Proposal for IEEE 802.16m Frame Structure for Single Band Operation

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Venue: Levi, Finland

Base Contribution: IEEE C802.16m-08/041

Purpose: Adopt the proposal into the IEEE 802.16m System Description Document

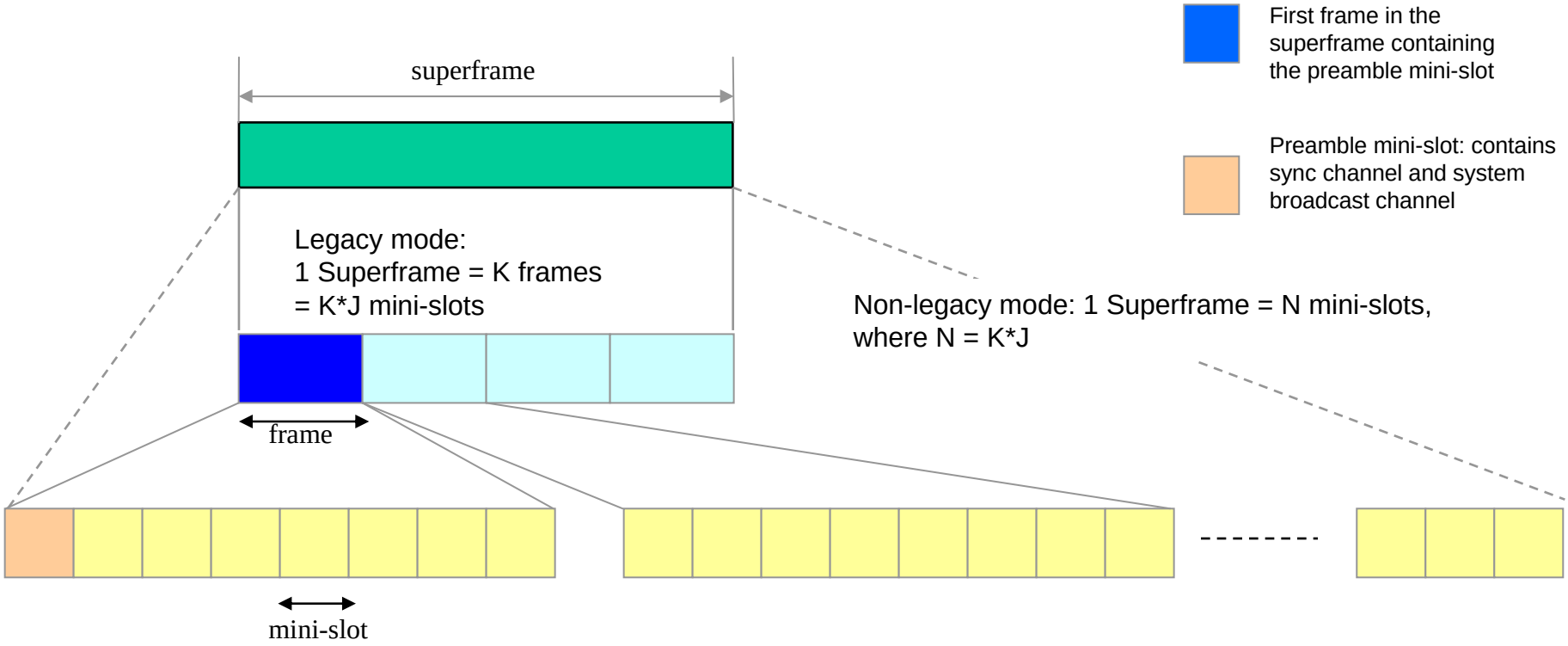
Scope

- This contribution presents the IEEE 802.16m frame structure for single band operation, i.e.
  - Both IEEE 802.16m MS and BS operate on the same system bandwidth
  - Both IEEE 802.16m and the legacy systems operate on the same system bandwidth
- Frame structure for multi-band operation is presented in a separate contribution (C802.16m-08/042).

