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Title	**Frame Structure for multi-hop relay**
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Re:	Call for technical proposals regarding IEEE project P802.16j
Abstract	This contribution proposes frame structures for multi-hop relay, i.e., one for MMR-BS frame and another for RS frame. The proposed multi-hop frame structures are based on two frame unit and operate based on a 2-frame unit.
Purpose	Propose the text regarding frame structure design for multi-hop relay
Notice	
Release	
Patent Policy and Procedures	

Frame Structure for multi-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 multi-hop relay. The proposed frame structures utilize the MMR-BS frame and RS frame defined in the 2-hop case [1] and BS frame defined in Section 8.4.4.2. Furthermore, the frame structures proposed here are based on a 2-frame unit. More specifically, MMR-BS frame and BS frame constructs the MMR-BS frame for multi-hop relay, while RS frame and MMR-BS frame defined in the 2-hop case are used to construct the RS frame for multi-hop relay.

2. Proposed Solution

The frame structure for multi-hop relay may support multi-hop topology as described in Figure A [3].

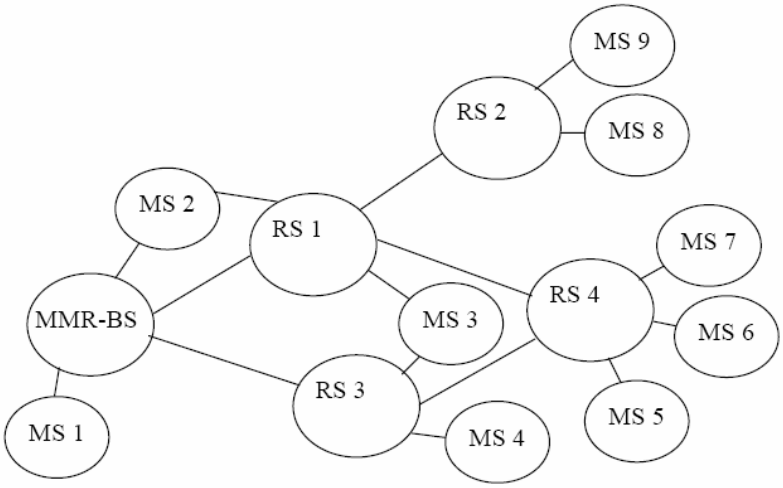

Figure A. Topological constructs

Figure C shows the detailed frame structure of MMR-BS and RS for multi-hop relay. The multi-hop frame structure is based on a 2-frame unit. In (j)th frame, the MMR-BS and even-hop RS communicates with MSs in the access region and communicate with odd-hop RS in the relay region, while odd-hop RS communicates with MSs in the access region and communicates with MMR-BS or even-hop RS in the relay region. Even-hop RS, which is the last-hop, communicates with MSs in the (j)th frame. In (j+1)th frame, MMR-BS and odd-hop RS, which is the last hop, communicates with MSs. Even-hop RS communicates with MSs in the access region and communicates with odd-hop RS in the access region, while odd-hop RS communicates with MSs in the access region and communicates with even-hop RS in the relay region.

An example of a multi-hop environment is illustrated in Figure B where a simple 3-hop relay environment is shown. MMR-BS serves two RSs (RS1, RS2) through relay link and serves MS1 through access link. RS1 communicates with MMR-BS and RS2 through the relay link and communicates with MS2 through the access link. RS2 communicates with RS1 through the relay link and communicates with MS3 through the access link.
The multi-hop frame structure is based on a 2 frame unit. In (j)th frame, the MMR-BS and odd-hop RS transmit/receive DL/UL data, while even-hop RS communicates with MSs in its own cell. (e.g. RS2 communicates with MS3 in Figure B). In (j+1)th frame, odd-hop RS and even-hop RS transmit/receive DL/UL data, while MMR-BS communicates with MS which is directly attached to it. As described in [1], the access region precedes the relay region

