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Proposed Text for the 802.16m SDD Uplink Physical Structure

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11.6 Uplink 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 uplink 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). Figure 11.6-1 illustrates the uplink physical structure in the example of two FFR groups with FFR group 2 including both localized and distributed resource allocations.

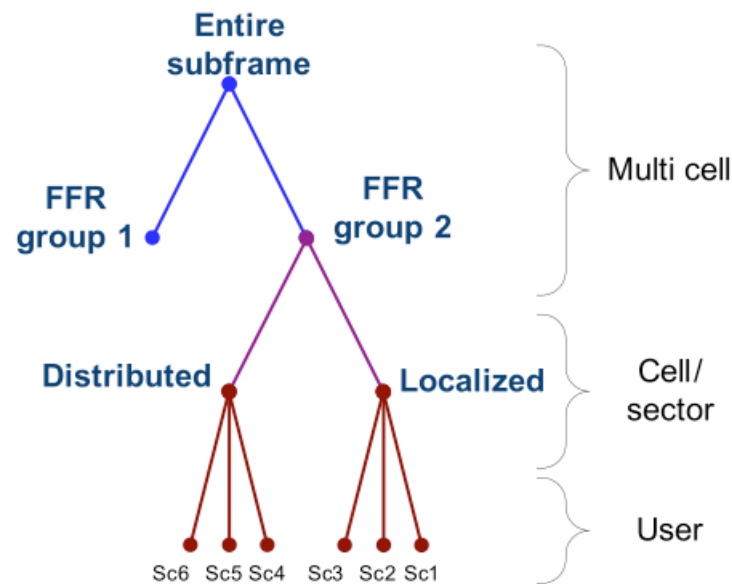


Figure 11.6-1

11.6.1 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} the number of OFDMA symbols depending on the subframe type. A logical resource unit (LRU) is the basic logical unit for distributed and localized resource allocations and its size is $P_{sc} * N_{sym}$ subcarriers for data transmission. For

control channel/message transmission, the size is TBD. 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.

11.6.1.1 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 the LRU for distributed allocations. The minimum unit for forming the DRU is a tile. T different types of tiles are defined, where T is TBD. The minimum unit for forming the UL DRU is a UL tile; the UL tile sizes are $6 \times N_{\text{sym}}$, where N_{sym} depends on the subframe type. 18×2 for UL transmit power optimized distributed allocation and other tile sizes are FFS.

11.6.1.2 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 LRU for localized allocations, i.e., P_{sc} subcarriers by N_{sym} OFDMA symbols.

11.6.2 Subchannelization and Resource mapping

11.6.2.1 Basic Symbol Structure

The subcarriers of an OFDMA symbol are partitioned into $N_{\text{g,left}}$ left guard subcarriers, $N_{\text{g,right}}$ 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.

11.6.2.2 Uplink Subcarrier to Resource Unit Mapping

The main features of resource mapping include:

- Support of localized resource unit (LLRU) and distributed resource unit (DRU) in an FDM manner.
- DRUs comprise multiple tiles which are spread across frequency partitions to get diversity gain.
- FFR can be applied in UL.

Based on the main design concepts above, the UL subcarriers to resource unit mapping process is defined as follows and illustrated in Figure 11.6.2.2-1:

1. First-level or outer permutation is applied to the PRUs in the units of N_1 and N_2 PRUs, where $N_1=4$ (TBD) and $N_2=1$ (TBD). Direct mapping of outer permutation can be supported.
2. Distributing (TBD) the reordered PRUs into frequency partitions.

3. The frequency partition is divided into localized (LLRU) and/or distributed (DRU) resources for each resource. Using sector specific permutation can be supported; directly mapping of the resources can be supported for localized resource. The sizes of the distributed/localized resources are flexibly configured per sector (TBD). Adjacent sectors do not need to have same configuration of localized and diversity resources.
4. The localized and distributed groups resources are further mapped into 1 LRUs. For the LLRU resources, the mapping is direct. For the DRU resources, an tile or hopping permutation is carried out for permuting or hopping the tiles of the distributed groups.

