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Re:	IEEE 802.16j Technical Contribution
Abstract	This contribution informs the definition of R-TTG/R-RTG.
Purpose	For more clear understanding of R-TTG/R-RTG
Notice	
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Patent Policy and Procedures	

On the Definition of transition gap for accommodating Relay operation

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1. Introduction

For TDD systems, frame structure for 2-hop and multi-hop relay is described in reference [1]. For proper RS operation in frame structure, there needs to define transition gaps within DL and UL subframe. In this contribution, we will define clearly transition gaps of RS.

2. TTG/RTG parameters in 802.16e system

In reference [2], TTG/RTG is defined as follows:

3.45 BS receive/transmit transition gap (RTG): A gap between the last sample of the uplink burst and the first sample of the subsequent downlink burst at the antenna port of the base station (BS) in a time division duplex (TDD) transceiver. This gap allows time for the base station (BS) to switch from receive to transmit mode and SSs to switch from transmit to receive mode. During this gap, the BS and SS are is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp up, and the transmit/receive (Tx/Rx) antenna switch to actuate, and the SS receiver sections to activate. Not applicable for frequency division duplex (FDD) systems.

3.63 BS transmit/receive transition gap (TTG): A gap between the last sample of the downlink burst and the first sample of the subsequent uplink burst at the antenna port of the base station (BS) in a time division duplex (TDD) transceiver. This gap allows time for the base station (BS) to switch from transmit to receive mode and SSs to switch from receive to transmit mode. During this gap, the BS and SS are is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp down, the transmit/receive (Tx/Rx) antenna switch to actuate, and the BS receiver section to activate. Not applicable for frequency division duplex (FDD) systems.

In reference [3], SSTTG/SSRTG is defined as follows:

"3.53 SS Rx/Tx gap (SSRTG): The SSRTG is the minimum receive to transmit turnaround gap. SSRTG 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 SS."

"3.54 SS Tx/Rx gap (SSTTG): The SSTTG is the minimum transmit to receive turnaround gap. SSTTG 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 SS."

In OFDMA-TDD system as in reference [2], TTG/RTG is defined as follows:

"In TDD and H-FDD systems, subscriber station allowances must be made by a SSRTG and by a SSTTG. The B S shall not transmit downlink information to a station later than (SSRTG+RTD) before the beginning of its first scheduled uplink allocation in any UL-subframe, and shall not transmit downlink information to it earlier than (SSTTG-RTD) after the end of the last scheduled uplink allocation, where RTD denotes Round-Trip Delay. In a ddition the SS should be allowed to receive the downlink preamble for each frame that contains DL data for it, by assuring the period specified above does not overlap with the preamble. The parameters SSRTG and SSTTG are capabilities provided by the SS to BS upon request during network entry (see 11.8.3.1).TTG parameter is se t to SSTTG + RTD and RTG parameter is set to SSRTG-RTD."

3. Transition gaps in 802.16j frame structure

Figure 1 describes an example of 2-hop relay environment. MR-BS serves RS through the relay link and serves MS1 through the access link. RS1 communicates with MR-BS through the relay link and communicates with M S2 through the access link.

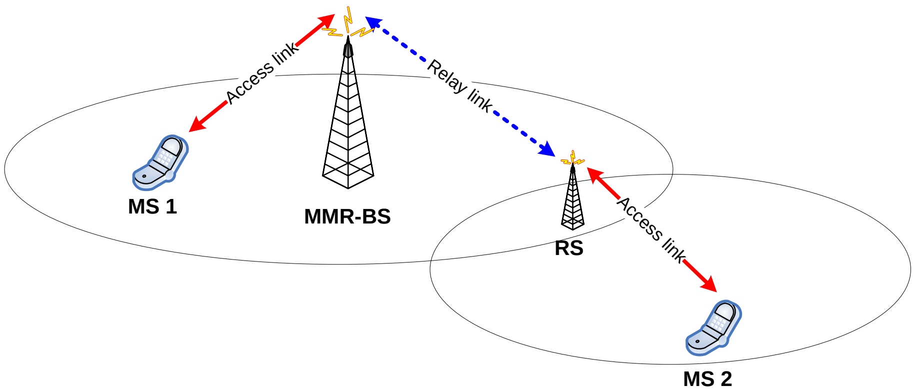

Figure 1. 2-hop relay environment

Figure 2 represents timing operation within 1 frame in 2-hop relay environment, referring to the frame structure defined in reference [1]. In the access region of the DL subframe, MR-BS and RS transmit preamble, MAP and data burst to its serving MS. During this time, Both MR-BS and RS operate as a Tx. mode.

In the relay region of the DL subframe, MR-BS continues its Tx mode, while RS needs to change its mode fro m Tx to Rx, for receiving data from MR-BS. Due to this mode transition, RS may need transition time gaps for proper mode change. To synchronize with MR-BS frame and RS frame,RS should finish its mode transition bef ore arriving the DL relay zone data from MR-BS.

During TTG, MR-BS changes its mode transition from Tx mode to Rx mode, while RS continues its Rx mode d uring TTG. Only time gap needs to align the start symbol of the UL access region.

