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Abstract	The document proposes that RSs should transmit an amble at a fixed position in the frame structure. The RS-amble transmission is configurable.
Purpose	Review and adopt.
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RS-amble Position for Multihop Relays

Introduction

The current relay frame structure specifies that an RS should use the access preamble for synchronization when the RS gets access into the wireless network. However, after the initial entry is performed, an RS is not able to use the access preamble for synchronization because it has to transmit the access preamble synchronously with the access station (BS or RS) to which it is attached. Due to this situation, the RS has to rely only on pilot tones to perform the synchronization. Because the relay zone in the frame structure can be small, this can cause synchronization misadjustment, especially for a mobile RS and therefore, a separate RS amble is proposed to be sent by an RS so that subordinate RSs can use this RS-amble for synchronization.
In addition, in 16e system, MSs use the access preamble to measure the relative signal strength of neighboring BSs. Therefore, the RS-amble shall also be used for the neighborhood monitoring and other measurements, such as channel quality and interference estimation.

Some requirements for RS-amble position

Based on the above discussion, the position for the RS-amble should satisfy the following requirements:

- It should be on a fixed position relative to the beginning of the access preamble in order to allow those RS that want to monitor the ambles to do it for other RSs also, and to create less interference in the network;
- The transmission/reception (TX/RX) of the RS-amble could be configured depending on the radio network deployment (e.g. if a fixed RS deployment is preferred, then there may not be a need to TX the RS-amble in every frame, while if there are present mobile RSs that have a relative high mobility, TX of RS-amble may be required more often).
- Some RSs such as ones which do not support subordinate RSs for synchronization and ones which do not send an access (frame start) preamble (e.g. transparent relays, or when there are no subordinate MSs) may not need to transmit the RS amble.

Proposed RS-amble position

We are proposing the RS-amble to be fixed at the last OFDMA symbol at the end of the DL-subframe.

There is an issue with the optional common sync symbol (8.4.6.1.1.1) that could be transmitted every 4^{th} frame. The problem can be avoided either by turning off the transmission of the common sync symbol or by using a transmission pattern for the RS-amble that does not collide with that of the common sync. Also, it is discussed in [1] that the frames can be very well time-aligned across the multiple hops. This allows all the MSs (even those that have an RS as an access station) to use the common sync symbol transmitted only by the MR-BS.

The position of the RS-amble at the end of the DL-subframe is also appealing due to the fact that it does not break the continuity of the DL zones in the frame structure. Note that both the preamble and the common sync symbol are not considered as part of any zone, although they are part of the DL-subframe. We consider the same thing is applicable to RS-amble, also.

