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Re:	IEEE 802.16j-06_034: “Call for Technical Proposals regarding IEEE Project P802.16j”
Abstract	This document describes a requirement and definition of the MR transparent relay frame structure to support multi-hop relay operations.
Purpose	To define the transparent relay frame structure
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Frame Structure for Transparent Relay Mode

Introduction

The frame structure for transparent relay operation shall be defined to enable backward compatibility and efficient R-link operation. This contribution proposes an in-band frame structure for transparent relay operation, as necessary complementarily of C80216j-06_233r8.

The following assumptions are made:

- No changes are required for a IEEE802.16e-2005 MS operation;
- It enables efficient and flexible R-link operation by extension of IEEE802.16e-2005 frame structure;
- The impact upon the current IEEE802.16e frame structure is minimized
- The R-link delay is minimized;
- Only centralized scheduler is supported for transparent RS
- MS is located within the coverage of MR-BS, and can receive broadcast information from MR-BS directly
- Only TDD frame is considered in this contribution

This contribution proposes a frame structure for in-band transparent relay operation. This relaying frame structure is an extension of 802.16e OFDMA TDD frame structure.

Transparent Relay and Non-Transparent Relay Operation

Two kinds of relay operations are given in the past sessions: transparent relay and non-transparent relay operation. RS shall work in one mode at one time. The relay operation mode may be configured at network deployment or RS network entry..

In transparent relay operation, MS associated to RS is located within the coverage of MR-BS, and the DL control signal from MR-BS can directly reach MS without RS relaying. RS does not transmit preamble and MAPs. All MSs and RSs within one MR-cell are synchronized to MR-BS via its preamble, and get DL / UL MAP. MS does not recognize the existence of the RS even though it communicates with the MR-BS via the transparent RS. In this relay mode, the control signal and the data traffic is separated in DL. Transparent relay only supports centralized scheduler. Transparent relay is dedicated for throughput enhancement, where MS is located within the coverage of BS’s broadcast information.

In comparison, in non-transparent relay operation, RS has to take the responsibility to transmit a preamble and also MAP at the beginning of the DL sub-frame. Therefore, a MS recognizes it as a BS. All data and control signal transmission between MR-BS and MS are relayed. The non-transparent RS may support centralized or distributed scheduler.

Transparent RS and non-transparent RS can coexist in one MR-cell.

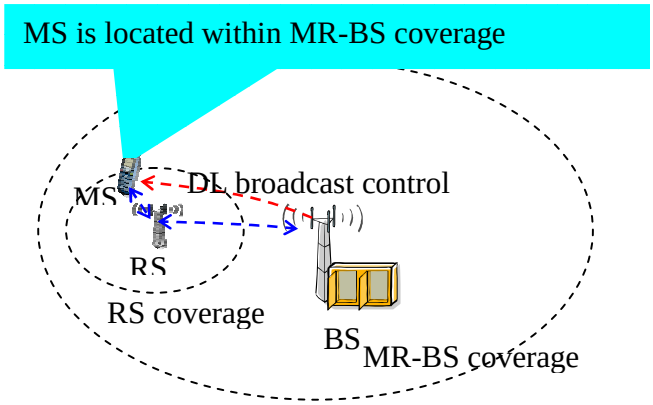

Fig.1 Transparent RS

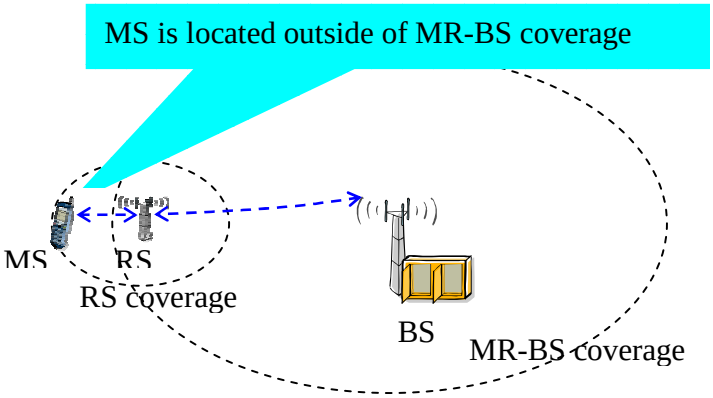

Fig.2 Non-Transparent RS

Proposed Transparent Relay Frame Structure

The current TDD frame structure divides the frame into two sub-frames for downlink and uplink transmission. In this proposal, a simple extension to the frame structure is proposed to enable relaying that involves defining the existence of a relay link and also access link for RS-MS transmission and reception intervals in the MR-BS DL and UL sub-frames, respectively. Athough there shall not be any change in MR-BS preamble and MAP for access link, to facilitate communication between MR-BS and RS, there may be a R-MAP in which the channel resource information for relay link can be defined, where R-MAP is located following legacy MAP or defined as an extension of legacy MAP

