Proposal For Requirement that RS Transmit Preamble

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Purpose:
This contribution is submitted in response to the call for contributions for technical requirements. The purpose of this contribution is to present the arguments for requiring that RSs transmit preambles.

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Overview

• There have been contributions that propose the following scheme:
  – MMR-BS broadcasts preamble, FCH, DL-MAP, UL-MAP, UCD and DCD. (MS receives preamble from MMR-BS)
  – RS does not transmit preamble or broadcast data.
  – Unicast data is relayed by the RS (MS receives unicast data from RS)

• We have the following concerns regarding this scheme:
  – It is not strictly backwards compatible, i.e. it will not work with all 802.16e-2005 compliant MSs.
  – This usage will lead to decreased system capacity.
Backwards Compatibility

• The 802.16e-2005 spec does not specify that the preamble cannot be used for channel estimation.
• The 802.16e-2005 spec does not specify that MSs must support high speed mobility.
• Standards compliant implementations can use the preamble for:
  – Channel estimation mechanism;
  – Link adaptation mechanism;
• A standards compliant implementation that achieves a given level of performance in an 802.16e network (and uses the preamble for channel estimation) will perform significantly worse in an 802.16j network when the RS does not transmit a preamble.
System Capacity Limitations

- Pilot distribution in the downlink is not designed for multiple transmitters in a symbol.
- Larger cyclic prefix (CP) will need to be used to cover time synchronization errors.
Downlink Pilot distribution mechanism

- Downlink pilots are allocated before subchannels are allocated from remaining available subcarriers.
- No mechanism to separate pilots during simultaneous MMR-BS/RS transmissions so that
  - MMR-BS transmits some pilots;
  - RS transmits other pilots.
- No mechanism to associate pilots with subchannels.
- One option is to have all MMR-BSs and RSs transmit in complete symbols at different times in TDM fashion:
  - This is inefficient – system capacity will decrease
- Another option is to have multiple RSs transmit pilots simultaneously:
  - This will create interference depending how far apart the RSs are!
  - MS/SS cannot be changed and won’t be able to distinguish one set of pilots from the other.
Cyclic Prefix Length

• In current systems CP is designed to cover maximum multi-path delay spread.
• When RS does not transmit preamble, the MS synchronizes with the MMR-BS and is unaware of the RS.
• Distance to the RS is different, so a timing error is introduced.
• This error is in addition to the multi-path delay spread, so the length of the CP will have to be increased to cover both delay spread and the additional timing error.
• CP length of 1/8 is commonly used. Going to ¼ results in a large drop in capacity.
Recommendation

- We recommend that the RS be required to transmit a preamble when it participates in downlink data transmissions.
  - In the case of macro-STC or macro-diversity handover, whether RS transmits preamble should be controlled by the MMR-BS