In the access region of the UL subframe, Both MR-BS and RS operate as an Rx mode to receive from their MSs . In the relay region of the UL subframe, RS needs mode transition from Rx mode to Tx before transmitting the UL relay zone data from RS.

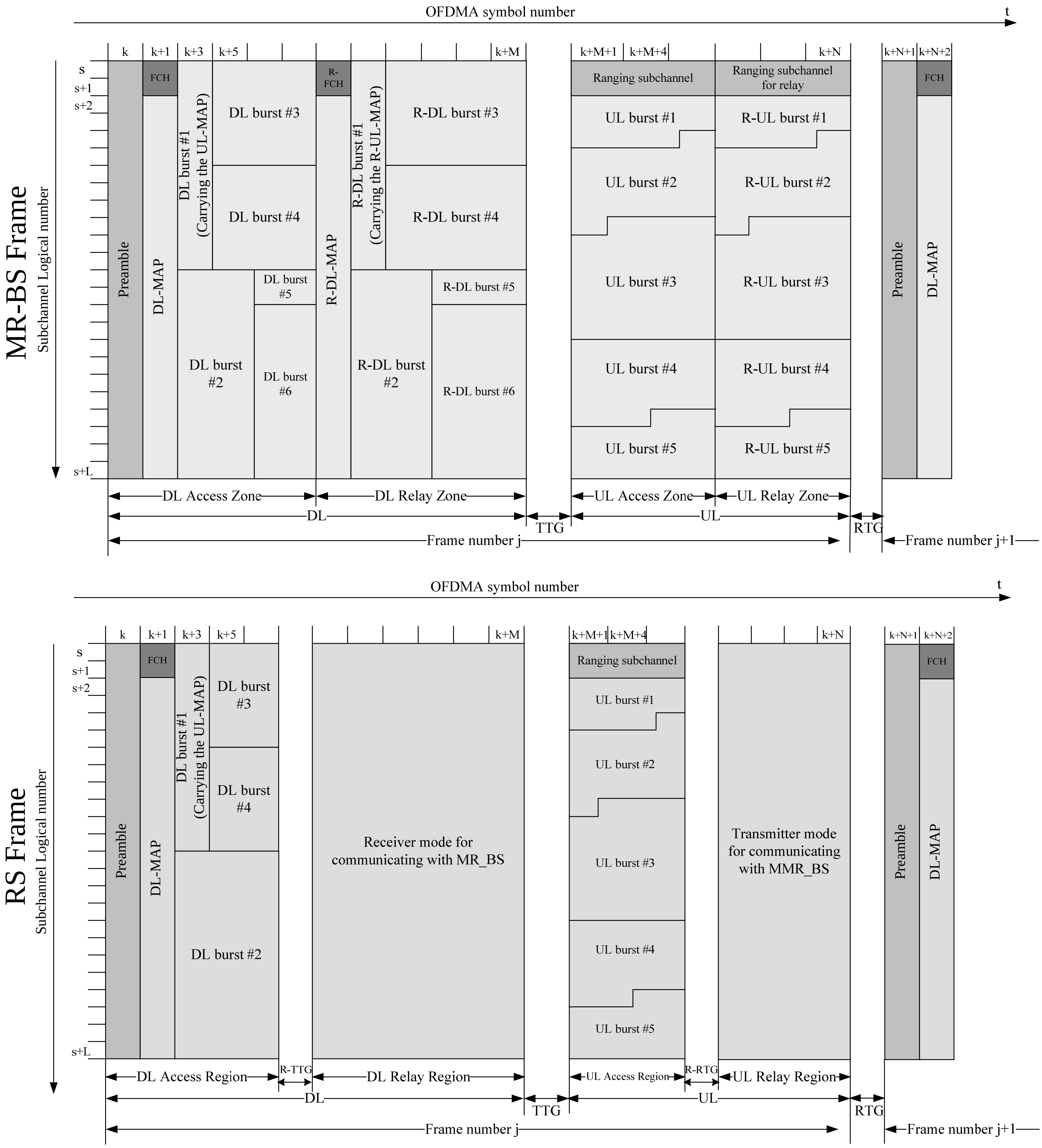

Figure 2. MR-BS and RS frame strucuture in 2-hop environment.

4. Definition of R-TTG/R-RTG

Similar as current specification in [3], we can define mode change transition gap, which are called, RSTTG and RSRTG. RSTTG is mode change time from Tx. to Rx, RSRTG is mode change time from Rx. to Tx. Using this definition, we can define R-TTG, the time gap between DL access region and DL relay region within DL sub-frame, and R-RTG, the time gap between UL access region and UL relay region within UL sub-frame. In Figure 3, if R-TTG has one OFDM symbol length, the maximum RSTTG could be R-TTG + RTD/2. In other words, when RSTTG and RTD/2 is given value, R-TTG may be defined as simple equation as follows:

R-TTG = $\lceil OFDM\ symbol\ unit(RSTTG - RTD/2) \rceil$.