Fig.3 illustrates the transparent relay frame structures from the view of MR-BS and RS. The proposed frame structure is enabled relaying with main features:

- In DL subframe, MR-BS→MS/RS transmissions require no changes to the frame structure in IEEE 802.16e because MR-BS takes RS as a special MS for down stream operation. For RS→MS transmissions, it shall be allocated in a separate zone or data region, where RS transmission/reception does not conflict.
- In UL subframe, MS→MR-BS/RS transmissions require no changes to the frame structure in IEEE 802.16e because both MR-BS and RS perform upstream reception the same as legacy BS. A separate relay zone shall be allocated for RS→MR-BS transmission to avoid RS transmission/reception at one time.

Based on Fig. 3, the basic two-hop relay frame structure is composed of a DL sub-frame and a UL sub-frame like in the 802.16e case. Between the DL sub-frame and the UL sub-frame a TTG is placed

The DL sub-frame is given as:

- The DL sub-frame is composed of a zone/region for MR-BS to MS / RS transmissions and a zone/region for RS to MS transmissions named as transparent access zone / region.

- It is responsible for MR-BS to assign zones/regions so that tx/rx of RS does not conflict
- Between these two zones/regions a Relay RTG (RRTG) is placed.
- Legacy operation is used for the DL transmission from MR-BS to MS / RS.
- R-MAP is for RS resource allocation
- The sequence of these two zones/regions may be changed.

The UL sub-frame is given as:

- The UL sub-frame is composed of a zone for MS → RS / MR-BS transmissions and a zone for RS → MR-BS transmissions.
- It is responsible for MR-BS to assign zones/regions so that tx/rx of RS does not conflict
- Between these two zones a Relay RTG (RRTG) is placed.
- Legacy operation is used for the UL transmission from MS to MR-BS and from RS to MR-BS.
- R-MAP is for RS resource allocation
- The sequence of these two zones may be changed.