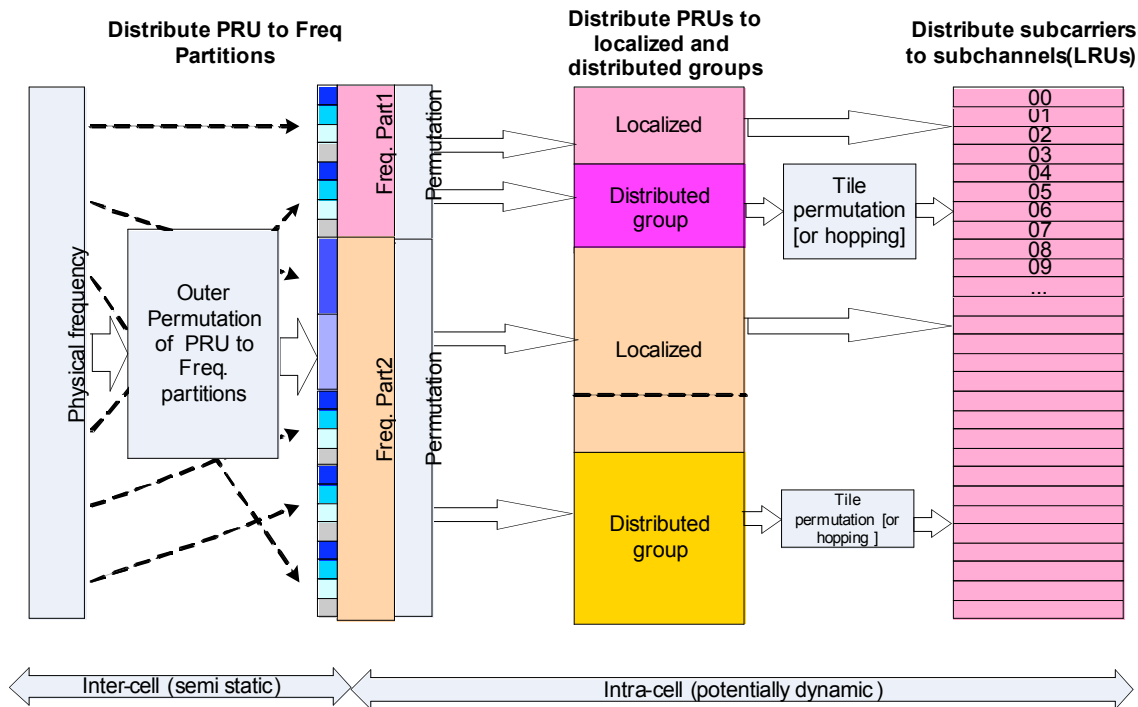


Figure 11.6.2.2-1

11.6.2.3 Subchannelization for UL Distributed Resource

A second-level permutation permutes PRUs within a frequency partition. The localized resource could be directly mapped. The tile permutation defined for the uplink distributed resource allocations spreads the tiles of the DRU across the whole allocated frequency band. The granularity of the inner permutation is equal to the minimum resource unit for forming a DRU as defined in Section 11.6.1.1.

Two kinds of distributed resource allocation are used for UL distributed subchannelization, (1) regular distributed allocation (2) UL transmit power optimized distributed allocation. The UL transmit power optimized distributed allocation will be allocated first. The rest of the frequency resource will be regular distributed allocation. A second level hopping/permutation sequence (TBD) is defined for the power optimized allocation that spreads the hopping units across frequency. The second-level or inner

permutation defined for the UL regular distributed resource allocations spreads the tiles of the DRU across the frequency band. The granularity of the inner permutation is equal to the tile size for forming a DRU according to section 11.6.1.1.

11.6.2.4 Subchannelization for UL Localized Resource

Localized subchannels contain subcarriers which are contiguous in frequency. There is no second-level or inner permutation defined for the UL localized resource allocations. The LLRU is directly mapped to localized LRU within each frequency partition. Precoding and/or boosting applied to the data subcarriers will also be applied to the pilot subcarriers.

Uplink LLRUs frequency allocations can match that of downlink LLRUs such that channel reciprocity traits can be exploited.

11.6.3 Pilot Structure

The transmission of pilot subcarriers in the uplink is necessary for enabling channel estimation, measurement of channel quality indicators such as SINR, frequency offset and timing offset estimation, etc. The uplink pilots will be dedicated to localized and distributed resource units and will be precoded using the same precoding with the data subcarriers of the resource allocation. The pilot structure is defined for up to 4 Tx streams with orthogonal patterns..

Pilot patterns shall have a mode which enables active interference suppression algorithms to be employed. This includes:

- Pilot locations fixed within each DRU and LRU
- Pilot sequences with low cross correlation

The pilot pattern may support variable pilot boosting. The boosting values are TBD.

11.6.4 Uplink Physical Structure for Legacy Support

The 802.16m uplink physical structure supports both FDM (frequency division multiplexing) and TDM (time division multiplexing) with the legacy system. When the legacy system operates in the PUSC mode, then the type of multiplexing is TBD. If the legacy system operates in the AMC mode, then the uplink resources for the legacy and the 802.16m system are multiplexed using FDM or TDM.