Project	**IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>**	
Title	**802.16m DL PHY Structure Baseline Content Suitable for Use in the 802.16m SDD**	
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Re:	IEEE802.16m-08/015r1 (“Charter and Scope of TGm Rapporteur Groups”)	
Abstract	Baseline Downlink Physical Structure from the DL PHY Rapporteur Group	
Purpose	To be discussed and adopted by TGm for use in the 802.16m SDD	
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Proposed Text for the 802.16m Downlink Physical Structure

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11.5 Downlink Physical Structure

As described in section 11.4, the 5 ms radio frame is divided into 8 subframes. Each of the subframes can be allocated for downlink transmission. Each subframe is divided into a number of frequency partitions, where each partition consists of a set of physical resource units across the total number of OFDMA symbols available in the subframe. Each frequency partition can include contiguous (localized) and/or non-contiguous (distributed) physical resource units. Each frequency partition can be used for different purposes such as fractional frequency reuse (FFR) or multicast and broadcast services (MBS). Figure 11.5-1 illustrates the downlink physical structure in the example of two frequency partitions with frequency partition 2 including both localized and distributed resource allocations.

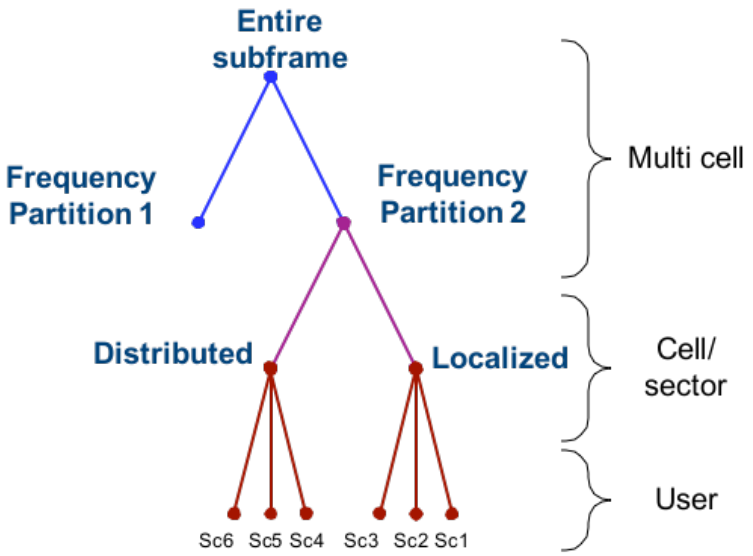

Figure 11.5-1: Hierarchical representation of the downlink physical structure

11.5.1 Physical and Logical Resource Unit

A physical resource unit (PRU) is the basic physical unit for resource allocation that comprises P_{sc} consecutive subcarriers by N_{sym} consecutive OFDMA symbols. P_{sc} is 18 subcarriers and N_{sym} is 6 OFDMA symbols for regular subframes, and N_{sym} is 5 OFDM symbols for irregular subframes. A logical resource unit (LRU) is the basic logical unit for distributed and localized resource allocations. A LRU is P_{sc}*N_{sym} subcarriers for regular subframes and irregular subframes. Note that the LRU includes in its numerology the

number of pilots that are used in a PRU, and may include control information. So, the effective number of data subcarriers in an LRU depends on the number of allocated pilots and control channel presence.

11.5.1.1 Distributed resource unit

The distributed resource unit (DRU) can be used to achieve frequency diversity gain. The DRU contains a group of subcarriers which are spread across the distributed resource allocations. The size of the DRU equals the size of LRU for distributed allocations. The minimum unit for forming the DRU is equal to one subcarrier.

11.5.1.2 Localized resource unit

The localized resource unit (LLRU) can be used to achieve frequency-selective scheduling gain. The LLRU contains a group of subcarriers which are contiguous across the localized resource allocations. The size of the LLRU equals the size of the PRU, i.e., P_{sc} subcarriers by N_{sym} OFDMA symbols.

11.5.2 Subchannelization and Resource mapping

11.5.2.1 Basic Symbol Structure

The subcarriers of an OFDMA are partitioned into $N_{g,left}$ left guard subcarriers, $N_{g,right}$ right guard subcarriers, and N_{used} used subcarriers. The DC subcarrier is not loaded. The N_{used} subcarriers are divided into PRUs. Each PRU contains pilot and data subcarriers. The number of used pilot and data subcarriers depends on the type of resource allocation, i.e., distributed or localized resource allocations, as well as the type of the subframe, i.e., regular or irregular.

11.5.2.2 Downlink subcarrier to resource unit mapping

The DL subcarrier to resource unit mapping process is defined as follows and illustrated in the Figure 11.5.2.2-1:

1. First-level or outer permutation is applied to the PRUs in the units of N PRUs, where N is TBD;
2. Distributing (TBD) the reordered PRUs into frequency partitions.
3. The frequency partition is divided into localized (LLRU) and/or distributed (DRU) resources using the PRU as unit for each resource. The sizes of the groups are flexibly configured per sector (TBD). Adjacent sectors do not need to have same configuration of localized and diversity groups;
4. The localized and distributed groups are further mapped into LRUs (by direct mapping of LLRU and by “Subcarrier permutation” on DRUs) as shown in the following figure.

