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Title	**A General Frame Structure for IEEE802.16j Relaying Transmission**
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Re:	This is a response to a Call for Technical Proposal regarding IEEE Project P802.16j http://ieee802.org/16/relay/docs/80216j-06_034.pdf
Abstract	This document proposes a general frame structure to support flexible access for 802.16j relaying mode.
Purpose	A technical contribution is submitted to IEEE 802.16j TG for considerations and further discussions.
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A General Frame Structure for IEEE802.16j Relaying Transmission

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Introduction

A frame structure has been specified for 802.16j to enable multi-hop relaying operations [1] and the frame structure is intended for in-band relay operation with non-transparent RS, in which case a RS transmits a preamble at the beginning of the DL subframe. This frame structure is very well defined for relaying mode. As well-understood it provides a good basis for the frame structure.

Based on [1] and [2], this contribution proposes a more general relaying frame structure to make access transmission more efficient. This frame structure is also intended to support any possible radio resource reuse in access link.

Further assumptions and requirements

Further to [1], some of the assumptions are modified and extended as follows:

- Fully backward compatible so that no changes are required for an existing MS operation defined in IEEE802.16e-2005 [2];
- No efficiency loss on access link for a IEEE802.16e-2005 MS operation;
- To enable efficient and flexible R-link operation by modification of IEEE802.16e-2005 frame structure;
- The impact on the current IEEE802.16e frame structure is minimized;
- A unified frame structure to enable multi-hop relaying and all the usage models;
- Both centralized scheduler and distributed scheduler are supported;
- Supports access links radio resource reuse;

This contribution proposes a frame structure for both in-band and out-bands relay operation

Problem identifications

The frame structure specified in [1] has defined two separated zones. For instance, for the DL access zone is dedicated to the BS→MS related traffic and RS→MS related traffic and the other DL relay zone is dedicated to the BS→RS(s) related traffic.

As this specification, the BS→MS access link as that of the same defined link in IEEE802.16e-2005 will have much less resources while considering the deployment of relaying transmission. Furthermore, for a standard IEEE802.16e-2005 transmission, it should not be limited by a relay frame structure.

In addition, in order to support both in-band and out-band, the access link and relay link should not be separated by the time-frame.

Possible solutions

Frame structure should allow BS→MS access link to occupy full length of the frame. There are mainly two advantages of this solution: one is fully backward compatible and hence less impact on BS→MS access link;

another is more flexible to support relaying with high efficiency, such as supporting a single relaying with much low throughput.

In addition, it allows access link and relay link to transmit simultaneously thereby accommodating for different transmission modes, i.e. without relay in a relaying deployment network or with relay but with the relayed MS having less resource. Also, it could support any types of radio resource sharing.

Furthermore, we propose to insert a relay-zone preamble on relay link to support any multihop (>2) extension. This preamble could also make more feasible on link measurements.

Relaying frame structure

The proposed relay frame structure is based on the existing frame structure as already defined in [1]. In order to support access link transmission over full frame length, two parts need to be defined in the frame structure. The first part of the frame structure which defines the relay link supporting transmission from MR-BS to MS(s) through RS(s) is illustrated in Figure 1. The latter is based on the defined frame structure in [1]. However, it introduces a relay zone preamble, which could be the same as the preamble at that of DL access-zone. In contrast, the relay zone preamble could be different from the preamble of DL access-zone.