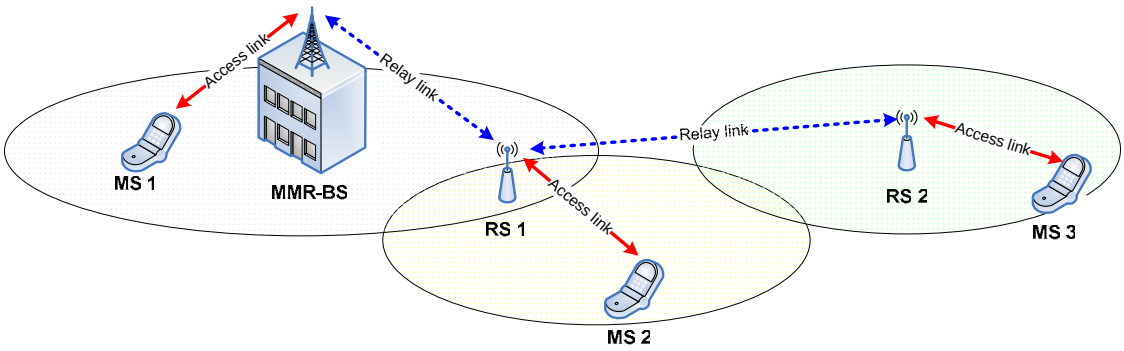

Figure B. An example of multi-hop relay environment showing a 3-hop relay

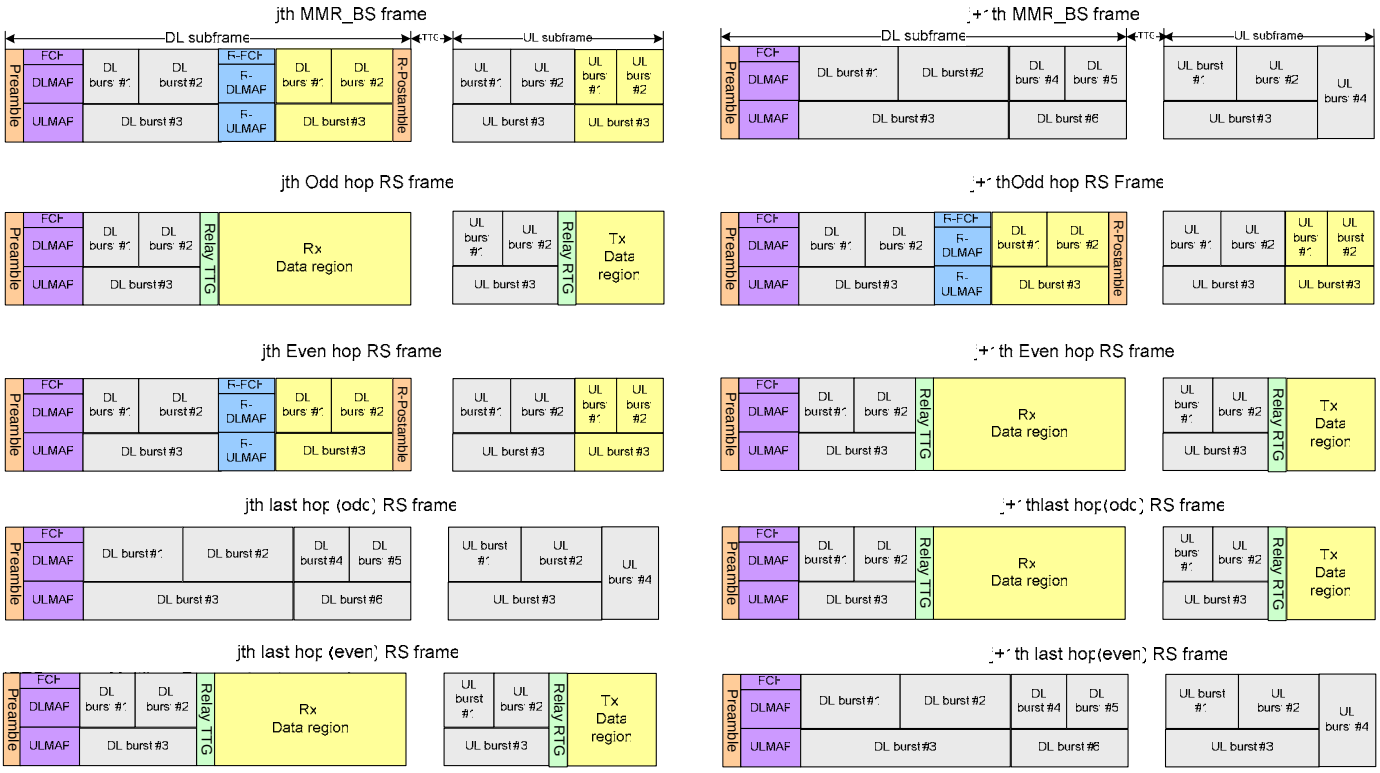

Figure C. Detailed frame structure of MMS-BS and RSs for mutihop relay

2.1 Multi-hop Frame Structure Operation

This section describes the operation of frame structure for multi-hop relay, i.e., more than two hop relay. Figure E shows multi-hop relaying system where MMR-BS or RS and next hop RS communicate with each other through relay link, while MSs communicate with their serving MMR-BS or RS. Depending on the RS configuration, RS may be classified as even hop RS or odd hop RS.

Even hop RS follows the even hop frame structure, while the odd hop RS follows the odd hop frame structure. In the multi-hop operation, frame structures operate with a 2-frame unit. In the (j)th frame, MMS-BS communicates with MSs and RS in time division, while MMS-BS communicates with MS in the (j+1)th frame.

In the (j)th frame, odd hop RS frame communicates with MSs in the first time zone in each DL/UL subframe, while in the second time zone in each DL/UL subframe, odd hop RS frame communicates with its previous hop RS. When the current RS is the first hop RS, the first hop RS frame communicates with MMR-BS in the second time zone in each DL/UL subframe.

In the (j+1)th frame, odd hop RS frame communicates with MSs in the first time zone in each DL/UL subframe, while in the second time zone in each DL/UL subframe, odd hop RS frame communicates with its next hop RS. When the current RS is the last hop RS, the last hop RS frame communicates with MSs in DL/UL subframe of the (j+1)th frame.

In the (j)th frame, even hop RS communicates with MSs in the first time zone of each DL/UL subframe, while in the second time zome of each DL/UL subframe, even hop RS communicates with its next hop RS. When the current RS frame is the last hop RS, the last hop RS frame communicates with MSs in DL/UL subframe of the (j)th frame.

In the (j+1)th frame, even hop RS frame communicates with MSs in the first time zone in each DL/UL subframe.