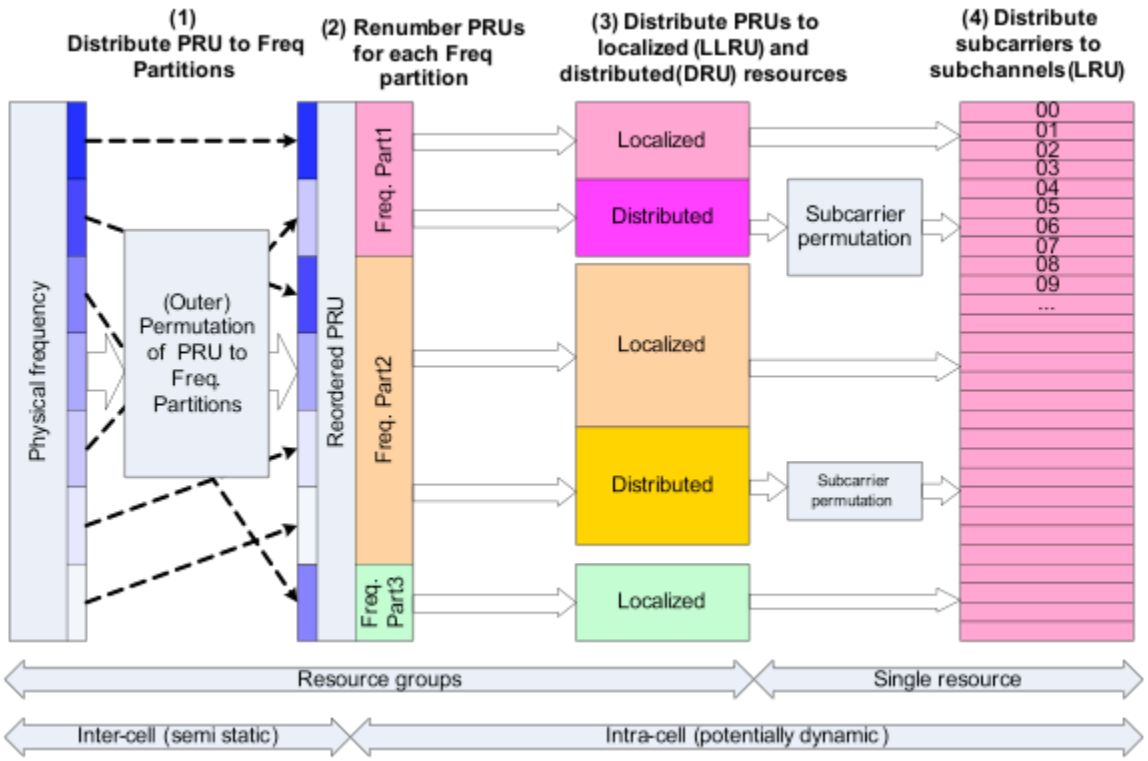

Figure 11.5.2.2–1 Illustration of the downlink subcarrier to resource block mapping

11.5.2.3 Subchannelization for DL distributed resource

The second-level or inner permutation defined for the DL distributed resource allocations spreads the subcarrriers of the DRU across the whole frequency band. The granularity of the inner permutation is equal to the minimum unit for forming a DRU according to 11.5.1.1.

Suppose that there are N_{RU} LRUs in a distributed group. A permutation sequence P (TBD) for the distributed group is provided. The subchannelization for DL distributed resource spreads the subcarriers of LRUs into the whole available bandwidth of distributed resource, as indicated in the following procedure:

Let n_k denote the number of pilot tones in each OFDMA symbol within a PRU, and N_{RU} be the number of LRUs within the distributed resource .

For each k-th OFDMA symbol in the subframe

1. Allocate the n_k pilots in each OFDMA symbol within each PRU;

2. Renumber the remaining $N_{RU} * (P_{sc} - n_k)$ data subcarriers in order, from 0 to $N_{RU} * (P_{sc} - n_k)-1$ subcarriers. Apply the permutation sequence P (TBD) to form the permuted subcarriers 0 to $N_{RU} * (P_{sc} - n_k)-1$. The contiguous renumbered subcarriers are grouped into pairs/clusters before applying permutation, for example, to support SFBC, renumbered subcarriers 0 to $N_{RU} * (P_{sc} - n_k)-1$ are first paired into $(N_{RU} * (P_{sc} - n_k)-1)/2$ clusters.

3. Map each logically contiguous $(P_{sc} - n_k)$ subcarriers into a distributed LRUs (i.e. subchannels) and form a total of NRU distributed LRUs.

11.5.2.4 Subchannelization for DL localized resource

There is no second-level or inner permutation defined for the DL localized resource allocations. The PRUs are directly mapped to LLRUs within each frequency partition defined in 11.5.

11.5.3 Pilot Structure

The transmission of pilot subcarriers in the downlink is necessary for enabling channel estimation, measurements of channel quality indicators such as the SINR, frequency offset estimation, etc. To optimize the system performance in different propagation environments and applications, IEEE 802.16m supports both common and dedicated pilot structures. The categorization in common and dedicated pilots is done with respect to their usage. The common pilots can be used by all MSs. Dedicated pilots can be used with both localized and diversity allocations. Pilot subcarrriers that can be used only by a group of MSs is a special case of common pilots and are termed shared pilots. The dedicated pilots are associated with a specific resource allocation, can be only used by the MSs allocated to said specific resource allocation, and therefore can be precoded or beamformed in the same way as the data subcarriers of the resource allocation. The pilot structure is defined for up to four transmission (Tx) streams and there is [a unified] [a non-unified] pilot pattern design for common and dedicated pilots. There is equal pilot density per Tx stream, while there is not necessarily equal pilot density per OFDMA symbol of the downlink subframe. Further, there is equal number of pilots for each PRU and the pilot design philosophy targets at avoiding the collision of pilots among interfering sectors.

11.5.3.1 Common pilot structure

11.5.3.2 Dedicated pilot structure