Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	Limitations on the number of bursts per SS
Date Submitted	**2004-11-03**
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Re:	IEEE P802.16e/D5-2004
Abstract	Define limitations on the number of bursts per SS (concurrently, or in the zone/frame), required to reduce costs and power of the MSS.
Purpose	Adopt changes.
Notice	
Release	
Patent Policy and Procedures	

Limitations on the number of bursts per SS

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1. Motivation

The definitions of OFDMA PHY in 802.16 do not limit the number of bursts that are transmitted simultaneously on several subchannels and need to be concurrently processed by a single SS, nor on total bursts directed to one SS in a frame. The theoretical limit on concurrency is the number of subchannels which is 192 in the extreme case (AMC 1x6 in 2K mode).

This requirement incurs extensive processing and memory requirements at the MSS side. However such high level of concurrency and use of multiple bursts per MSS is not required for system operation. We propose to limit the level of concurrency and the number of bursts per MSS in order to enable cost effective and power efficient MSS implementation.

2. Details

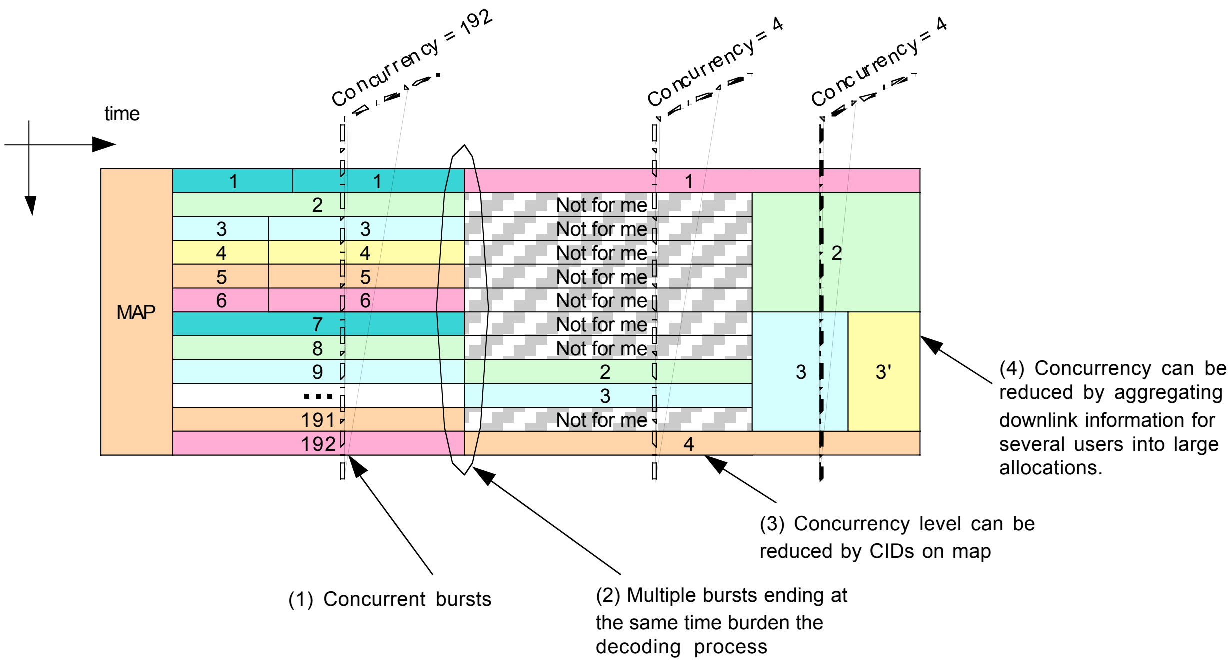
2.1. Implementation effects of concurrency and multiple bursts per SS

Concurrent bursts are bursts that share the same DL symbol.

Concurrent bursts affect the MSS in the following aspects:

- Memory requirements.
  The minimum requirement (without taking into account FEC decoding rate) is to buffer 960 metrics (maximal FEC block size) per concurrent burst (on each burst one FEC block may be incomplete and should be stored until last subcarriers arrive). This results in 184K metrics in extreme case (192 subchannels) and 57K for PUSC (60 subchannels).
- Processing delay
  The delay is proportional to the number of concurrent bursts. The delay is incurred when all last FEC blocks end at the same time.
- Peak power.
  When all FEC blocks end at the same time, a peak in processing is caused.

In addition decoding multiple bursts per frame requires extensive processing and complicates control.



2.2. System requirement

Following we analyze the incentive to map multiple or concurrent bursts to one MSS and how many bursts are needed.

2.2.1. Reasons to create concurrency between bursts

- Boosting – each burst can transmitted in different boosting so that their power averages. This way the BS can improve utilization of its power amplifier. There are 8 boosting levels.
- AAS – there is an advantage to transmitting several beams in parallel to several directions instead of directing all power in one direction and increasing interference in adjacent cells.
- Different burst profiles – in principle there is no reason to mix burst profiles in the same symbol, however there would probably be some linkage between burst profiles and boosting levels.

2.2.2. Reasons for multiple bursts for one user

<u>Saving CID overhead in the map</u>

- By default CIDs do not appear in the map. This feature is intended to save map overhead.
- When CIDs don't appear in the map all users are required to decode all bursts.
- However, when there are no CIDs on map, it makes sense to aggregate all PDU with the same physical parameters (burst profile, boosting, etc) to one burst (even if belonging to different SS).
- So the maximum number of bursts required in this approach is about 13 (number of DIUCs) + 2-3 for repetition and boosting (assuming boosting goes with burst profile except for QPSK, and repetition is used only for QPSK).

<u>Multiple CIDs of the SS.</u>

- A different policy is allocating bursts per SS-es. In this approach the overhead of putting CIDs on the map is smaller (1 CID per map IE).
- When there are CIDs on the map, each SS decodes only bursts belonging to it.
- However, concurrency can still occur because of different CIDs (of same SS).
- Unicast CIDs can be concatenated, so multiple bursts will be required only when using broadcast/multicast in addition to unicast (total 2-3 bursts per SS).

Scheduling

- Two dimensional scheduling constraints may produce multiple bursts per user (to fill gaps).

2.3. Number of DL zones required

Downlink zones can change permutation and enable special features:

- Permutation zones: PUSC, FUSC, AMC, O-FUSC
- Special features: AAS, STC, MIMO

It seems unlikely that a system will use all permutations in all AAS/STC/MIMO zones in one frame. A practical system can use 2 permutations and 2 special features thus there are 4 downlink zones.

2.4. Proposed limitation

In order not to over limit the BS design we suggest to define maximum of 6 zones (about twice of what is required), and maximum of 16 bursts in each zone per SS.

3. Changes summary

[Apply changes to 802.16e/D5 to make the following changes to the baseline document]:

8.4.4.2 PMP frame structure
[Add the following text after figure 219 (802.16REVd/D5, p.502)]
The following restrictions apply to downlink allocations:
(a) The maximum number of downlink zones is 8.
(b) For each SS, the maximum number of bursts to decode in one downlink subframe is 64. This includes all bursts without CID or with CIDs matching the SS's CIDs.
(c) For each SS, the maximum number of bursts transmitted concurrently and directed to the SS is limited to 16 (including all bursts without CID or with CIDs matching the SS's CIDs). Bursts transmitted concurrently are bursts that share the same OFDMA symbol. Note that concurrency pertains to the symbols allocated in the DL-MAP, therefore when STC/MIMO is applied the definition of concurrency pertains to OFDMA symbols *before* STC/MIMO encoding.
If the BS allocates more bursts or zones, then the SS is required to decode the first bursts/zones until the limit is reached.