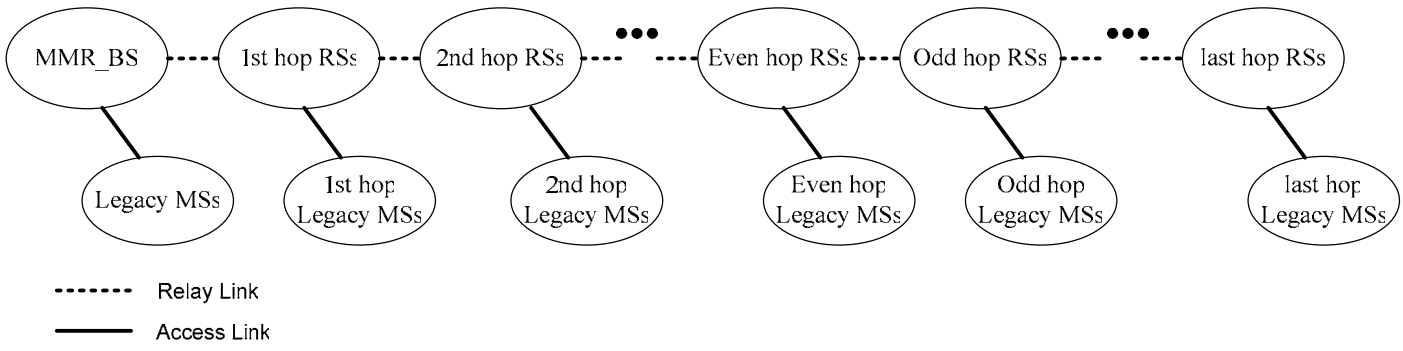

Figure D. Multi-hop relay system

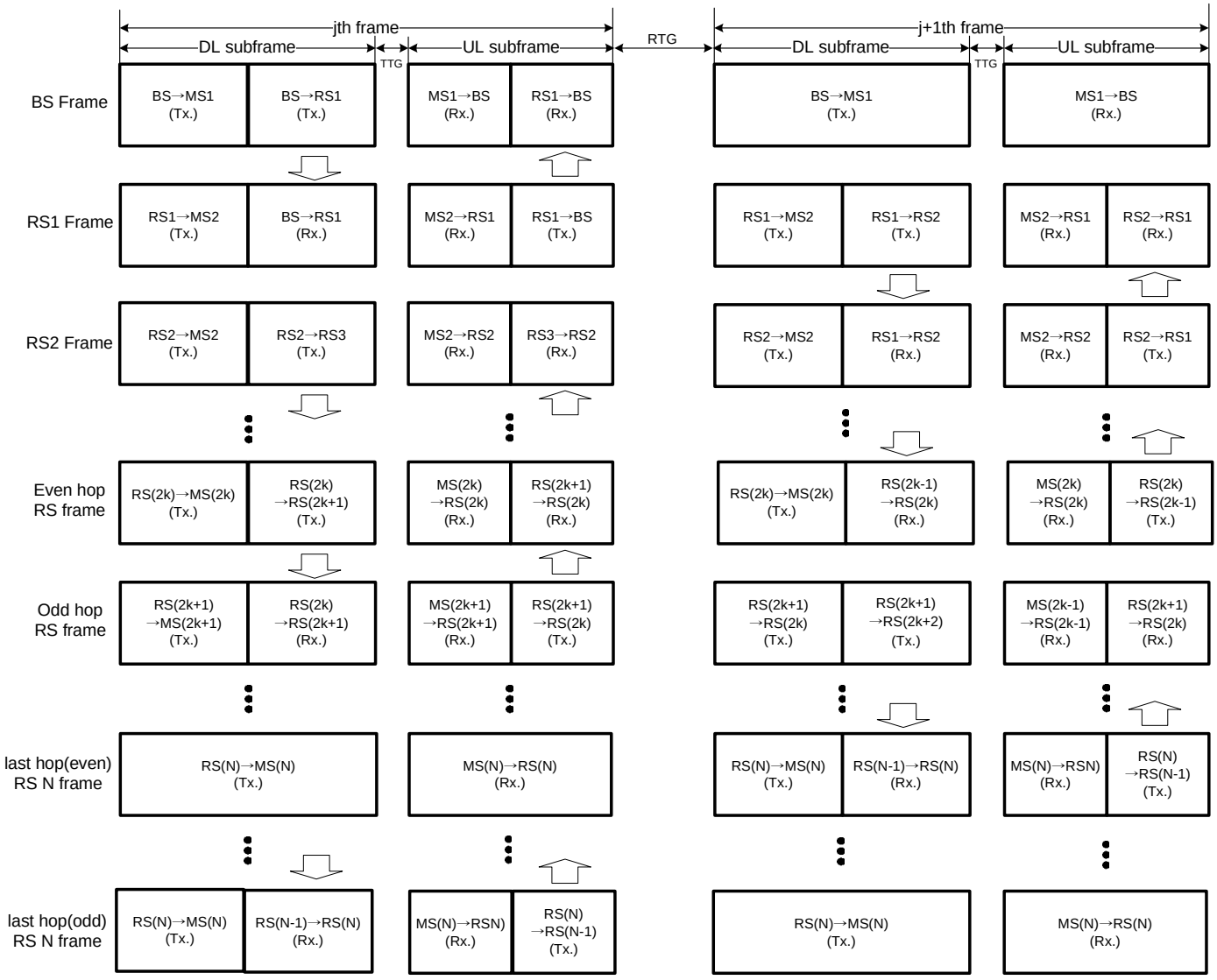

Figure E. Tx/Rx timing operation among BS, RSs and MSs in multi-hop situation

4. Proposed Text Change

---------- Text Start ----------

[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 MMS-BS frame and RS frame for communicating to/from MS.
Relay region: This is the region in the DL/UL subframe of the MMS-BS frame and RS frame for communicating between BS and RS, RS and RS.
RS Rx/Tx gap (RSRTG): The RSRTG is the minimum receive to transmit turnaround gap. RSRTG is measured from the time of the last sample of the received burst to the first sample of the transmitted burst, at

