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Abstract	Corrects unclear definitions of mini-subchannels.
Purpose	Adopt changes.
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Corrections for definitions of mini-subchannels

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1. Motivation

Following comment #228, definition of mini-subchannels was changed from subdividing a group of subchannels to subdividing a grop of slots. however there are still several problems with the definition of mini-subchannels.

1. Mini-subchannels create "extended slots" (of M x 3 symbols). These slots may be unaligned between subchannels, and in this case it is not clear how the data should be mapped.
2. It is not clear how the mini-subchannels interact with the subcarrier rotation defined in 8.4.6.2.2 (eq 110). The rotation is defined over 48 subcarriers in a slot, but in the mini-subchannel there are less than 48 subcarriers. Theoretically the data could have been mapped to the extended slot (=M slots), and then rotated, but the rotation is defined over the physical subcarriers, and uses the index of the symbol.
3. In addition the subcarrier rotation function is not defined well.
4. The mapping of data to tiles is not clear, since regularly mapping is defined in frequency first order, which is also the logical number of the tiles. However, in mini-subchannels, the subchannel number changes because of rotation function, so the order is different between the M slots.

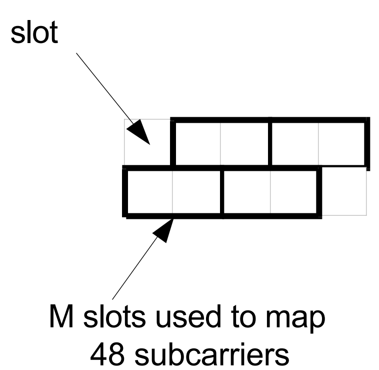
2. Details

2.1. Definition of slot

It is not clear what is a slot, when mini-subchannels are concerned. We suggest to keep the definition of slot as the physical unit (1 subchannel by 3 OFDMA symbols) and define "mini slot" as the portion of the slot allocated to a SS.

2.2. Slot alignment

The problem is that if the number of slots in the UL subframe isn't a whole multiple of M (level of mini-subchannel division), the "extended" slots created by mini-subchannels are not aligned:



In this case it is not clear where the first group of 48 subcarriers, the second group and so on, are mapped.

One simple way of solving this problem is to refrain from allocating more than one full subchannel for mini-subchannel allocations. The reason it that mini-subchannels are used for narrowing the allocation and gaining power (due to the low number of tones). When allocating more than a full subchannel then in the overlapping symbols there are twice as many tones, and the result is decrease in transmission power (per tone) of 3dB. The same result would occur if the BS allocates a normal transmission with half the number of slots instead of mini subchannel with M=2 (or in general case allocates mini-subchannels with M/2).

There is still a problem that the "extended slots" are wrapped around the end of the UL subframe. This can be resolved by allocating data to the mini-slots according to their physical time order (the same way frequency-first mapping is defined in the UL per C80216d-04_93r2)..

2.3. Subcarrier rotation

One way to define subcarrier rotation for mini-subchannels is to change Nsubcarriers in eq.(106) according to the number of available carriers in a mini-slot (48/M). However, the definition of this rotation is not clear even for the basic slots, since Nsubcarriers is not defined, and set to 24 in 8.4.6.2.3 (Uplink permutation example).

The reason for subcarrier rotation is to prevent duplication of the same data on different subchannels when using repetitions. The reasons for this are: (1) to increase frequency diversity (avoid placing the repeated data on the same tiles), (2) avoid PAPR increase. However the first issues is solved by UL rotation scheme, and the second by the subcarrier randomization (PRBS), so this rotation is redundant.

So the simplest solution, instead of correcting the definition of the subcarrier rotation, is simply to remove it.

2.4. Summary of proposed solution

- When using mini subchannels the allocation will not exceed one full subchannel, i.e. at most one slot will be allocated in each OFDMA symbol.
- The slots in the allocation shall be numbered in time-first order in the same order as the slots are allocated in the map.
- The number of slot modulu M is used as index to table 312, and determines which tiles are allocated to the SS.
- The tiles allocated to each SS shall be numbered in a frequency-first order beginning from the tile with the smallest symbol number and smallest frequency.
- The FEC, repetition and constellation mapping shall be applied to Duration/M slots (where duration is specified in the allocation).
- Then the subcarriers shall be mapped to the tiles in the frequency-first order defined above.
- Subcarrier rotation function will not be used for mini-subchannels.

3. Changes summary

8.4.6.2.4 Partition a subchannel to mini-subchannels
[Replace the paragraph in p.574 lines 45-52 (starting with "For example" and ending with "etc") with the following text]

When mini subchannels of order M are indicated in the map, the allocation shall be a multiple of M slots, and shall not exceed one full subchannel, i.e. at most one slot will be allocated in each OFDMA symbol.

Allocating tiles to mini-subchannels shall be done as follows:
The slots in the allocation shall be numbered in time-first order in the same order as the slots are allocated in the map. The number of slot modulu M is used as index to table 312, and determines which tiles are allocated to the SS.

Mapping data to mini-subchannels shall be done as follows:
The FEC, repetition and constellation mapping shall be applied as if the allocation was of duration/M slots (where duration is the number of slots specified in the map). The resulting data subcarriers shall be mapped to the data subcarriers in the tiles allocated to each SS in a frequency-first order beginning from the tile with the smallest symbol number and smallest frequency. The subcarrier rotation defined in eq.(110) (item (2) of section 8.4.6.2.2) shall not be applied to mini-subchannels.

4. References

http://ieee802.org/16/tgd/contrib/C80216d-04_69.pdf - Mini-subchannel support for OFDMA mode in IEEE 802.16d