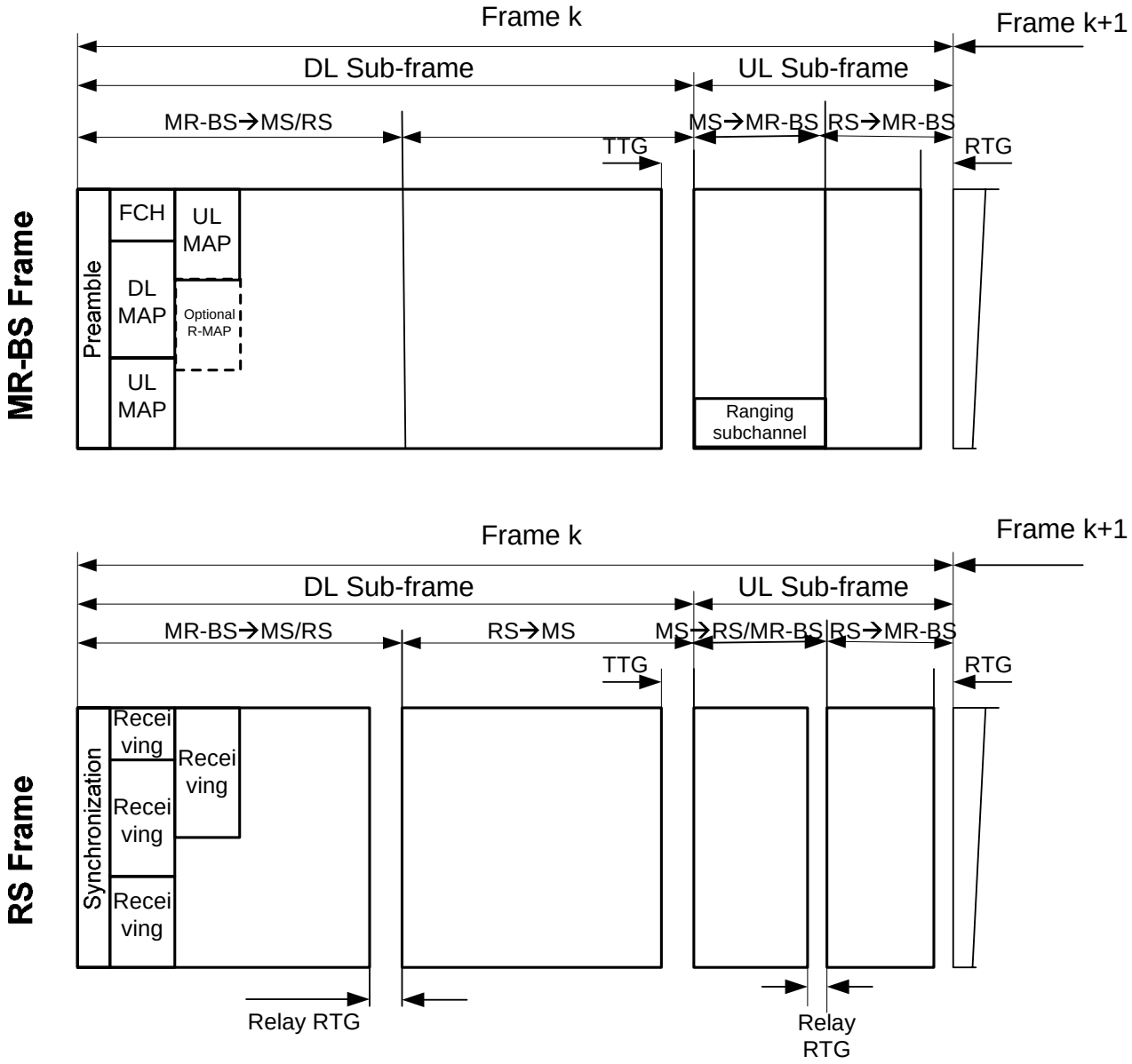

Figure.3. Example of minimum configuration for an in-band transparent relay frame structure

At initialization, the RS performs an initial network entry with the MR-BS in the same way as the MS does, the RS detects a preamble in the MR-BS frame and it establishes the synchronization with the MR-BS. RS and MS use one common ranging channel allocated by MR-BS for network entry.

Conclusion

This proposal provides a simple extension to the existing frame structure defined in IEEE Std. 802.16 that enables support for the transparent relay operation.

Proposed text changes

++++++++++++ start text proposal ++++++++++++++++++++++++++++++++

[Make the indicated modifications to section 6.3.7.2:]

For the case where MR-BS supports ~~two hop~~ multi-hop relay, the DL and UL subframes shall ~~include at least one access zone and may include one or more relay zone to~~ enable RS operating in either transmit or receive mode. The related frame structure is defined in the OFDMA PHY specific section.

[Change subclause 6.3.7.3 as indicated:]

6.3.7.3 DL-MAP
The DL-MAP message defines the usage of the DL intervals on the access links for a burst mode PHY. DL-MAP may optionally define the resource allocation for DL relay links.

[Change subclause 6.3.7.4 as indicated:]

6.3.7.4 UL-MAP
The UL-MAP message defines the uplink usage on the access link in terms of the offset of the burst relative to the Allocation Start Time (units PHY-specific). UL-MAP may optionally define the resource allocation for UL relay links.

8.4.4.7.1 Frame structure for transparent mode

[Insert section 8.4.4.7.1.1

8.4.4.7.1.1 MR-BS frame structure
For the TDD mode, an example of the MR-BS frame structure is shown in Figure xxx.

Each frame in the downlink transmission begins with a preamble followed by an FCH, DL-MAP, and possibly UL-MAP. R-MAP is located following legacy MAP or defined as an extension of legacy MAP. The frame structure consists of DL sub-frame period and UL sub-frame period. In each frame, the TTG shall be inserted

between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame. One common ranging subchannel is shared by all RSs and MSs within one MR-cell.

The DL sub-frame shall include at least one zone for MR-BS to its subordinate MR/RS transmissions and may optionally include a transparent access zone / region for RS to MS transmissions. The transparent access zone can be indicated by STC_DL_ZONE_IE() defined in Table 279. The UL sub-frame may include a zone for MS to MR-BS / RS transmissions and optionally include a zone for RS to MR-BS transmissions. The bandwidth allocation for transmissions between MR-BS and MS / RS follows legacy IEEE802.16e operation.