the antenna port of the RS.
RS Tx/Rx gap (RSTTG): The RSTTG is the minimum transmit to receive turnaround gap. RSTTG is measured from the time of the last sample of the transmitted burst to the first sample of the received burst, at the antenna port of the RS.
RSTG: Relay Subframe Time Gap.
RFTG: Relay Frame Time Gap.
R-TTG: Relay-TTG.
R-RTG: Relay-RTG.
R-FCH: Relay-FCH
Odd-hop RS: When the number of hop between MMS-BS and RS is odd, then RS is called odd-hop RS.

Even-hop RS: When the number of hop between MMS-BS and RS is even, then RS is called even-hop RS.

[Insert the followings after the end of section 8.4.4.8:]

8.4.4.8.2. PMP Frame structure for multi-hop relay

The MMR-BS frame and the RS frame for multi-hop relay are based on a 2-frame unit. More specifically, the MMR-BS frame defined in the 2-hop case and the BS frame defined in Section 8.4.4.2 constitutes the 2-frame unit for the MMR-BS frame for multi-hop relay. On the other hand, the RS frame and the MMR-BS frame defined in the 2-hop case constitute the 2-frame unit for the RS frame for the multi-hop relay. The 2-frame unit for the MMR-BS frame and the RS frame are described using (j)th frame and (j+1)th frame as shown, for instance, in Figure F. Odd hop RS, whose hop count is odd, frame has a 2-frame unit in the order of RS frame and MMR-BS frame, while even hop RS, whose hop count is even, has a 2-frame unit in the order of MMR-BS frame and RS frame.

In the (j)th frame, the access region and the relay region in the DL/UL subframe of the MMR-BS frame are identical to those of the MMR-BS frame in the 2-hop case. 1st hop RS may be allowed to receive postamble at the end of the relay region in the DL subframe of the (j)th hop.
The (j+1)th frame of the MMR-BS frame is identical to the frame as defined in Section 8.4.4.2.

In the (j)th frame, the access region and the relay region in the DL subframe of the odd-hop RS frame are identical to those of the RS frame in the 2-hop case.
The (j+1)th frame of the odd-hop RS frame is identical to the MMR-BS frame in the 2-hop case. Even hop RS right next to this RS may be allowed to receive this postamble at the end of the relay region in the DL subframe of the (j+1)th hop. The RFTG shall be inserted between the (j)th RS frame and (j+1)th RS frame and RTG shall be inserted at the end of (j+1)th RS frame to allow the RS to turn around.

The (j)th frame of the even hop RS is identical to the MMS-BS frame in the 2-hop case. Odd hop RS right next to this RS may be allowed to receive the postamble in the jth hop.
The (j+1)th frame of the even hop RS is identical to the RS frame in the 2-hop case. The RTG shall be inserted between the (j)th RS frame and (j+1)th RS frame to allow the RS to turn around and RFTG shall be inserted at the end of (j+1)th RS frame.
The (j)th frame of the odd hop RS, which is the last hop, is identical to the RS frame in the 2-hop case.
The (j+1)th frame of the odd hop RS is identical to the MMR-BS frame in the 2-hop case. TTG shall be inserted between the DL subframe and UL subframe.
The (j)th frame of the even hop RS, which is the last hop, is identical to the MMR-BS frame in the 2-hop case. TTG shall be inserted between the DL subframe and UL subframe.

The (j+1)th frame of the even hop RS is identical to the RS frame in the 2-hop case

In the multi-hop case, the subchannel allocation, FCH/RFCH transmission, and the FCH/RFCH contents are the same as those in the 2-hop case. The other attributes of the MMS-BS frame and RS frame such as transition between modulation and coding, presence of multiple zones, are also the same as those in the 2-hop case.