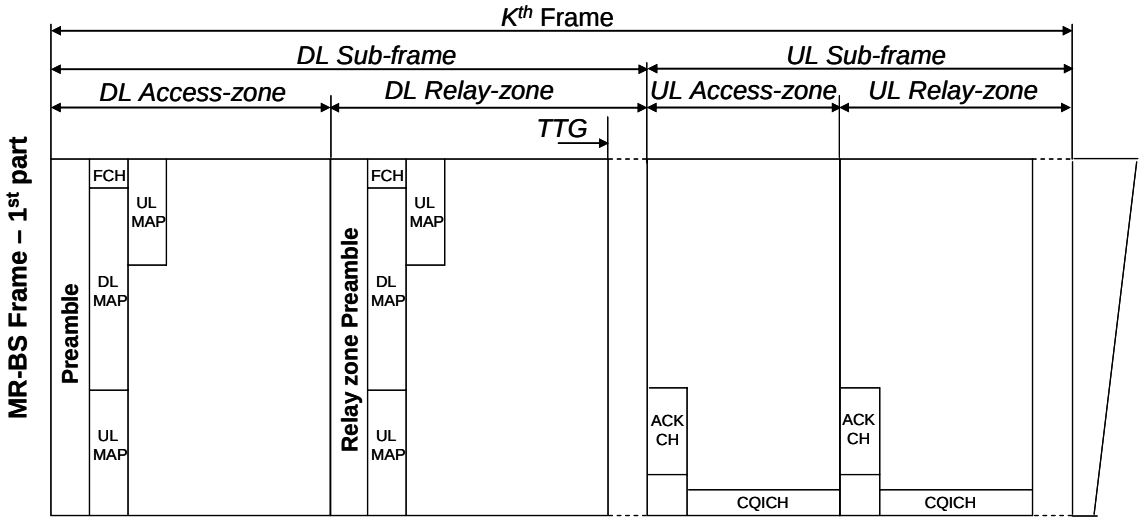

Figure 1: MR-BS frame – 1st part for relay-link

In this configuration, the relay zone preamble does not affect the MS(s) which have already been assigned in DL access-zone. However, for those MS(s) and RS(s) which have not been assigned at DL access-zone, they will treat this preamble as frame start preamble. All MS(s) and RS(s) access with the start of this preamble should be controlled by FCH.

However, if the relay-zone preamble is different from the frame start preamble, it will be only recognized by any other RS(s). All MS(s) will ignore this preamble.

The relay-zone preamble is a new part to the system and it could be an implementation issue to decide if uses the same preamble at that at the frame starts. However, we suggest using the same preamble as the frame-start preamble.

The Figure 1 only introduces a relay-zone preamble to the frame structure and the frame structure is only a part to introduce a relaying transmission. It is mainly shown transmissions through RS(s). Especially, it does not fully cover the access zone transmission. The period of relay-zone transmission should also allow access-zone transmission. However, because we introduced the relay-zone preamble and defined FCH, DL MAP and UL

MAP in relay-zone, the access zone should have no data transmission during these slots. Based on all these concerns, the 2nd part of MR-BS frame structure for access-zone is depicted in Figure 2.

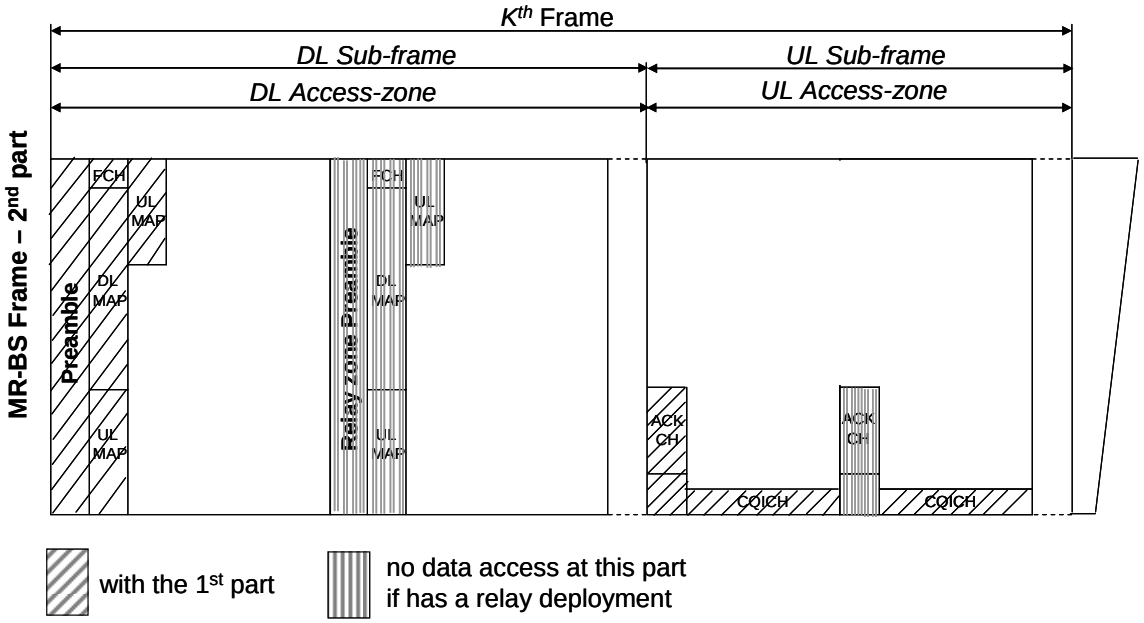

Figure 2: MR-BS frame – 2nd part for access zone

Comments

For the proposed frame structure, there are minor changes since it is fully based on the existing specified frame structure in [1]. Furthermore, it is an extension of the frame structure and we only propose it as an optional or alternative scheme.

