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Interference Nulling in AAS

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Suppose there is a cell using 802.16 technology based on OFDM modulation with capability of beamforming (Advanced Antenna System or AAS) at Base Station (BS). Downlink (DL) transmissions of the cell may cause interference to DL transmissions in close cells using same technology and operating at same frequency channel.

BS may decide to decrease interference by adjusting transmission power and/or AAS beamforming. The problem is to provide the BS with information on:

- Timing of DL transmission in neighbor cells
- Estimation of path loss between the BS and subscriber stations (SSs) to which the transmissions are addressed
- Location of above SSs

1. Assumptions

The following are the assumptions:

- All cells operate at TDD with synchronized DL and uplink (UL) sub-frames

2. Solution

DLFP DL Information Elements (DL IEs) specify location, modulation etc. of DL bursts. Figure 1 shows example of DLFP (FCH) relevance

![Figure 1. Correspondence between AI TOs and DL allocations](image-url)
1. DL allocations must be unicast, meaning that unicast CID are used in DL-MAP IEs. Then SS, after completion of DLFP (or DL-MAP) Rx has already information on future DL transmissions to the SS. 
   **Note**: To support this in DLFP, CID must be additionally included into DL IE. Then only one DL IE may be placed in DLFP.

2. BS shall allocate *Allocation Indication Zone* (AI Zone) starting at the beginning of the following UL sub-frame (see Figure 1). This zone is intended for AI signals to be transmitted by SSs.

3. AI Zone is divided into AI transmission opportunities (TOs). Each transmission opportunity is specified as certain number N of consequent subcarriers over M symbol duration intervals. The TOs are numbered in the order “subcarriers first”. Such order provides for 1-1 correspondence between TOs and DL allocations, so implicitly each TOs is allocated to certain SS (see Figure 1 where AI TOs are allocated to SSs #2, #3 and #6 and so are DL allocations).

4. Number of TOs in AI zone must be sufficient for maximum expected number of subsequent DL allocations.

5. If an SS receives a DL allocation, it transmits in the correspondent TO a subchannelized preamble or other well known waveform as e.g. focused contention, signal (with different combinations contention channel / code in each cell)

6. BS listens at AI TOs and thus collects AI information on future DL transmissions of SSs in neighbor cells, including their location, distance, path loss, transmit power. This information may be used later in DL beamforming to null interference for those SSs.

7. Some or all TOs might be allocated to signals from neighbor SSs that request interference nulling for long time rather than for specific time interval

3. **References**