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Re:	Call for technical proposals regarding IEEE project P802.16j
Abstract	This contribution proposes two frame structures for 2-hop relay, i.e., MMR-BS frame and RS frame. To support access link and relay link, DL/UL subframes in the BS/RS frame are further subdivided into two time regions. For MS transparency, the access region precedes the relay region in the DL/UL subframe.
Purpose	Discussion and Adoption in IEEE 802.16j
Notice	
Release	
Patent Policy and Procedures	

Frame Structure for 2-hop relay

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1. Introduction

This contribution proposes the frame structures, one for MMR-BS frame and another for RS frame for 2-hop relay. To support both access link and relay link in time division, each 802.16e DL/UL subframe is further splitted into two time regions. The first time region in each DL/UL subframe is placed for the access link, while the second time region is used for the relay link in each DL/UL subframe. For the access link synchronization channel, preamble is placed at the start of the first time region in the DL subframe, while postamble is inserted at the end of the second time region in the DL subframe for the relay link synchronization channel.

2. Design Consideration

Frame structure for 2-hop relay may be designed based on the following design criterion:

1. In the DL/UL subframe, access region for the access link precedes relay region for relay link
2. MMR-BS and RS transmit preamble at identical OFDMA symbol location for MS backward compatibility
3. Broadcast information such as FCH, DL/UL MAP is followed by data traffic for access link and relay link
4. To support mobile RS handover, amble is placed at fixed OFDMA symbol location

3. Proposed Solution

To enable a relay station (RS) while maintaining mobile station (MS) backward compatibility, the frame structure needs to be defined such that both access link and relay link are supported. If proposed frame structure supports both access link and relay link in a time division manner, DL/UL subframe defined in 8.4.4.2 may be further subdivided by two time regions. RS plays a role of BS for the access link, while RS is a simply MS for the relay link. Hence, MMR-BS frame and RS frame should be defined interactively in the time domain.

For MS backward compatibility, DL subframe in the proposed MMR-BS frame and RS frame need to have the first time region for the access link, denoted as access region, and the second time region for the relay link, denoted as relay region. Furthermore, MMR-BS frame and RS frame shall have synchronous transmission to guarantee MS backward compatibility. In the access region in the DL subframe, broadcast information such as FCH, DL/UL MAP is followed by data traffic. For consistency, DL subframe in the RS frame may be designed

such that broadcast information such as FCH, DL/UL MAP is followed by data traffic.

In the two time regions of DL/UL subframe in the RS frame, when RS need to change its mode (Tx to Rx or Rx to Tx), RS frame shall require guard time for transition. For this reason, guard time shall be inserted between two time regions of DL/UL subframe in the RS frame. The guard time between access region and relay region in DL subframe shall be R-TTG. The guard time between access region and relay region in the UL subframe shall be R-RTG.. The guard time between DL subframe and UL subframe shall be RSTF. The guard time between two consecutive frames shall be RFTG.

For access link synchronization channel, preamble shall be placed at the start of the first time region in the DL subframe. Synchronization channel for the relay link may be placed at any symbol location in the relay region of the DL subframe. However, to support mobile RS handover, symbol for the relay link synchronization should be placed at fixed OFDMA symbol location, which is identical through all MMR-BSs' frame and RSs' frame. If the Relay region in each MMR-BS and RS is allowed to be flexible, the symbol location for the synchronization should be independent of the flexible change of the relay region. By noting that the ratio of the DL subframe length to UL subframe length is identical through all MMR-BSs' frame and RS frame, synchronization symbol may be placed at the end of the relay region in the DL subframe. Thus, MMR-BS and all RSs frame may have synchronization channel at identical symbol location, regardless of the flexible change of the relay region. Hence, postamble may be inserted at the end of the second time region in the DL subframe for relay link synchronization channel. Note also that the flexible change of the Relay region may be initially indicated by using reserved bit in the STC_DL_Zone_IE. Later, to change the relay region, reserved bits in FCH may be used to indicate the starting OFDMA symbol time of the relay region.

