Proposal for IEEE 802.16m DL Resource Blocks and Channelization

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Re: IEEE 802.16m-08/005 – Call for Contributions on Project 802.16m System Description Document (SDD), on the topic of "Downlink Physical Resource Allocation Unit (Resource Blocks and Symbol Structure)"

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

Scope

- This contribution proposes a new resource block structure and channelization for IEEE 802.16m
- The pilot design and resource allocation and control structure are presented in separate contributions (see C802.16m-08/172 and C802.16m-08/176).

IEEE 802.16m System Requirements

- The TGm SRD (IEEE 802.16m-07/002r4) specifies the following requirements:
  - Provide support for FFR (A.2.2)
  - Provide support for MBS (Section 6.7)
  - Mobility support (Section 7.3)
- The proposed resource block and channelization design targets the above requirements.

Motivation

- The legacy 16e system uses a TDM approach to configuring diversity, localized and MIMO zones.
- In an FDM approach, the channelization can span across all symbols in a sub-frame. Different zones are configured to use a different portion of the band.
  - Spanning the channelization across all symbols allows for efficient power control of both control and traffic.

Overview of Channelization Design

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

Channelization (1/3)

- Within a 16m sub-frame, the bandwidth is divided into one or more zones. Each zone consists of a set of physical tones. The set of physical tones that belong to a zone may be either contiguous or non-contiguous.
- The zones are used for
  - Diversity channel assignments
  - Frequency selective scheduling (localized zone)
  - Fractional frequency reuse (FFR)
  - Single Frequency Network (SFN) transmission
- The hopping pattern is always confined within a zone.
  - For SFN transmission, the hopping pattern is the same in the corresponding zones in sectors that are involved in the SFN transmission
  - For FFR the hopping pattern is different for different sectors

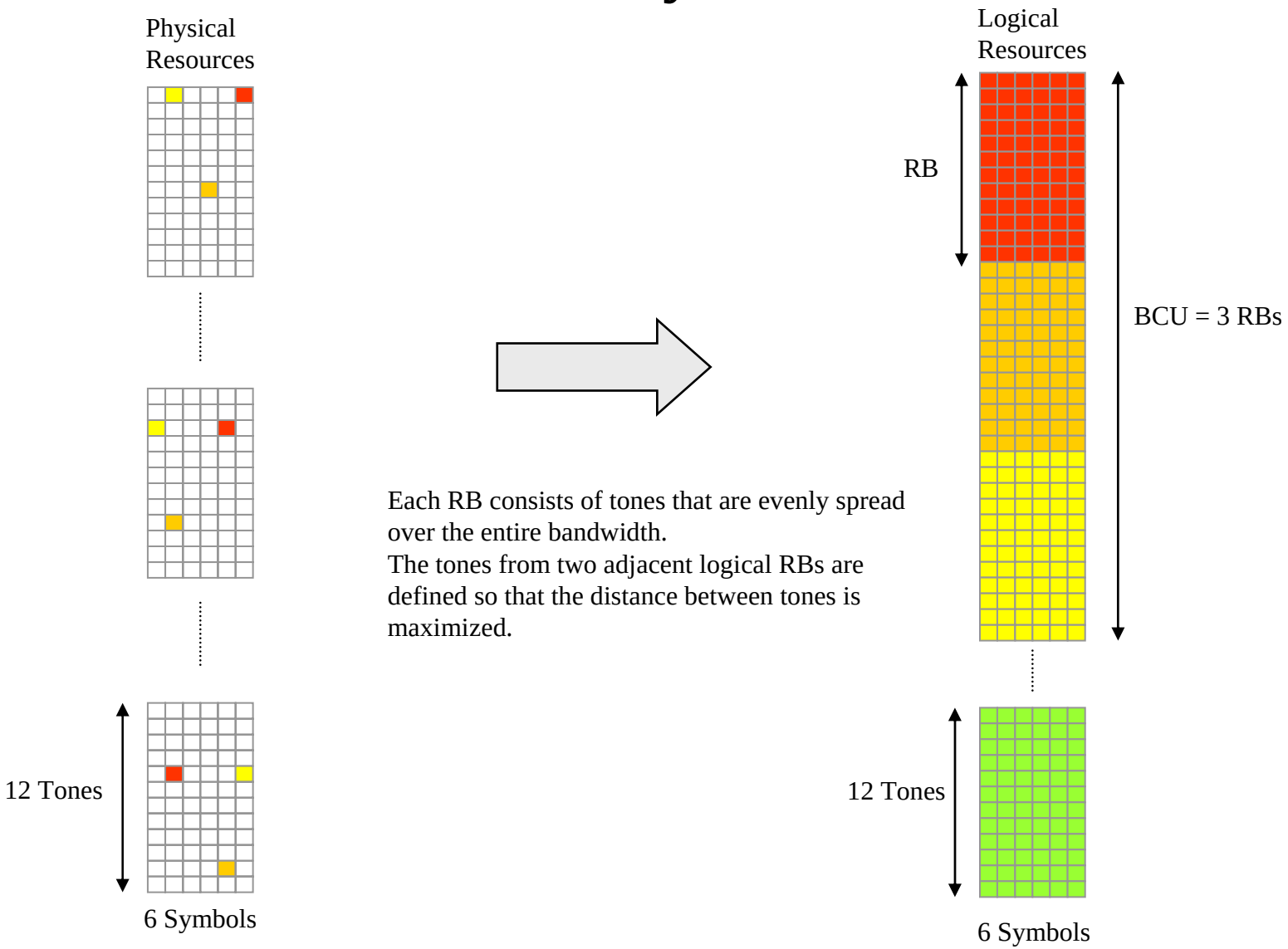
Channelization (2/3)