Proposed text changes

The text input here is based on the text input in [1] with minor modifications.

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

[Insert the followings after the end of section 3:]

MR-BS frame: Frame structure for DL transmission/UL reception by MR-BS.
RS frame: Frame structure for DL transmission/UL reception by RS.
DL Access_Zone: A portion of the DL sub-frame in the MR-BS/RS frame used for MR-BS/RS to MS transmissions.
UL Access_Zone: a portion of the UL sub-frame in the MR-BS/RS frame used for MS(s) to MR-BS / RS transmissions.
DL Relay_Zone: a portion of the DL sub-frame in the MR-BS/RS frame used for MR-BS/RS to RS transmission
UL Relay_Zone: a portion of the UL sub-frame in the MR-BS/RS frame used for RS to MR-BS/RS transmission.

[Insert the followings after the end of section 4:]

R-TTG: Relay-TTG.
R-RTG: Relay-RTG.
R-FCH: Relay-FCH
R-MAP: Relay MAP.
[Insert the following text at the end of the subclause 6.3.7.2:]

For the case where MR-BS supports two-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 downlink intervals on the access links for a burst mode PHY.

[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).
[Insert a new subclause 8.4.4.7:]

8.4.4.7 Frame structure of MR-BS and RS
This section describes the minimal requirements for an in-band frame structure for a MR-BS and its subordinate RS.
8.4.4.7.1 Frame structure for transparent mode.

8.4.4.7.2 Frame structure for non-transparent mode

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

Each MR-BS frame begins with a preamble followed by an FCH and the DL MAP and possibly UL MAP. The DL sub-frame shall include at least one DL Access Zone and may include one or more DL Relay_Zones. The UL sub-frame may include one or more UL Access Zones and it may include one or more UL Relay_Zones. 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. In the DL Access Zone, the subchannel allocation, the FCH transmission, and the FCH shall be defined as in Section 8.4.4.2.

The DL Relay_Zone shall include a R-FCH and a R-MAP. In the DL Relay Zone, the subchannel allocation may be the same as that in the DL Access Zone. The R-FCH may be the same as the FCH in the DL Access Zone. Other attributes of the MR-BS frame and the RS frame such as transition between modulation and coding, presence of multiple zones, may be the same as those described in 8.4.4.2.

The number, size, and location of the relay zones shall be configurable.