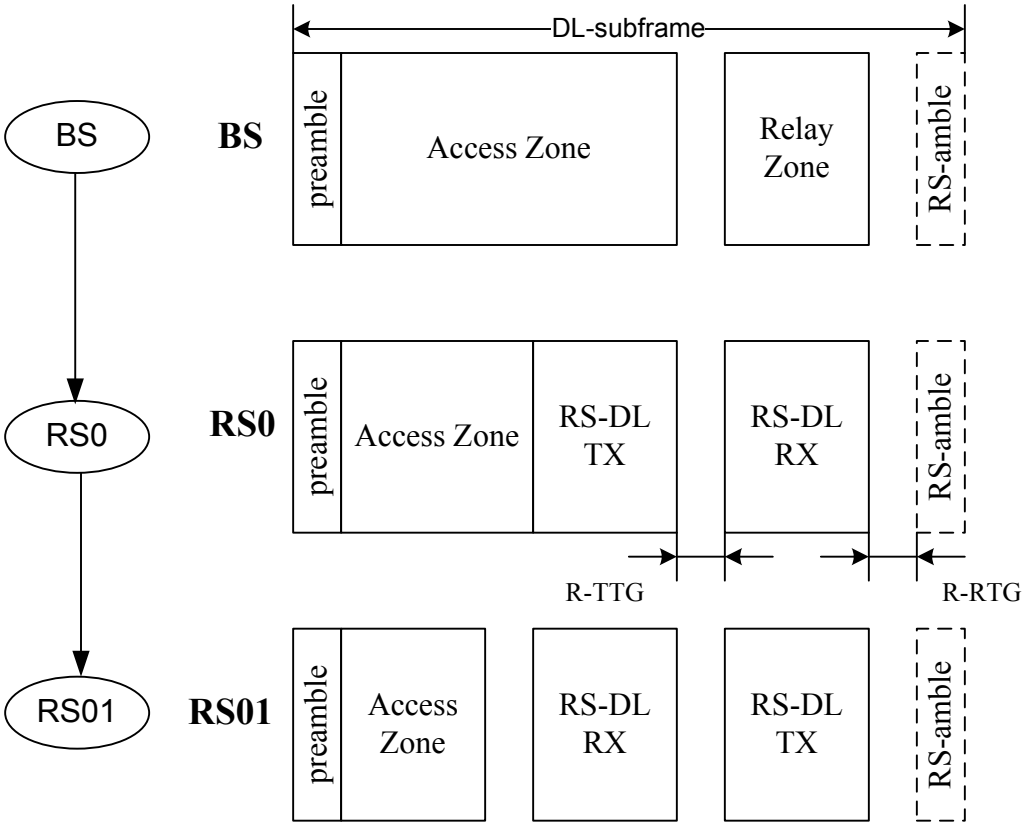

Figure 1. RS-amble position at the end of DL-subframe

An example of placing the RS-amble at the end of the DL-subframe for the single-frame structure is presented in the Figure 1, where we have considered that there are two RS-zones, and a 3-hops relay case. The RS-amble is represented with dash-line to indicate that it is not necessary to be transmitted every frame. When the RS-amble is not transmitted or received in a given frame, the scheduler can use the symbols assigned to RS-amble for traffic.