- Each zone has a one-dimensional ordered list of resources, in units of Basic Channel Units (BCU)
- BCU
  - A BCU consists of 3 resource blocks (RB), where a RB is 12 sub-carriers and 6 OFDM symbols. The details of the RB definition and the pilot design are described in a separate contribution (see C80216m-08/172).
  - For a 10 MHz system, there are 24 BCUs.
  - In the localized zone, a BCU is formed from contiguous physical tones.
  - In the diversity zone, a BCU is formed from physical tones that are spread over the entire zone.
  - Each BCU spans over all OFDM symbols in a sub-frame.
  - The partitioning of resources between the localized and diversity zone is in units of BCUs.

Channelization (3/3)

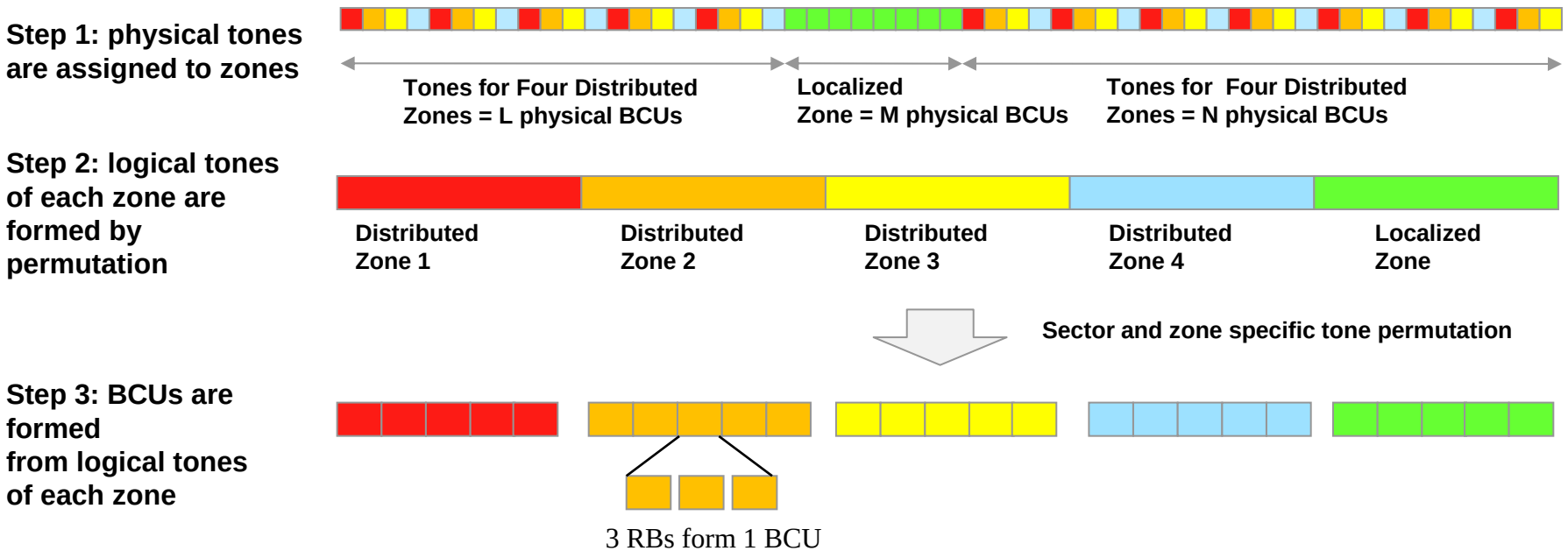
- Defining a BCU size of 3 RBs has the following advantages
  - The RB size provides enough granularity and flexibility for VoIP assignments (see C802.16m-08/177).
  - For non-VoIP assignments, the resource unit does not have to be as granular.
  - For group assignments, such as VoIP, groups are allocated in units of BCUs, whereas individual VoIP users can be allocated resources in units of RBs.
  - This BCU size is an adequate size for proper channel estimation using common pilots (see contribution C802.16m-08/172).
  - 3 RBs correspond to 394 kHz which provides adequate frequency selective scheduling performance
- The resources are assigned using a combination of a multicast message and separate unicast messages for each assignment. The details of the resource allocation and control structure are described in a separate contribution (see contribution C802.16m-08/176).