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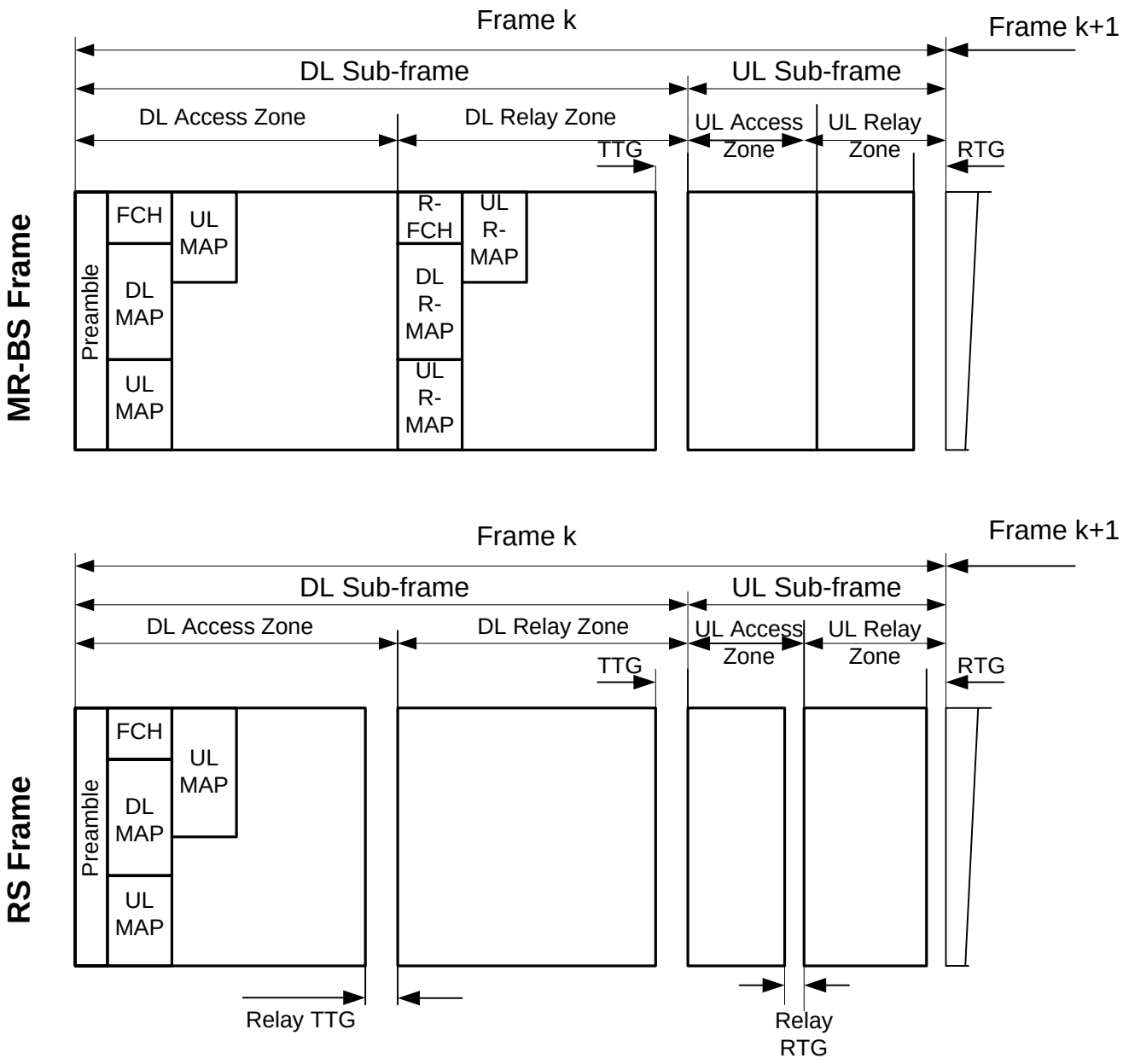

Figure xxx Example of minimum configuration for an in-band non-transparent relay frame structure

In order to further improve access link efficiency and support more flexible relay deployment, an alternative optional MR-BS frame structure is defined in the following Figure xxxx

