Proposed Frame Structure and Relay Region Indicator

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Purpose:
The purpose of this slide is to support proposed frame structure and relay region indicator.

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Proposed Frame Structure and Relay Region Indicator:
#06/256, #06/257, #06/258, #06/260, #06/263

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Outline

• Introduction
• Frame Structure for 2-hop relay
• Frame Structure for Multi-hop relay
• Frame Structure for out of band relay
• Initial relay region indicator
• Flexible relay region
• Summary
Introduction

- The frame structure for 2-hop and multi-hop relay are:
  - Simple extension of 802.16e frame structure
  - Minimize the number of transition gap
  - Dynamic change of access/relay region
  - Support various Resource Allocation
  - Support Mobile RS handover
  - Easy extension to multi-hop relay

- The frame structure for out of band
  - Reuse of 802.16e frame

- Initial Relay Region indicator
  - STC_DL_ZONE_IE

- Flexibility of Relay Region
  - R-FCH
Terminology

**MMR-BS Frame**: Frame structure for transmission/reception by BS

**RS-Frame**: Frame structure for transmission/reception by RS

**Access Region**: This is the region in the DL/UL subframe of the MMR-BS frame and RS frame for communicating to/from MS

**Relay Region**: This is the region in the DL/UL subframe of the MMR-BS frame and RS frame for communicating between BS and RS, RS and RS.

**RSTG**: Relay Subframe Time Gap

**RFTG**: Relay Frame Time Gap

**R-TTG**: Relay-TTG

**R-RTG**: Relay-RTG

**R-FCH**: Relay-FCH

**R-DL-MAP**: A MAC message that defines burst start times for both time division multiplexing and time division multiple access (TDMA) by a relay station on the downlink

**R-UL-MAP**: A set of information that defines the entire access for a scheduling interval for a relay link

**Odd-hop RS**: When the number of hop between MMR-BS and RS is odd, then RS is called odd-hop RS

**Even-hop RS**: When the number of hop between MMR-BS and RS is even, then RS is called even-hop RS
Frame structure for 2-Hop Relay
#06/256
<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Access link and One Relay link in a frame</td>
<td>♦ Minimize transition gap overhead</td>
</tr>
<tr>
<td>Access link is followed by Relay link</td>
<td>RS to MS link (access region) comes first in the DL/UL subframe</td>
</tr>
<tr>
<td></td>
<td>♦ MS backward compatibility</td>
</tr>
<tr>
<td>Flexibility in division of Access and Relay regions</td>
<td>Increase in resource utilization</td>
</tr>
<tr>
<td>Preamble for BS/RS to MS</td>
<td>(RS to MS link): amble transmission at the beginning of frame</td>
</tr>
<tr>
<td></td>
<td>♦ MS backward compatibility</td>
</tr>
<tr>
<td>Postamble for BS/RS to RS</td>
<td>(MMRBS/RS to RS link): amble transmission at the end of relay region : relay link synchronization</td>
</tr>
<tr>
<td></td>
<td>♦ fixed amble location</td>
</tr>
<tr>
<td>Coexistence of .16e system and .16j system</td>
<td></td>
</tr>
</tbody>
</table>
Operation of MMR-BS/RS Frame

- **Operation in the relay region of DL/UL subframe**

  - **MMR-BS Frame**
    - BS → MS1 (Tx.)
    - BS → RS1 (Tx.)
    - MS1 → BS (Rx.)
    - RS1 → BS (Rx.)

  - **RS Frame**
    - RS1 → MS2 (Tx.)
    - BS → RS1 (Rx.)
    - MS2 → RS1 (Rx.)
    - RS1 → BS (Tx.)