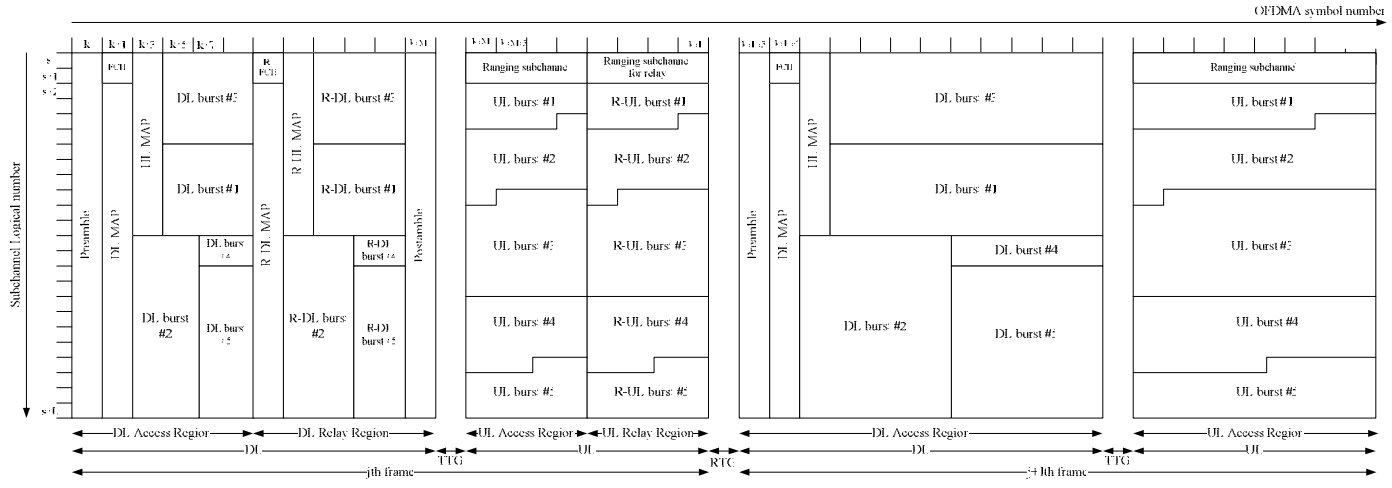

Figure F. MMR-BS frame structure

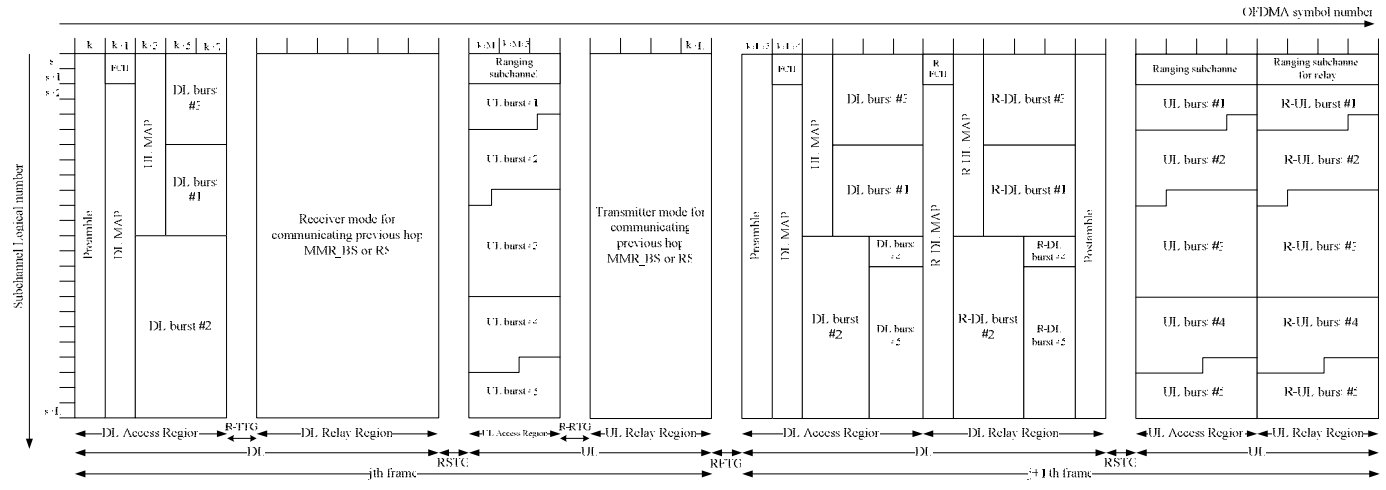

Figure G. Odd hop RS frame structure

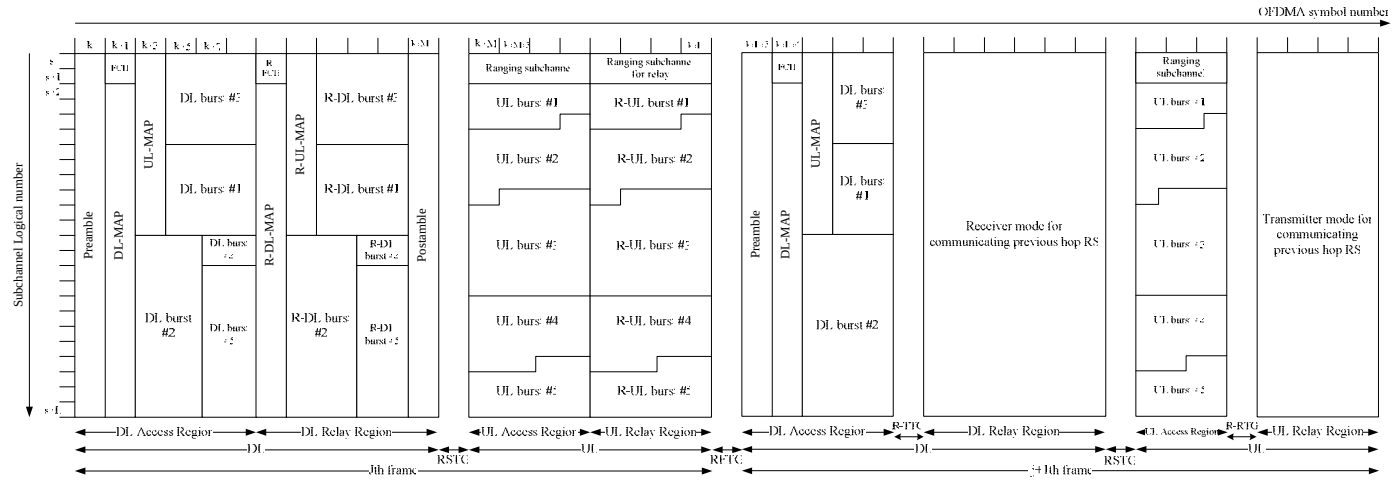

Figure H. Even hop RS frame structure

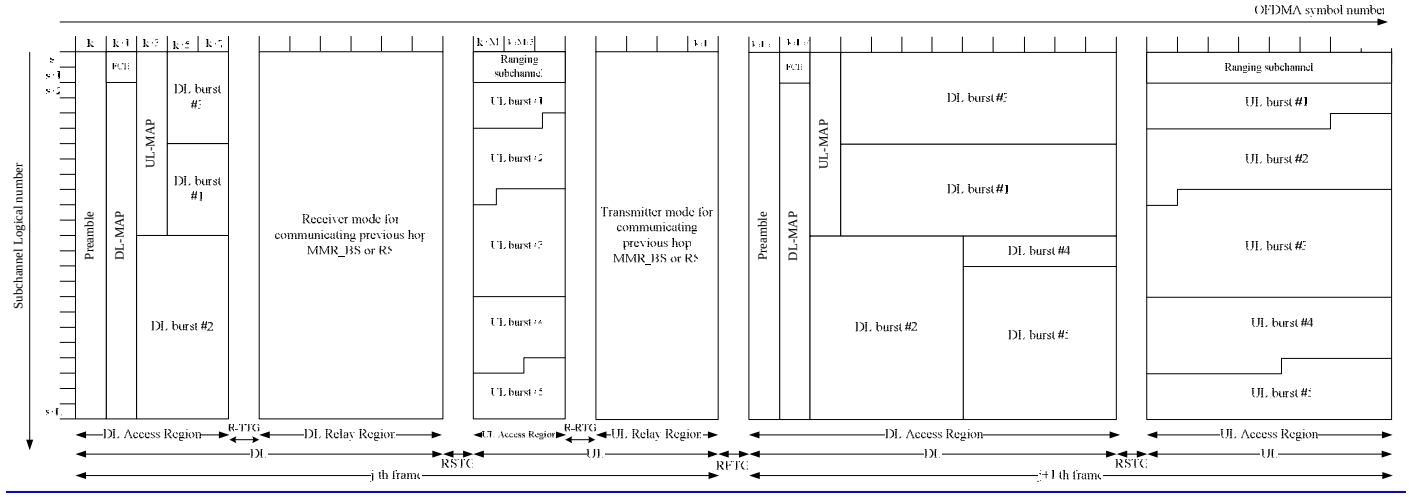