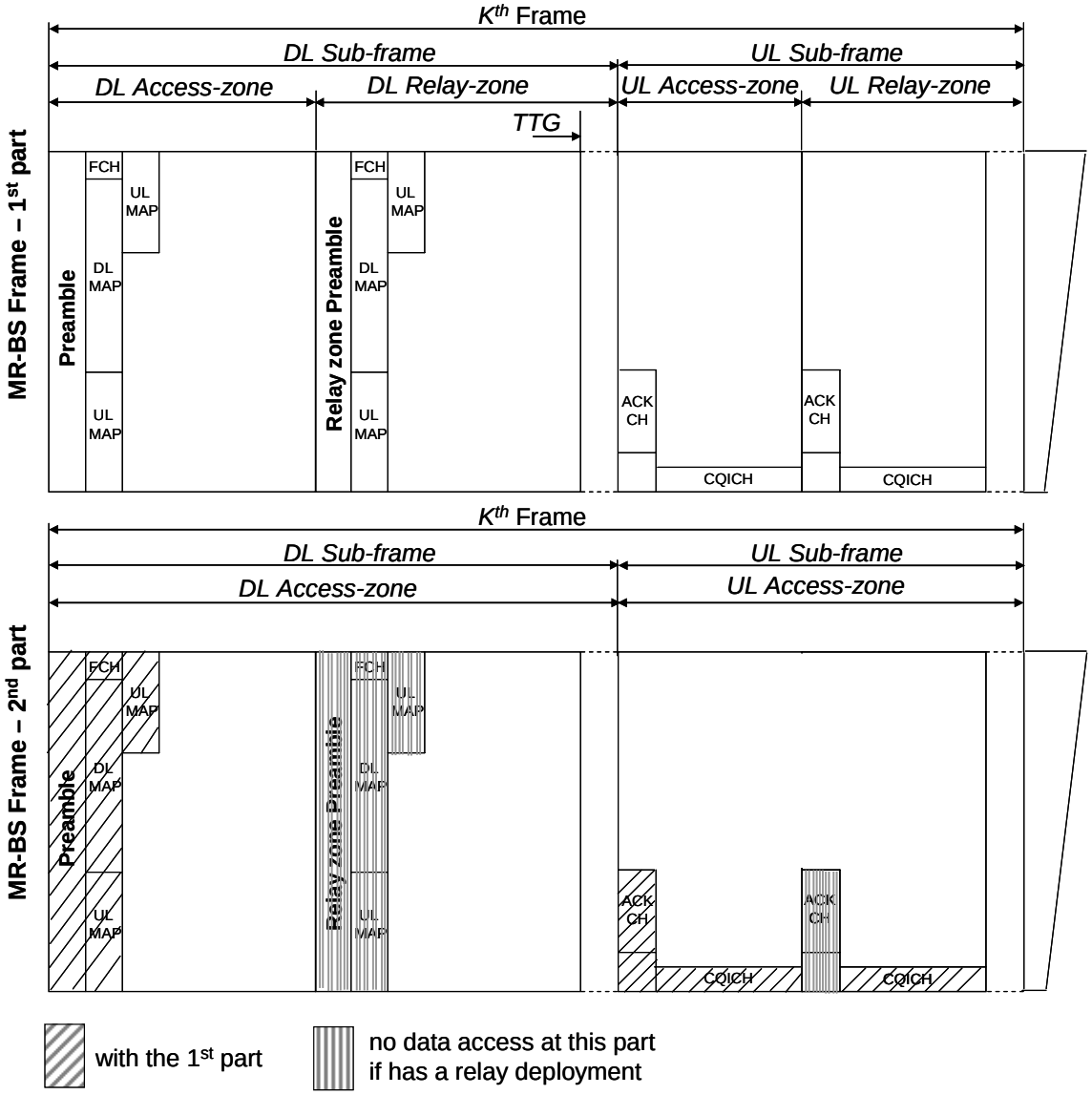

Figure xxxx: Alternative optional MR-BS frame structure

This frame structure has to use two parts to present a complete frame structure – each part might only support a certain number of data burst. As shown in the Figure xxxx, the 1st part is mainly supporting those data burst with relay on relay zone. The 2nd part is mainly supporting access zone.

With this frame structure, the access link can be transmitted simultaneously with relay link. For multihop (>2), it is more efficient for the network to assign multiuser access to achieve multiuser diversity gain.

In addition, a relay zone preamble is also introduced as an option to support multihop (>2) as the preamble should be operated on RSs for their DLs. In order to avoid interference, for the period of DL Relay-zone preamble, FCH and mapping, no data access is allowed. For CQICH, both access link and relay link should be assigned to share the resource efficiently.

Further noted on multihop (>2), there is no limitation on all relay-links to be completed during the period of one relay-zone. As the access-link covers both BS→MS(s) and RS→MS(s), the access link could be only BS→MS(s) or only RS→MS(s) or both. It also allows the mixed version of access link transmission.

8.4.4.7.2.2 Relay frame structure
For the TDD mode, an example of an RS frame structure is shown in Figure xxx.

The Relay Station transmits its frame start preamble time aligned with its serving MR-BS frame start preamble.

The DL sub-frame shall include at least one DL Access Zone and may include ~~at least~~ one or more DL Relay Zones. An R-TTG-may be placed between a DL Access Zone and a DL Relay Zone..
The UL sub-frame may include one or more UL Access Zones and one or more UL Relay Zones. An R-RTG may be placed between a UL Access Zone and a UL Relay Zone.

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. There may be more than one R-TTG and more than one R-RTG inserted in the RS frame. 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 contents of the FCH, DL MAP, and UL MAP in the Relay Frame may be different from those in the MR-BS Frame.

Each RS frame begins with a preamble followed by an FCH and the DL MAP and possibly a UL MAP. In the DL Access Zone, the subchannel allocation, the FCH transmission, and the FCH shall be as defined in Section 8.4.4.2. The content of

The number, size, and location of the relay zones shall be configurable.

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

References

[1] IEEE C802.16j-06/233r8, “Frame Structure to Support Relay Node Operation”, 2006-11-16.

[2] IEEE Computer Society and the IEEE Microwave Theory and Techniques Society, “IEEE Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1”, IEEE 28 February 2006.