Overview

- To allow coherent design and minimize implementation complexity, the same generic framework is used to support both legacy mode and non-legacy mode
- Multiple access is OFDMA for both DL and UL as in the legacy system
- The same OFDMA numerology as the legacy system is used for unicast transmission

Generic Frame Structure



- For non-legacy mode, each superframe consists of N mini-slots. For legacy mode, each superframe is divided into K frames and each frame is further divided into J mini-slot. N = K*J. Recommended values are K = 4, J = 8, N = 32.
- Each superframe starts with a 16m preamble mini-slot which contains the following:
  - Synchronization channel
  - System broadcast channel

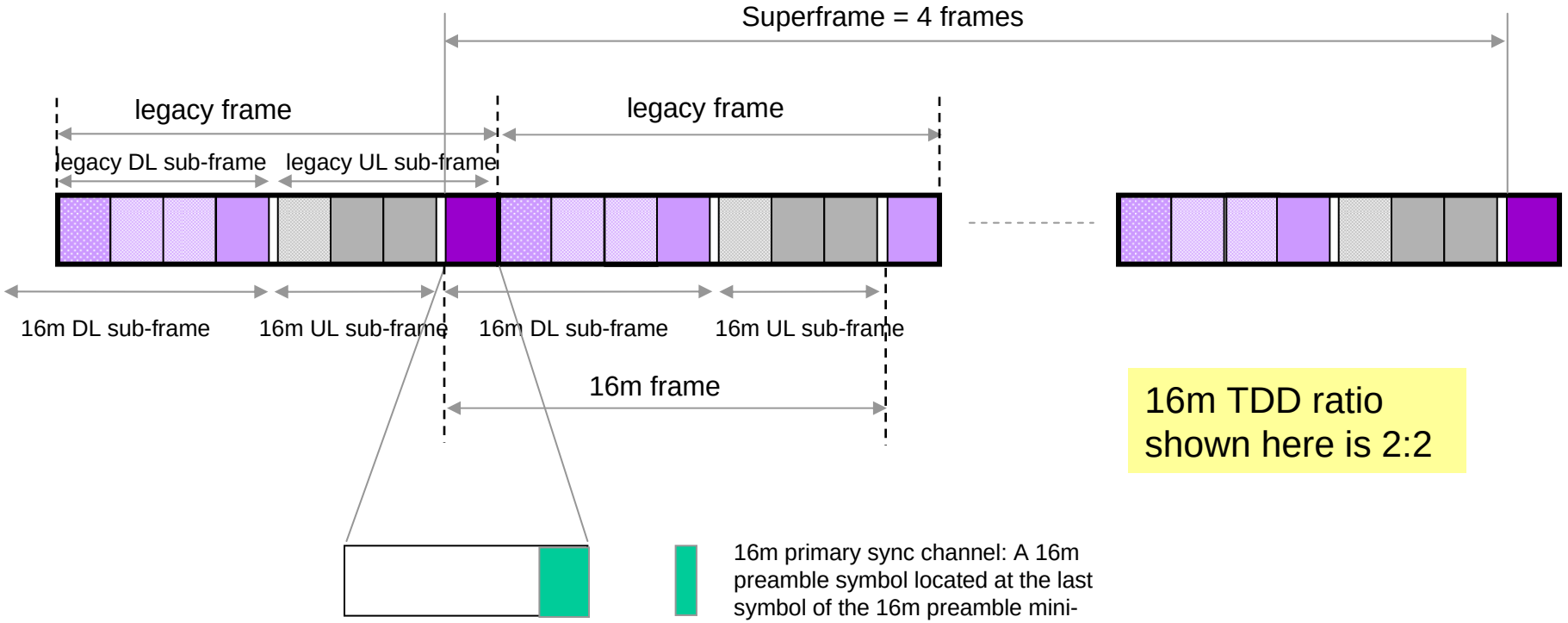
Overlay of IEEE 802.16m and Legacy Resource

- IEEE 802.16m and legacy systems are overlaid in a TDM fashion when both occupy the same bandwidth
  - Define legacy zone and 16m zone
  - Legacy zones are located at the beginning of the legacy DL sub-frame and the legacy UL sub-frame
- For the case of UL, FDM partitioning of resource between IEEE 802.16m and legacy systems are FFS
  - FDM partitioning can provide better UL coverage at the expense of imposing constraint on the UL channelization format of IEEE 802.16m
- Different TDD ratios can be configured for the legacy system and the IEEE 802.16m system

Superframe, Frame and Mini-Slot for Legacy Mode (1/2)

- A legacy 5ms frame is divided into 8 mini-slot, each containing 6 symbols.
- The first mini-slot in a legacy frame is the legacy preamble mini-slot. One symbol is punctured for use as TTG/RTG. The remaining 5 symbols consist of preamble, FCH and MAP and possibly legacy data zone
- The legacy DL sub-frame always starts with the legacy preamble mini-slot. The legacy UL sub-frame always starts with the legacy UL mini-slot.
- IEEE 802.16m mini-slot contains both IEEE 802.16m control and data. The IEEE 802.16m channelization for control and data is confined within the mini-slot.
- IEEE 802.16m TDD ratios are defined as M:N where M is the number of IEEE 802.16m DL mini-slots in a frame and N is the number of IEEE 802.16m UL mini-slots in a frame.
- There is one DL-UL TDD switch and one UL-DL TDD switch for IEEE 802.16m in each 5ms frame.
  - Larger number of TDD switches is FFS.