Mapping of Physical to Logical Resources for a Diversity Zone



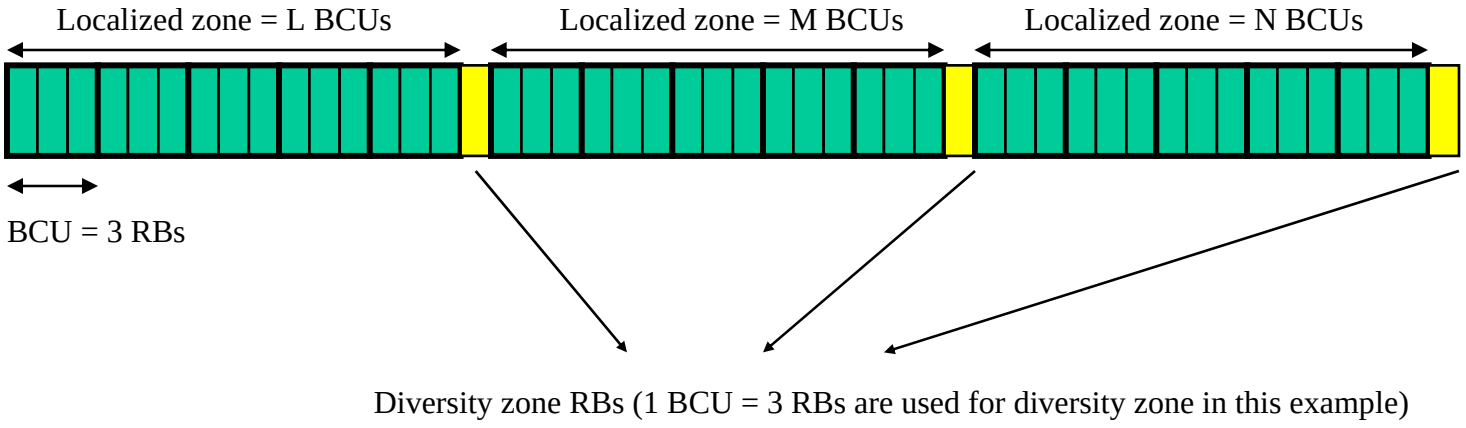
Channelization Procedure (1/2)

- Step 1: The sub-carriers in a band are partitioned between localized zone and diversity zone in units of physical BCUs, i.e. 36 tones. The physical tones in the band are assigned to each zone by first assigning contiguous tones, in units of BCUs, for the localized zones and evenly distributing the remaining tones for distributed zones. The assignment of physical tones to each zone can hop from time to time, e.g. symbol to symbol or set of symbols to symbols, frame by frame etc.
- Step 2: Once the zones are formed by a set of physical tones, the physical tones are permuted with a sector and zone specific permutation to map to logical tones.
- Step 3: An ordered list of RBs is then formed for each zone where each RB consists of a set of logical tones. BCUs are formed by grouping 3 RBs.



