Comment to C80216j-06_057 Proposal for Requirement that RS Transmits Preamble

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None.

Purpose:

This contribution is to clarify M4 requirement (MS backward compatibility) of IEEE 802.16j-06_016 w.r.t. preamble & midamble, plus recommends modifications to TR. The analysis applies to the access link only (the preambles & maps seen by MS).

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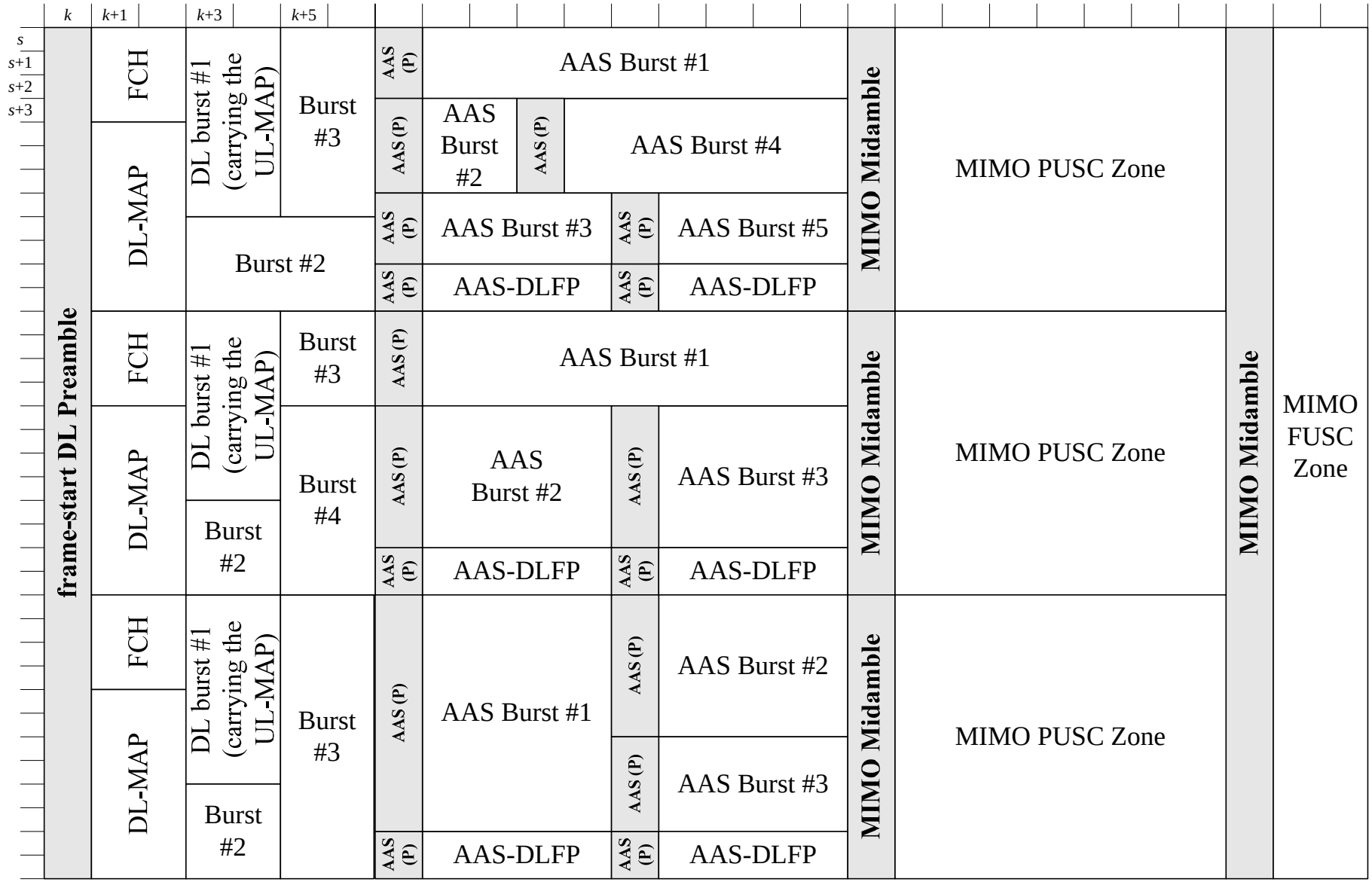
Outline

1. Preamble usage defined in 802.16 specifications
2. Frequency reuse scenarios
3. MS Operational Effectiveness in Presence of RS
4. Comparison analysis in different usage models
5. Recommended modifications to TR

Preamble Usage Defined in 802.16 Specifications

1. Frame-start DL Preamble
   (In 802.16-2004/16e-2005 page 552/513)
2. AAS Preamble
   (In 802.16e-2005 page 367)
3. MIMO Midamble
   (In 802.16e-2005 page 599)

Preamble Definition



Frequency Reuse Scenarios

1. SFSS - BS and RS operate at "**same** *center carrier frequency*" and "**same** *segment*"
2. SFDS - BS and RS operate at "**same** *center carrier frequency*" but "**different** *segment*"
3. DF - BS and RS operate at "**different** *center carrier frequency*"