Superframe, Frame and Mini-Slot for Legacy Mode (2/2)



16m TDD ratio shown here is 2:2

16m primary sync channel: A 16m preamble symbol located at the last symbol of the 16m preamble mini-slot, i.e. one symbol prior to the legacy preamble.

Legacy preamble DL mini-slot: contain legacy preamble, FCH and MAP, and legacy data

16m DL mini-slot: contain 16m control and data

legacy UL mini-slot: contain legacy UL data and control

legacy DL mini-slot: contain legacy DL data

16m preamble mini-slot: contain 16m synchronization channel, and 16m broadcast control channel

16m UL mini-slot: contain 16m control and data

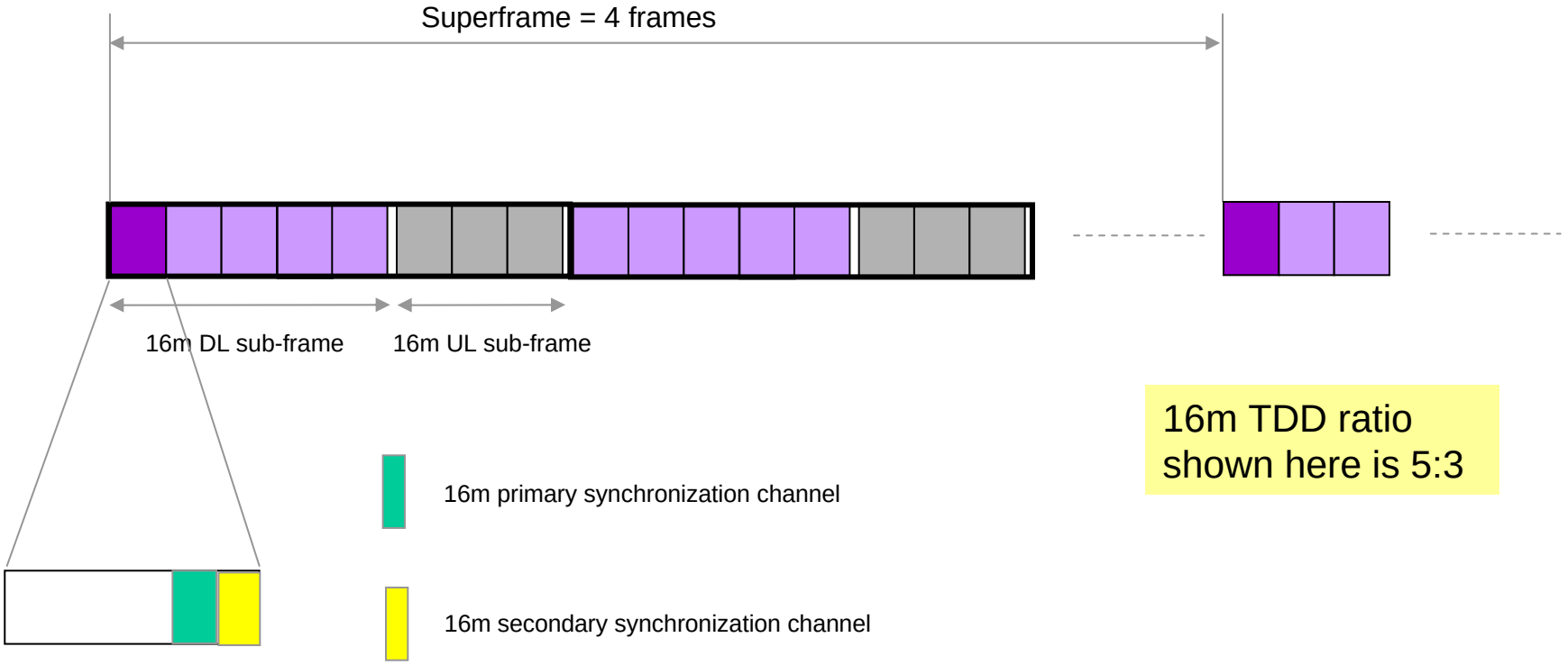
16m Preamble for Legacy Mode

- A IEEE 802.16m MS uses both legacy preamble and 16m preamble for synchronization and system access.
- The 16m primary synchronization channel is a 16m specific preamble used for the following:
  - Synchronization
  - Indication of whether legacy support is enabled in the IEEE 802.16m system. With this indication, the format of the 16m preamble mini-slot, and the relationship and boundaries between superframe, frame and mini-slot can be deduced by the MS.
- The 16m secondary synchronization channel is the same as the legacy preamble and used for the following:
  - Contains cell specific sequence for cell search and best sector(s) selection
  - Fine synchronization

Superframe and Mini-Slot for Non-Legacy Mode (1/2)

- A superframe consists of 32 mini-slots.
- TDD ratio is defined as M:N where M is the number of consecutive DL mini-slots and N is the number of consecutive UL mini-slots.