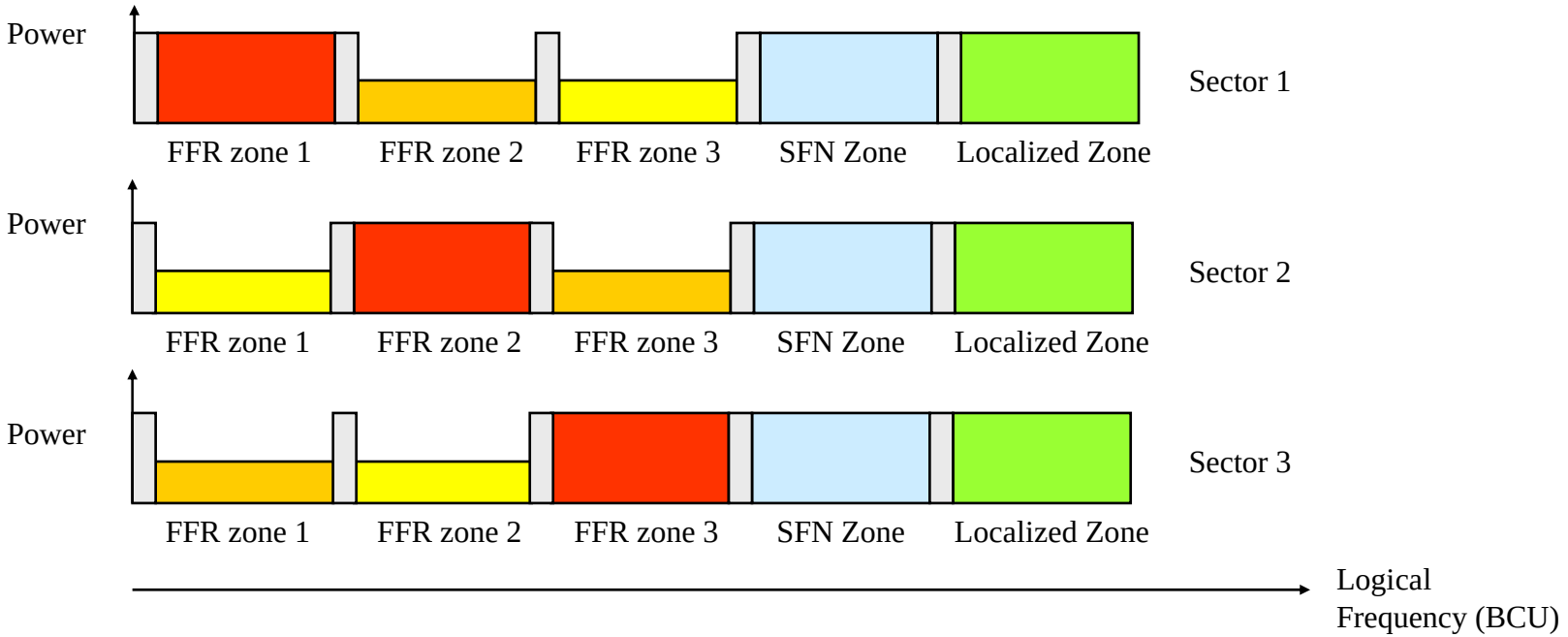
Channelization Procedure (2/2)

- In a band, if the diversity zone is a size of one or two BCUs, then the RBs used to form the BCUs can be distributed across the band. This improves the diversity order of the logical BCUs.
- To improve channel estimation in each of the disjoint diversity RBs, a high density pilot pattern should be used in these RBs (see C802.16m-08/172).



Zone Configuration

- The figure below illustrates how the different zones can be configured in one sub-frame. Zones configuration is signaled in the superframe configuration control in the superframe header.
- A separate control channel is contained within each zone.
- The control channel spans all OFDM symbols.
- The FFR zones can be either diversity or localized zones.



Summary

- The proposed resource block and channelization satisfies the requires of the TGm SRD.
- The new resource block design efficiently supports both VoIP and non-VoIP traffic.
- The new design also provides support for
  - Diversity resource allocation
  - Localized resource allocation
  - FFR
  - MBS