Scope Of Discussion - 1

1. In cases of SFDS or DF, transmitting frame-start DL preamble should be **mandatory** for the RS, and transmitting midamble by RS should follow 802.16 specifications defined for BS in SFSS
   - RS is the only source for transmitting frame-start DL preamble and midamble
2. In the case of SFSS, transmitting preamble & midamble may be **optional** for the RS

Scope Of Discussion - 2

1. With regards to AAS Preamble and MIMO Midamble, transmitting preamble or midamble by RS should follow 802.16 specifications defined for BS in SFSS
   - RS is the only source for transmitting preamble or midamble due to spatial diversity
2. With regards to Frame-start DL Preamble, transmitting preamble may be **optional** for the RS in SFSS

The Purposes of Frame-start DL Preamble for MS

1. Cell search & frame boundary detection
2. Cell ID & segment identification
3. Frequency/timing offset compensation
4. Channel estimation
5. Channel quality measurement (CINR)

The Analysis of RS Transmitting Frame-start DL Preamble

Tx frame-start DL preamble	Tx FCH	Comment
N	N	
Y	Y	
Y	N	Not recommended*1
N	Y	Not recommended*1

***1: the preamble and FCH could be in different channel conditions**

RS shall be required to either transmit the frame-start DL preamble plus FCH, or transmit none

Relay Station Modes

- SFSS (Same Frequency Same Segment)
  - **Mode I -** RS doesn't Tx frame-start DL preamble and FCH
  - **Mode II -** RS Tx the frame-start DL preamble and FCH
- SFDS or DF (Same Frequency Different Segment or Different Frequency)
  - **Mode III -** RS Tx frame-start DL preamble and FCH

MS Operational Effectiveness in Presence of RS

RS Mode / Effectiveness to BS		Mode I	Mode II	Mode III
BS cell search & BS frame boundary detection @ MS		Same	Conditional*3	Same
BS cell ID & BS segment identification @ MS		Same	Same	Same
DL frequency/timing offset compensation @ MS		Same	Conditional*3	Same
DL channel estimation @ MS	Only by pilots in its burst	Same	Same	Same
	Also by preamble and/or pilots in other bursts	Possibly Negative*1	Possibly Negative*2	Same
Channel quality measurement @MS (CINR accuracy of BS preamble)		Same	Possibly Negative*3	Same

Same: No change w.r.t. MS operational effectiveness
Conditional: Could be positive, same or negative depending on the operating environment, e.g., whether it is in range extension model or throughput enhancement model, whether the RS signal received by the MS is much stronger than the BS signal, whether the RNG-RSP (ranging response) message can be used effectively, etc
***1: depend on sources of bursts included in the channel estimation algorithm**
***2: due to channel estimation algorithm**
***3: MS may receive multi-path or co-channel interference signals from BS & RS**

MS Operational Effectiveness in Presence of RS

Effectiveness to RS \ RS Mode		Mode I	Mode II	Mode III
RS cell search & RS frame boundary detection @ MS		N/A	Conditional*3	Same
RS cell ID & RS segment identification @ MS		N/A	Conditional*4	Same
DL frequency/timing offset compensation @ MS		Conditional*1	Conditional*3	Same
DL channel estimation @ MS	Only by pilots in its burst	Same	Same	Same
	Also by preamble and/or pilots in other bursts	Possibly Negative*2	Possibly Negative*2	Same
Channel quality measurement @MS (CINR accuracy of RS preamble)		N/A	Possibly Negative*3	Same

Same: No change w.r.t. MS operational effectiveness
Conditional: Could be positive, same or negative depending on the operating environment, e.g., whether it is in range extension model or throughput enhancement model, whether the RS signal received by the MS is much stronger than the BS signal, whether the RNG-RSP (ranging response) message can be used effectively, etc
***1: time synchronization problem between BS & RS, Doppler shift**
***2: due to channel estimation algorithm and sources of bursts included in the algorithm**
***3: MS may receive multi-path or co-channel interference signals from BS & RS**
***4: N/A when RS transmits the same preamble as BS, otherwise, the same**

Comparison Analysis in Different Usage Models

1. In pure ranging extension usage model
2. In pure throughput enhancement usage model
3. In mixed usage model

Pure Ranging Extension

- In a RS coverage, MS cannot detect frame-start DL preamble from BS; or MS can detect frame-start DL preamble from BS but cannot correctly decode FCH from BS
- Mode I RS cannot work in this case

Pure Throughput Enhancement

- In a RS coverage, MS can correctly decode FCH from BS
- Mode I, II, and III RS could be used in this case

Mixed Usage Model

- In a RS coverage, some MSs are operating in pure ranging extension while some MSs are operating in pure throughput enhancement
- Mode I RS may not work in this case

Recommended Modifications to TR

M4	PHY frame structure for backward compatibility with legacy 16 mobile station	The specification shall define a backward compatible frame structure that supports relay links while accommodating the legacy access links.	MMR-BS (M) RS (M)	

Add the following text

- RS shall be required to either transmit the frame-start DL preamble and FCH, or transmit none
- Transmitting AAS Preamble and MIMO Midamble by RS should follow 802.16e-2005 defined for BS

Issues for Further Discussion During Technical Proposal Phase

1. We recommend RS be required to transmit the frame-start DL preamble when it operates with BS at “same frequency, different segment” or “different frequency”

2. In pure range extension usage model, we recommend that the RS be required to transmit the frame-start DL preamble