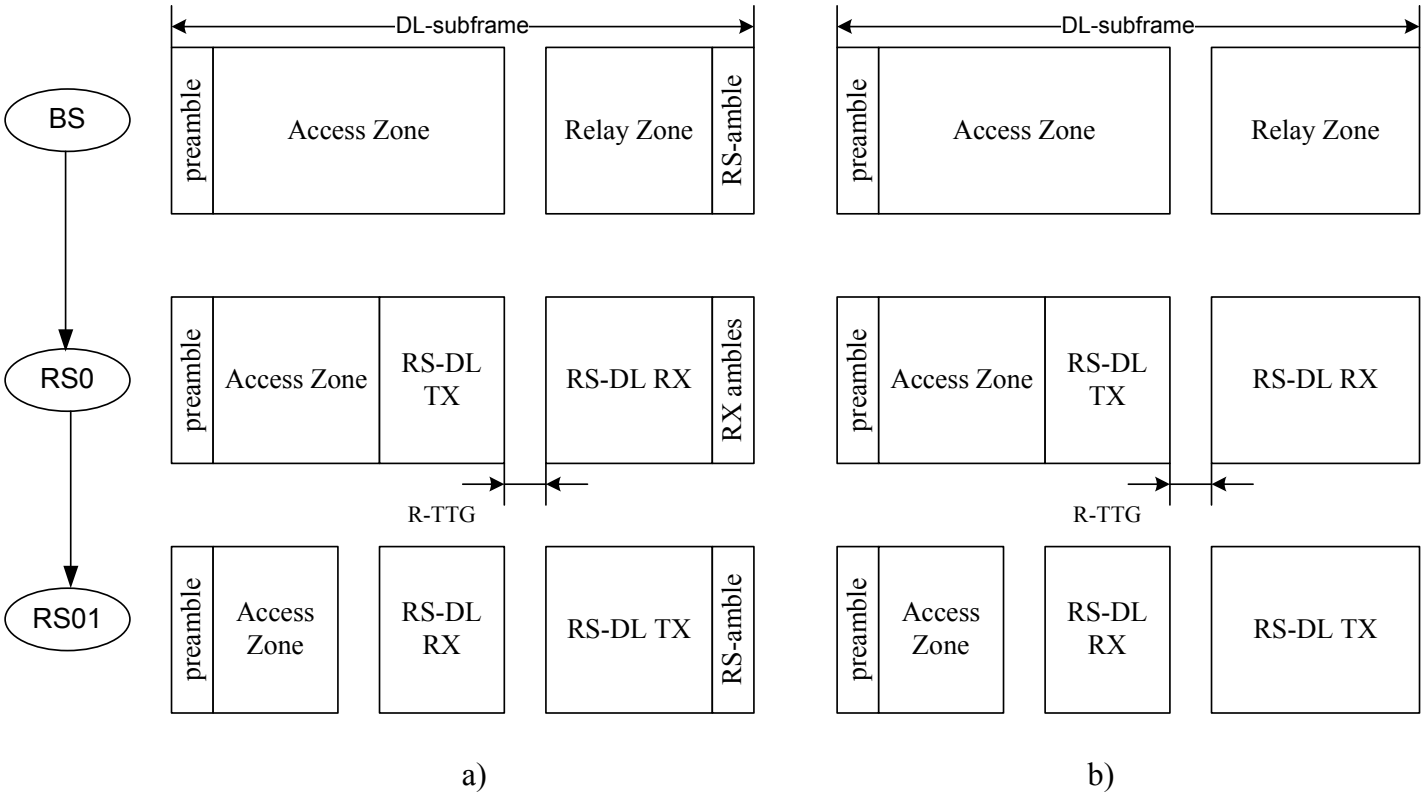

Figure 2. Examples of re-using the RS-amble and transition gaps symbols

Figure 2a) shows how the transition gaps (R-TTG and R-RTG) symbols have been re-used by the scheduler to TX data. Note that in this case RS0 is in RX both during the reception of the relay zone and during the reception of the RS-amble, therefore no transition gap is necessary.
Figure 2b) shows how both the transition gaps (R-TTG or R-RTG) and the RS-ambles symbols have been re-used by the scheduler to transmit data traffic. In this case the RS-amble is not transmitted at all.

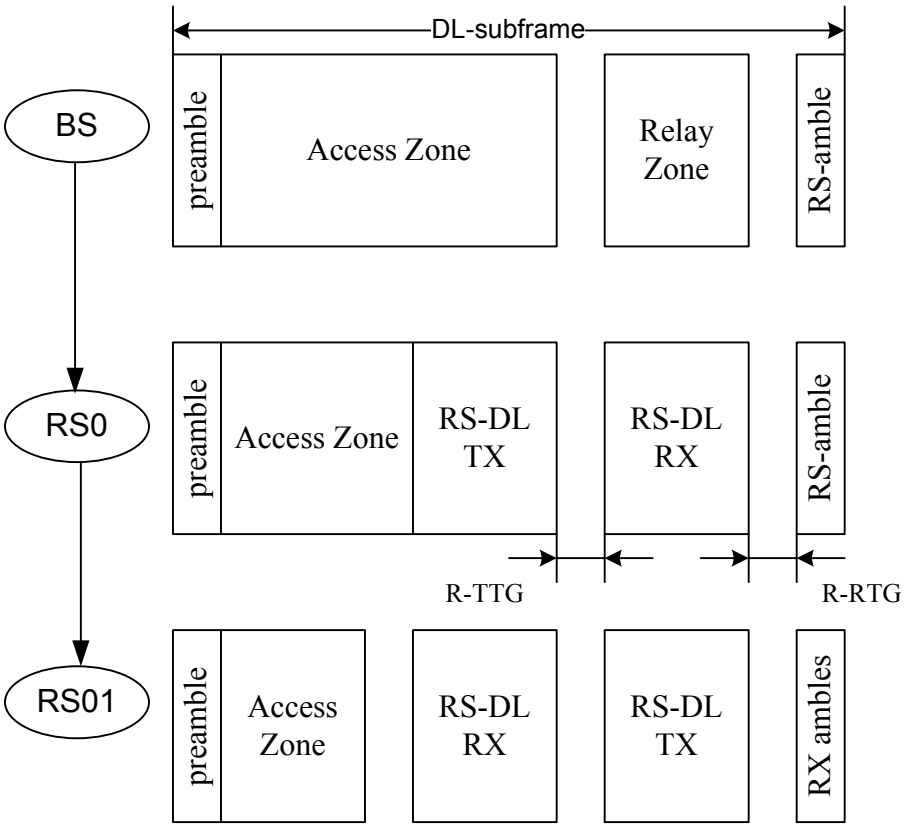

Figure 3. Example of transition gaps and RS-amble symbols present in the frame structure

Figure 3 presents an example where the transition gap (R-RTG) was necessary to be inserted in RS0 frame structure before the RS-amble transmission, because in the RS-zone preceding the RS-amble of RS0 was in the RX mode. So in this case, the scheduler for RS0 could not reuse the transition gap. Note that such frame structure should be avoided by the scheduler because bandwidth is wasted by the transition gaps.

Note that both Figure 2 and Figure 3 are examples for single-frame structure. More efficient re-use of transition gaps and RS-amble symbols can be envisioned for multi-frame structure as well as for single-frame structure.

It is worth mentioning that the re-use idea of symbols can be applied when the Common Sync symbol is transmitted, also.

References

[1] IEEE C802.16j-07/102r2, “Frame Alignment Requirements” Jan. 2007

Specification Changes

[Insert new subclause 8.4.4.7.2.3, with the following]

8.4.4.7.2.3 RS-amble position

The RS-amble should be transmitted in the last OFDMA symbol of the DL subframe. The RS amble shall not be transmitted in the frame that the optional Common_Sync symbol of the 802.16e (see 8.4.6.1.1.1) is transmitted by the MR-BS. An R-TTG or R-RTG may be inserted before RS-amble or Common_Sync symbols.

The transmission of the RS-amble is configurable.