  - **Subframes:**
    - DL subframe
    - UL subframe

- **Regions:**
  - DL Access Region
  - DL Relay Region
  - UL Access Region
  - UL Relay Region
MMR-BS/RS Frame

RS performs initial network entry in the access region of the MMR-BS frame as an MS does:

After completion of initial network entry, RS communicates with MMR-BS in the relay region:
Transition Gap

- Transition Gap is needed at RS’s frame
  - Due to TX/RX switching time and round trip delay
  - 1 symbol gap is enough
- To reduce overhead due to the transition gap, the number of TX/RX switching should be minimized
Implementation #1: PUSC with all subchannels

- Maximize radio resource with utilizing all subchannels
MMR-BS and RS Frame
Implementation #2: PUSC with segmentation

- Avoid interference with frequency division manner
MMR-BS and RS Frame Implementation #3: time scheduling

- Avoid interference with time scheduling (time division manner)
Frame structure for multi-hop relay
#06/257
## Design Summary

- Easy extension of 2-hop relay frame structure

<table>
<thead>
<tr>
<th>2-frame unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>- which allows fat pipe both for relay and access region in DL/UL subframe</td>
</tr>
<tr>
<td>- Support coexistence of .16e system and .16j system</td>
</tr>
<tr>
<td>- Support (DL subframe:UL subframe)=(1:1),…,(2,1),…,(3:1)</td>
</tr>
<tr>
<td>- Support MS to RS link with minimum throughput requirement</td>
</tr>
<tr>
<td>- Minimize the number of transition gap</td>
</tr>
<tr>
<td>- Relax burden for fast processing to relay within 1 frame</td>
</tr>
</tbody>
</table>
Operation of MMR-BS/RS frame

Operation of multi-hop relay frame in 2-frame unit
MMR-BS/RS frame

- **jth MMR_BS frame**
  - DL subframe
    - Preamble
    - DL burst #1
    - DL burst #2
    - DL burst #3
    - DL burst #4
    - DL burst #6
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **j+1th MMR_BS frame**
  - DL subframe
    - Preamble
    - DL burst #1
    - DL burst #2
    - DL burst #3
    - DL burst #4
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **jth Odd hop RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **j+1th Odd hop RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **jth Even hop RS frame**
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **j+1th Even hop RS frame**
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **jth last hop (odd) RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **j+1th last hop (odd) RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **jth last hop (even) RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3

- **j+1th last hop (even) RS frame**
  - Rx.
  - Data region
  - UL subframe
    - UL burst #1
    - UL burst #2
    - UL burst #3
Implementation: time scheduling

- Avoid interference with time scheduling (time division manner)
Benefit of Postamble over Midamble

-For Dynamic change of relay region-

- Avoid Interference from boosted power (amble) to data
- Reliable CINR measurement
- Easy for quick cell search at mobile RS
- Easy for periodic channel measurement of neighbor at fixed RS
Frame structure for out of band relay
#06/258
Frame Structure for out of band

- 16e frame structure can be reused for out of band
Initial Relay Region
Indicator
#06/260
Initial Relay Region Indicator

After completing its initial network entry in access region,

- **DL relay region**: ‘STC_DL_ZONE_IE’ indicates DL relay region
- **UL relay region**: R-ULMAP assigns ‘allocation start time’ and ‘No. OFDMA symbols’
Flexibility of Relay Region
#06/263
Flexibility of Relay Region

Time resources of access region and relay region may be changed.

- DL relay region: R-FCH indicates ‘offset’ of the starting point of DL relay region
- UL relay region: R-ULMAP assigns ‘allocation start time’ and ‘No. OFDMA symbols’

**Diagram: MMR-BS Frame**

- (n)th frame
- (n+1)th frame
Summary

- Frame Structure for 2-hop
  - Access region precedes relay region
  - Fixed amble location (relay link)

- Frame Structure for multi-hop
  - Easy extension of 2-hop relay frame
  - 2-frame unit

- Frame Structure for out of band
  - Reuse of .16e frame structure

- Initial Relay Region Indicator
  - STC_DL_ZONE_IE

- Flexibility of Relay Region
  - R-FCH