Within the DL sub-frame, R-TTG shall be defined by OFDM symbol unit because DL access zone and DL relay zone could be represented by OFDM symbol units. Similarly, R-RTG are described in Figure 4. R-RTG also could be defined as simple equation as follows:

R-TTG = $\lceil OFDM\ symbol\ unit(RSTTG + RTD/2) \rceil$

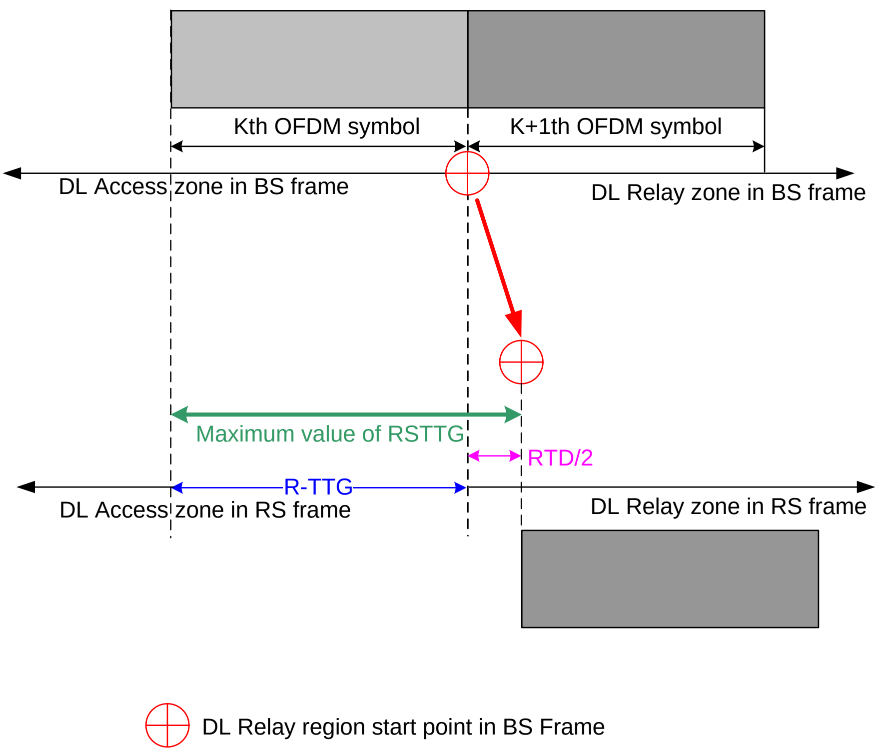

Figure 3. R-TTG in RS DL sub-frame

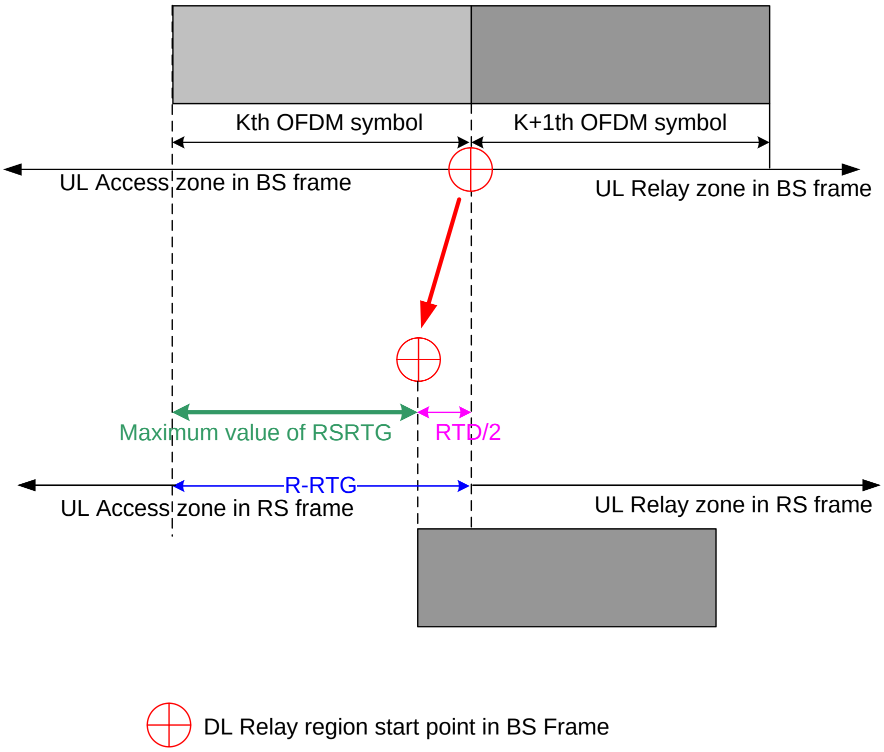

Figure 5. R-RTG in RS UL sub-frame

5. Reference

[1] IEEE C80216j-07_135, "Comments on Frame Structure for multi-hop relay", January, 2007.

[2] IEEE 80216e-2005, "*Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1*", February, 2006.

[3] IEEE 80216-2004, "*Part 16: Air Interface for Fixed Broadband Wireless Access Systems*", June, 2004.