Figure I. Odd hop RS frame structure for the last hop

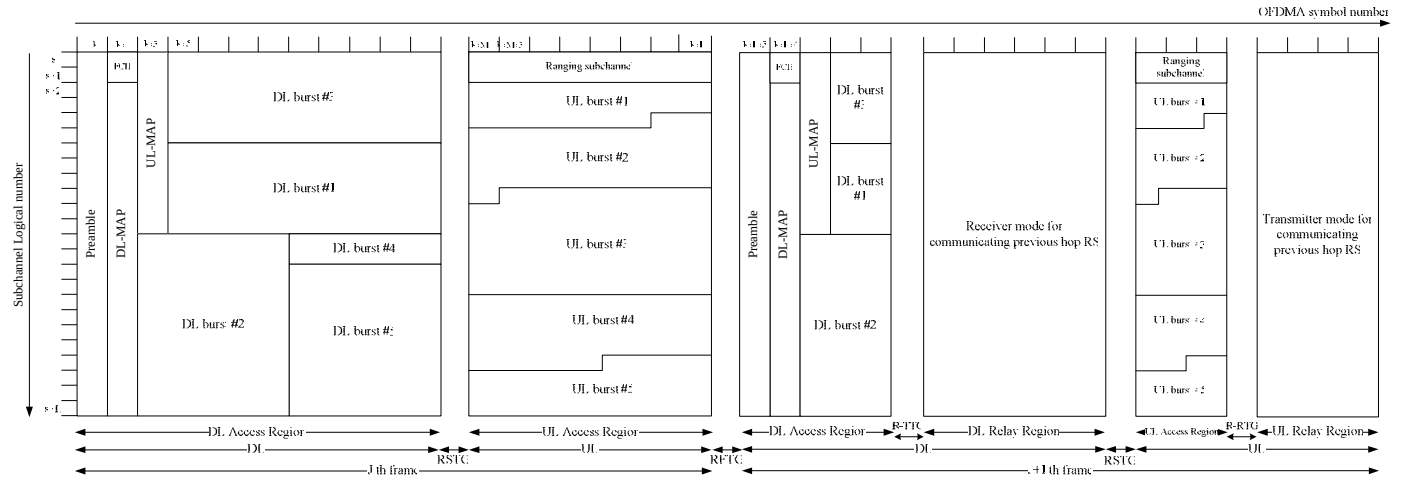

Figure J.Even hop RS frame structure for the last hop

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5. Reference

[1] IEEE 802.16j-06/0xx, “Frame Structure for 2hop relay”, Samsung Electronics, October 2006.

[2] IEEE P802.16j PAR, March, 2006

[3] IEEE 802.16j-06/015, “Harmonized Contribution on 802.16j (Mobile Multi-hop Relay) Usage Models”, Sep. 2006

[4] IEEE 8 0216j-06_026, “P802.16j BASELINE DOCUMENT”, Sep. 12, 2006.

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