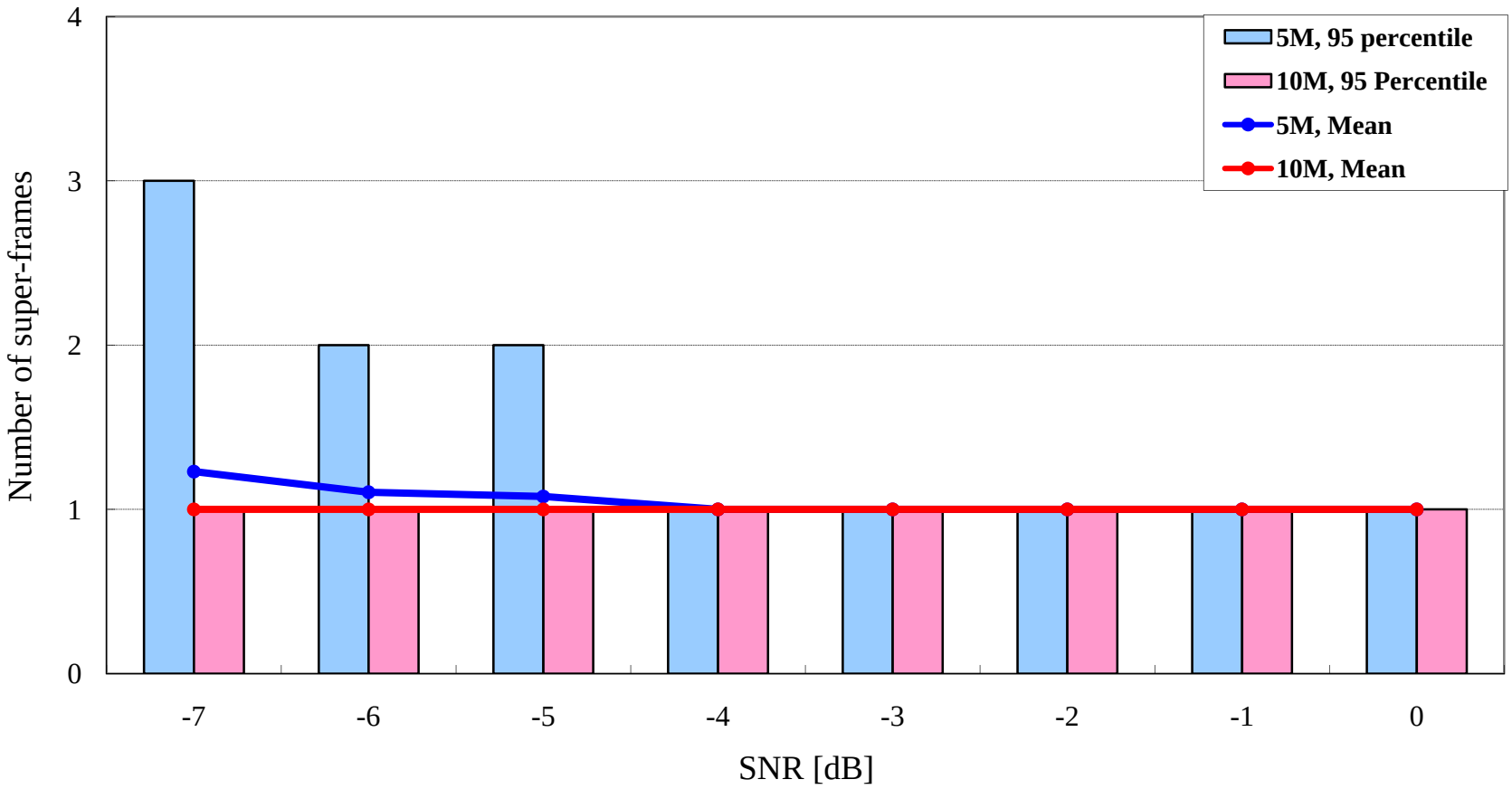
Simulation Assumption

Parameter	Assumption	
FFT size	512	1024
Total number of sub-carriers	432	864
Number of sub-carriers for SCH [1)]	216	432
Length of sequence in the set	108	216
Sequences	BPSK modulated sequence (FD)	
Channel Models	PED B, 60km/h	
Number of cell IDs	1024	
Number of antennas	1 Tx, 2 Rx	
Power Boosting	7 dB [2), 3)]	
Cell ID Detection	Ideal timing and frequency offset compensation are assumed	

1) SCH occupies every other subcarrier for 2x time repetition.
2) 7dB boosting comes from 3dB equal OFDM symbol power gain and 4dB PAPR gain against random data symbols. PAPRs of all SCH are 4dB lower than those of 99% random data symbols.
3) Power boosting is reflected on the timing synchronization only. It is assumed that there isn't any power boosting gain on cell ID detection. This is suitable for the interference limited environment.

Performance

- Timing & Cell Acquisition time (Number of super-frames)



Text Proposal to 802.16m SDD

Insert the following text into Physical Layer clause (Chapter 11 in [IEEE 802.16m-08/003r1])

11.x Synchronization Channel

Synchronization channel differentiates 1024 unique cell identities. Synchronization channel is transmitted at every 20msec on the one OFDMA symbol in the super-frame header. For FFT sizes of 512 and 1024, Synchronization channel spans 432 and 864 subcarriers of the OFDMA symbol respectively, and occupies every other subcarrier over this span.