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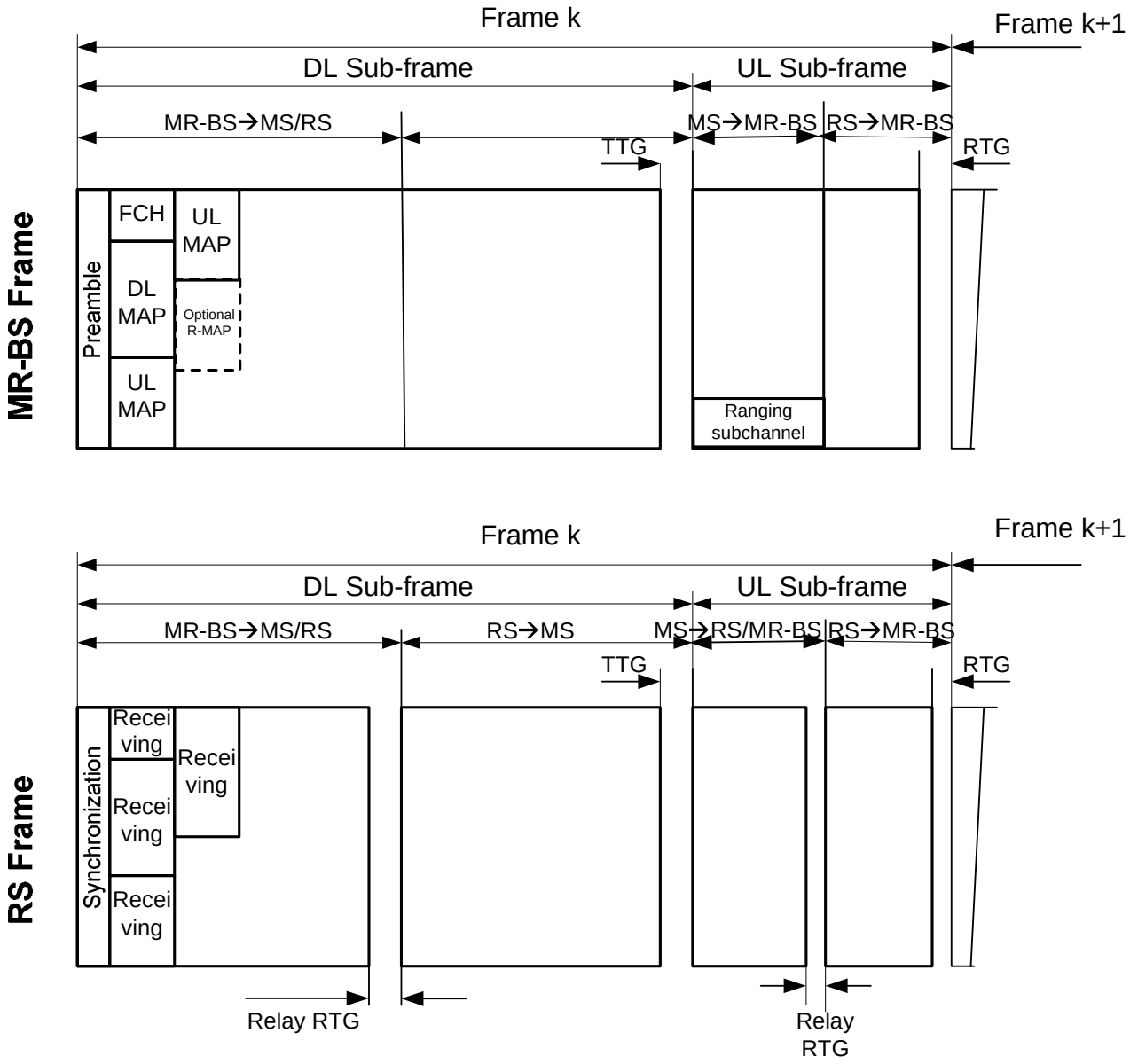

Figure xxx Example of minimum configuration for an in-band transparent relay frame structure

[Insert section 8.4.4.7.1.2:]

8.4.4.7.1.2 Relay frame structure

From RS view, an example of an RS TDD frame structure is shown in Figure xxx.

RS does not transmit preamble and MAP at the beginning of the frame. Instead it listens and receives the preamble, legacy MAP or optional R-MAP from MR-BS. The detailed allocation for RS can be indicated by legacy MAP or R-MAP. The indication method shall be negotiated in RS network entry procedure. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame.

The DL sub-frame may include a zone for receiving data from MR-BS and a transparent access zone / region for RS transmissions. The UL sub-frame may include a zone for receiving data from MS and a zone for transmitting data to MR-BS. One ranging channel is shared by RS and MS, while RS may indicate itself as relay for differentia in initialization.

If the relay station switches from transmission to reception mode, an R-TTG shall be required. If the relay station switches from reception to transmission mode, an R-RTG shall be required.

++++++++++++++++++++ *End of text proposal* ++++++++++++++++++++++