Proposal for IEEE 802.16m Fractional Frequency Reuse

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*<http://standards.ieee.org/faqs/affiliationFAQ.html>

Re: IEEE 802.16m-08/024 – Call for Contributions on Project 802.16m System Description Document (SDD), on the topic of "Interference Mitigation"

Purpose: Adopt the proposal into the IEEE 802.16m System Description Document

Scope

- This contribution proposes an adaptive fractional frequency reuse scheme for IEEE 802.16m
- This contribution focuses primarily on the DL. However, the same techniques can apply to the UL. The UL case is discussed in more detail in the contribution on UL power control (see C802.16m-08/613).

IEEE 802.16m System Requirements

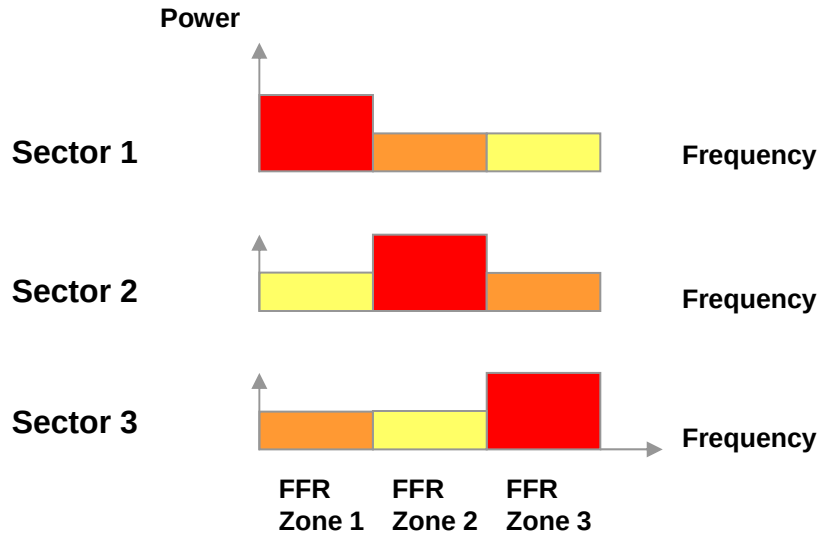
- The TGm SRD (IEEE 802.16m-07/002r4) specifies the following requirements:
  - Provide support for FFR (A.2.2)
- The proposed scheme is an adaptive FFR scheme.

Overview of FFR (1/2)

- Fractional frequency reuse (FFR) can be used to improve the coverage for cell edge mobiles.
- In FFR, the bandwidth is divided into multiple zones where each sector defines some high power zones and some power restricted zones.
- A coverage gain can be obtained when neighbouring sectors define non-overlapping high power zones.
- The zones are logical zones that can consist of tones that are either contiguous (localized zones) or non-contiguous (distributed zones).
- The channel condition for a cell edge interference limited mobile improves on the high power zone as neighbouring sectors reduce the power on the power restricted zones.
- In order to obtain an accurate estimate of the channel on each zone, each sector must define each zone using the same tones.
- The hopping pattern for the diversity channels in each zone should use a different hopping pattern in order to obtain interference diversity.

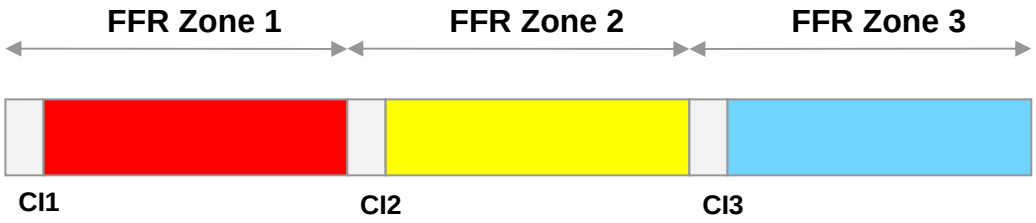
Overview of FFR (2/2)

- An example of how the high power and low power (power restricted) zones can be defined is illustrated in the figure below.
- If there are three sectors per cell, each sector can divided the bandwidth into 3 zones where one zone is a high power zone and the other zones are power restricted.



Control Channel Overview

- Each FFR zones has its own control channel.
- The control channel consists of a multicast control segment, which contains a combination index. The combination index indicates how the resources within the zone are partitioned (see contribution C80216m-08/176).
- Each partition within the FFR zone contains the unicast control segment, which is located at the beginning of the partition.
- A cell edge mobile can be instructed to only decode the control information in the high power FFR zone in order to decrease the number of blind decoding attempts.
- Cell centre mobiles can try to decode the control information in each FFR zone.



Adaptive FFR

- The transmit power level on the power restricted FFR zones can be adapted.
- The power level can be controlled based on feedback from the mobiles.
  - The mobiles feedback the C/I for each FFR zone.
  - The mobiles can also feedback an interference indicator that represents the amount of interference caused to the MS.
- The mobiles determine which BSs are the strongest interferers by measuring the signal strength of the preamble.
  - This information is reported to the serving sector.
- Backhaul communication is used to slowly adapt the maximum transmit power levels for the different FFR zones.
  - Each sector sends a power level adjustment indicator to a neighbour list
  - The neighbour list is determined from the active set of the cell edge mobiles that have a coverage problem.
  - The BS can decide to send power level adjustments to neighbouring BSs based on the number of cell edge mobiles that have a coverage problem.

Adaptive FFR Operation

- Once the FFR zones are configured, the mobiles feedback the C/I for each FFR zone and the interference measured on the high power FFR zone.
- The interference indicator indicates how much interference is caused to the mobile.
  - The interference indicator can be determined based on the average interference measured on each FFR zone.
- A dedicated feedback channel is required to signal the interference indicator and the C/I for each FFR zone.
  - This information is sent to the serving BS.
- The BS receives a number of interference indicators from different mobiles.
  - If the number of mobiles that report a given interference level exceeds a threshold, the BS can instruct the interfering BSs to reduce the transmit power on the corresponding FFR zone.

Summary

- The proposed adaptive FFR scheme satisfies the requirements of the TGm SRD.
- Backhaul communication is used to slowly adapt of the transmit power level on different FFR zones.
- The scheme can be used to improve cell edge coverage.
- The transmit power in neighbouring BSs is only reduced when there is a coverage problem.

Proposed Text for SDD

- Section 11.x Interference Mitigation
  - [*Add content of slides 4 and 5 to this section*]
- Section 11.x.1 Adaptive Fractional Frequency Reuse
  - [*Add figure on slides 6 and 7 to this section*]
- Section 11.x.2 Adaptive FFR Operation
  - [*Add content on slide 8 to this section*]