Superframe and Mini-Slot for Non-Legacy Mode (2/2)



16m TDD ratio shown here is 5:3

16m DL mini-slot: contain 16m control and data

16m preamble mini-slot: contain 16m preamble symbol, and 16m system broadcast control channel

legacy UL mini-slot: contain legacy UL data and control

16m UL mini-slot: contain 16m control and data

16m Preamble for Non-Legacy Mode

- The same primary and secondary synchronization channels are defined for both legacy and non-legacy modes. A IEEE 802.16m MS uses the same synchronization and system access procedure for both legacy and non-legacy mode.
- As in the case of legacy mode, the 16m primary synchronization channel is used for following:
  - Synchronization
  - Indication of whether legacy support is enabled in the IEEE 802.16m system. With this indication, the format of the 16m preamble mini-slot, and the relationship and boundaries between superframe, frame and mini-slot can be deduced by the MS.
- As in the case of legacy mode, the 16m secondary synchronization channel has the same sequence construct as the legacy preamble to ensure the 16m MS employs the same synchronization and system access procedure regardless of whether legacy support is enabled or not:
  - Contains cell specific sequence for cell search and best sector(s) selection
  - Fine synchronization

Channelization and Control

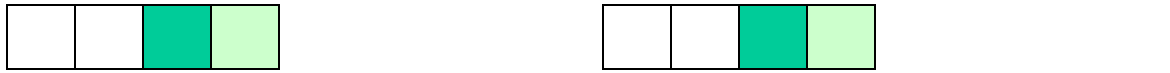
- New channelization and control channel design are defined for IEEE 802.16m mini-slots
- The channelization for control and traffic is confined within each mini-slot and span across all the symbols within the mini-slot.
- Extended mini-slots can be defined to concatenate the sub-channel resource across multiple mini-slots to reduce control overhead and improve UL coverage. This is FFS.

DL HARQ Timing

The minimum HARQ ACK and Retrx delay and the number of HARQ channels are defined in system broadcast signaling which corresponds to particular partitioning of legacy and 16m, and TDD ratios. With these parameters defined, the precise HARQ timing can be deduced.

Example 1: 16m TDD ratio of 2:3 (ACK delay and Retrx delay are 4 mini-slots, 2 HARQ channels)

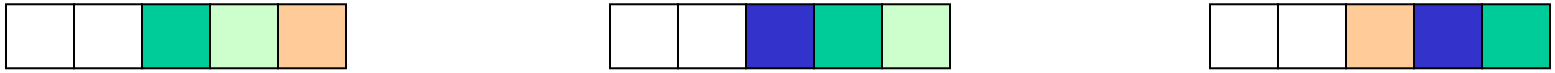
DL tx/retrx



UL ACK

Example 2: 16m TDD ratio of 3:2 (ACK delay and Retrx delay are 4 mini-slots, 4 HARQ channels)

DL tx/retrx



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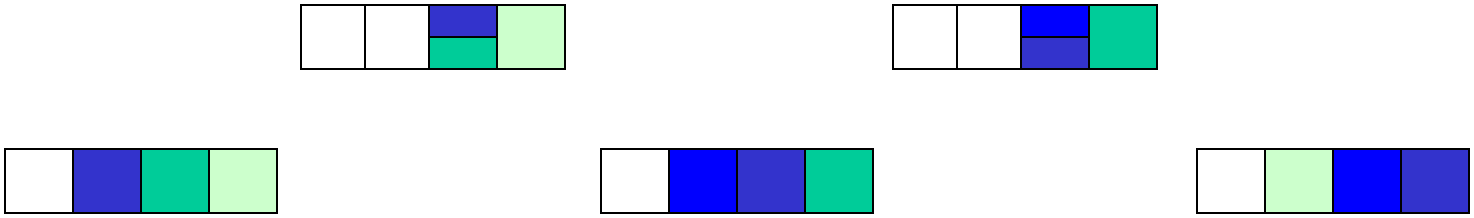
DL ACK

UL tx/retrx



Example 2: 16m TDD ratio of 3:2 (ACK delay and Retrx delay are 4 mini-slots, 2 HARQ channels)

DL ACK

UL tx/retrx