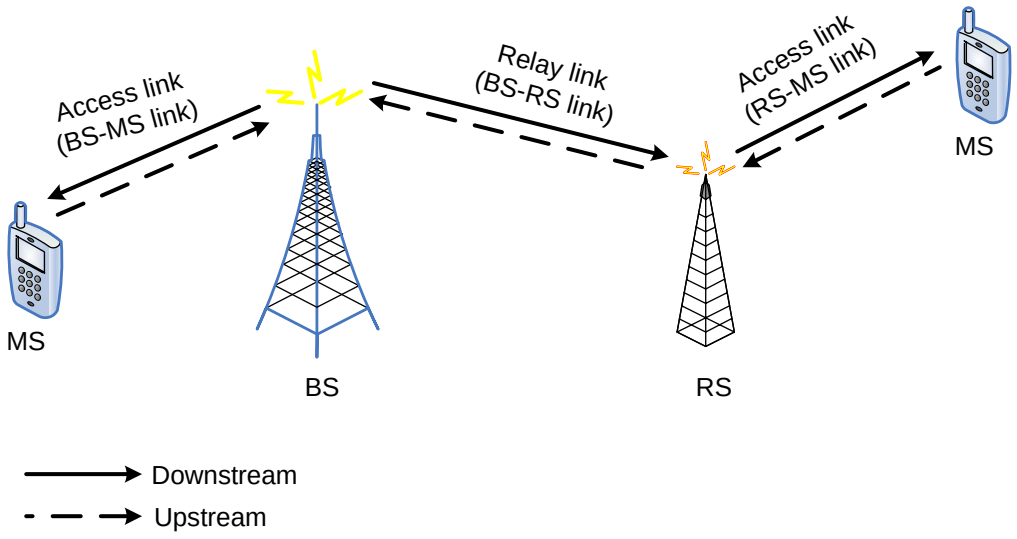

Figure 1 Access link and Relay link

4. Proposed Text Change

[Insert the followings after the end of section 3.88:]

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 devision multiplex 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

[Insert the followings after the end of 8.4.4.8:]
On initialization, RS performs initial network entry with MMR-BS in the same way that an MS does. In the beginning, RS detects a preamble in the MMR-BS frame and establishes synchronization with the MMR-BS. RS continues with the remaining initial entry network procedures in the access region of the MMR-BS frame. After completion of the initial network entry, RS communicates with MMR-BS in the relay region of the MMR-BS frame.

8.4.4.8.1 PMP frame structure for 2-hop relay

The MMR-BS frames and RS frame, designed for supporting 2-hop relay network, are based on the DL/UL subframe structures. Each subframe, i.e. the DL and the UL subframe, in the MMR-BS and the RS frames are split in to two time regions, i.e., access region and relay region. In the MMR-BS and RS frame structures, the relay region always follows the access region. The access region and the relay region can further contain multiple zones (e.g. PUSC, FUSC, PUSC with all subchannels, AMC, TUSC1, and TUSC2) as described in Section 8.4.4.2.
The access region in the DL subframe of the MMR-BS frame begins with a preamble and is followed by a downlink transmission period for the access link. On the other hand, the relay region in the MMR-BS frame

begins with a downlink transmission period for the relay link and may end with a postamble, which also marks the end of the DL subframe. In each frame, RS may be allowed to receive the postamble. The access region in the UL subframe of the MMR-BS frame is dedicated to receiving on the access link. Likewise, the relay region in the UL subframe of the MMR-BS frame is dedicated to receiving on the relay link. In each MMR-BS frame, the TTG and RTG shall be inserted between the DL and UL subframes and at the end of each MMR-BS frame, respectively, to allow the MMR-BS to turn around.

The access region in the DL subframe of the RS frame begins with a preamble and is followed by a downlink transmission for the access link. The relay region in the DL subframe of the RS frame, however, is dedicated to be receiving on the relay link. R-TTG shall be inserted between the access region and the relay region in the DL subframe to allow RS to turn around. RS shall complete its mode change from Tx to Rx earlier than R-RTD/2 after MMR-BS begins its transmission for RS.

The access region in the UL subframe of the RS frame is dedicated to receiving on the access link, while the relay region in the UL subframe of the RS frame is dedicated to transmitting on the relay link. R-RTG shall be inserted between the access region and relay region in the UL subframe to allow RS to turn around. RS shall complete its mode change from Rx to Tx earlier than R-RTD/2 before MMR-BS begins its reception mode for RS. In each RS frame, RSTG shall be inserted between the DL subframe and UL subframe and RFTG shall be inserted between two consecutive RS frames.

In the access region, subchannel allocation, FCH transmission, and the FCH contents are the same as Section 8.4.4.2. In the relay region, the subchannel allocation may be same as that in the access region. Similarly, R-FCH transmission and the R-FCH contents may be the same as the FCH transmission and the FCH contents in the access region, respectively. Other attributes of the MMR-BS frame and RS frame such as transition between modulation and coding, presence of multiple zones, are the same as those described in 8.4.4.2.

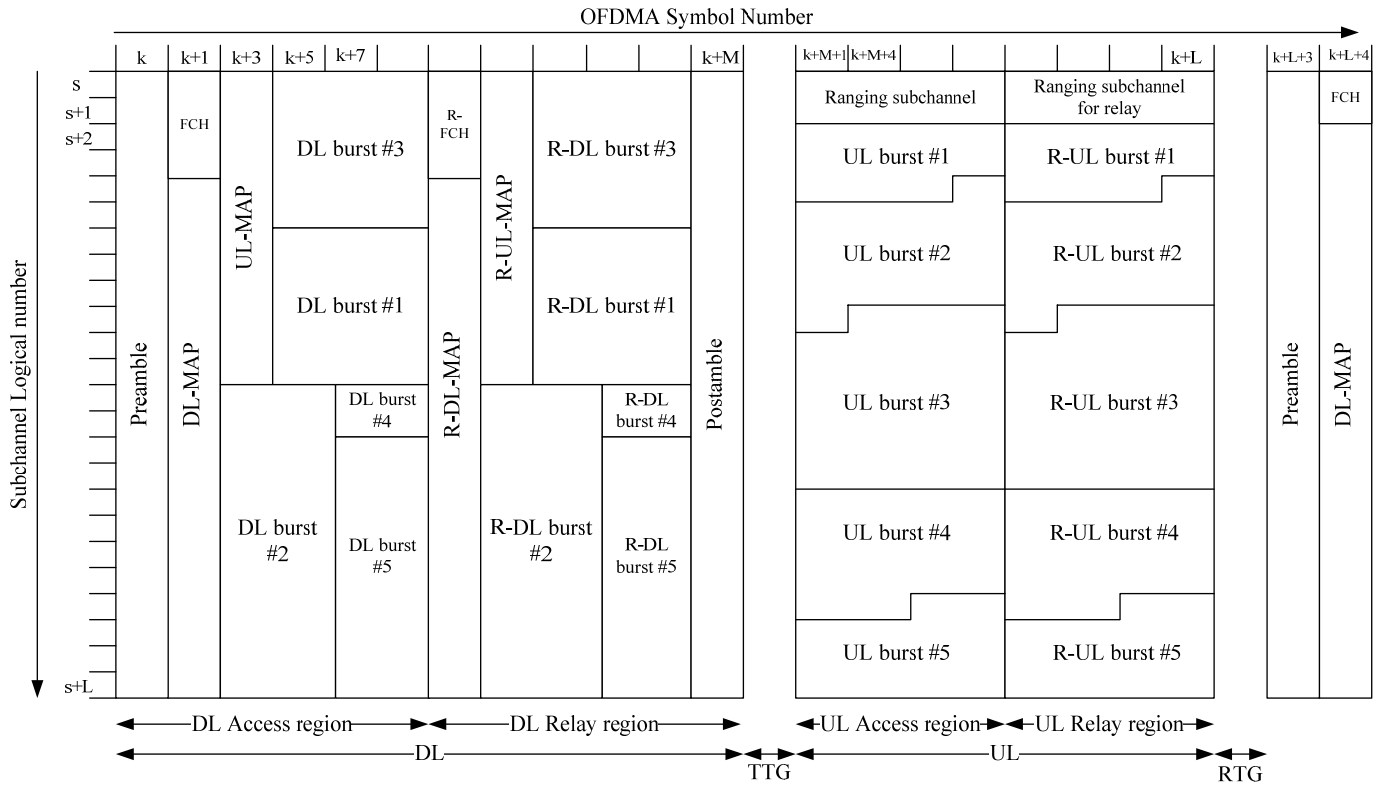

Figure xx Example of a MMR-BS Frame

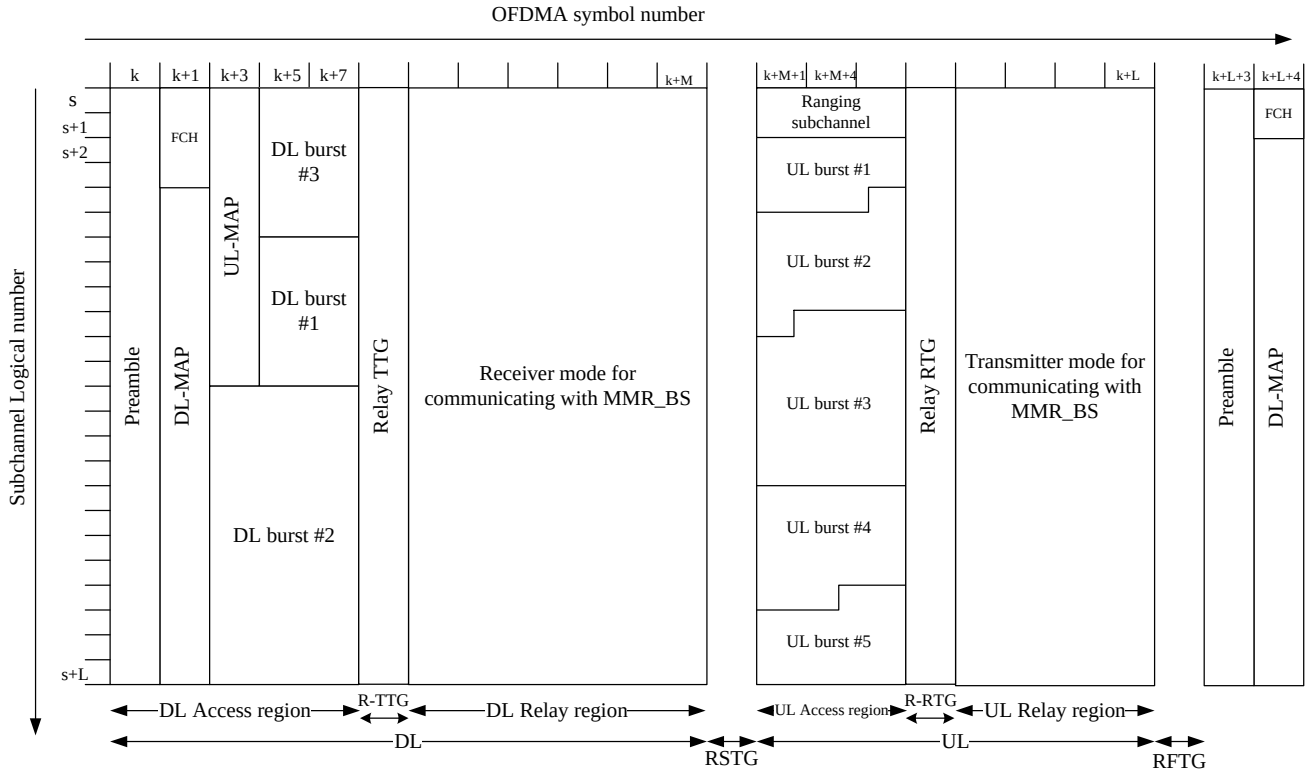

Figure yy Example of a RS Frame

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[4] IEEE 802.16j-06/014, “Harmonized definitions and terminology for 802.16j Mobile Multihop Relay”, Sep. 2006.