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Re:	Call for technical proposals 802.16j-06/027
Abstract	This contribution contains a technical proposal for a relay midamble that can optionally be transmitted by an MR-BS or RS in the R-DL interval. This midamble can be received by an RS instead of the preamble transmitted in the access link when the RS is transmitting its own preamble.
Purpose	For discussion and approval of inclusion of the proposed text into the P802.16j baseline document.
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Relay midamble

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Introduction

When the BS and RSs operate in a frame time synchronous manner [1], it is not practical for the RS to receive preamble transmissions in a TDD system due to the fact that they are also required to transmit preambles to support connection of SS as defined in IEEE Std. 802.16.

Consequently, the proposal is to define a new relay midamble that can be transmitted by an MR-BS or RS during the R-Link transmission interval for reception by an RS in place of reception of the preamble in the access link interval.

The midamble is designed to have properties very similar to the normal preamble to minimize the impact on the existing standard and also enable reuse of existing technology defined for SS/MS receiver at the RS receiver.

Relay midamble (RM) properties

The properties of the proposed relay midamble are summarized in Table 1.

Table 1. Relay midamble properties.

Property	**Preamble**	**RM**	**Notes**
Duration	1 symbol	1 symbol	
Sequence type & subcarrier allocation	As defined in 8.4.6.1.1 of IEEE Std. 802.16	As defined in 8.4.6.1.1 of IEEE Std. 802.16	Sequence type and subcarrier allocation technique is the same as that used for the preamble.
Power	+9dB	+6dB	
Repetition rate	Every frame	Flexible	See [1].
Location	Fixed (first symbol)	Flexible	See [1].
Status	M	O	

In summary, the sequence used for the relay midamble is the same as the set (or possibly a subset [2]) of sequences used for the preamble. The two differences are that the power of each tone is boosted by +6dB over unboosted data subcarrier power and the location of the RM is flexible [1]. This prevents a simple time domain correlator at the SS from selecting the RM over the preamble as the candidate point for frame start and downlink channel selection during network entry.

Table 2 compares the power boosting difference between the various different data and pilot tone modulation types.

The existence of the RM is controlled by the MR-BS. The option for the RS to request transmission of an RM is left FFS. However, two mechanisms are envisaged. The first is static request during network entry through a SBC message indicating RM is required for operation. The second is dynamic request through an unsolicited MAC management message from the RS to the MR-BS.

Table 2. Comparison of data and pilot tone boosting.

Modulation Type	I Value	Q Value	Amplitude	Boost	
				Amplitude	Power (dB)
QPSK	0.71	0.71	1.00	1.00	0.00
Preamble	1.00	0.00	1.00	2.83	9.03
Ranging	1.00	0.00	1.00	1.00	0.00
Pilot	1.00	0.00	1.00	1.33	2.50
RM	1.00	0.00	1.00	2.00	6.02

Proposed text changes

[Insert a new subclause at the end of Section 8.4.6.1.1 as indicated:]

8.4.6.1.1.3 Relay midamble (RM)

The MR-BS or RS may also transmit the RM in the R-DL transmission interval to facilitate RS synchronization and identification of the MR-BS or RS by other RSs.

The subcarrier sets and the series used to modulate the RM pilots shall be the same as that defined for the preamble in 8.4.6.1.1. The modulation used for the RM pilots is boosted BPSK as defined in 8.4.9.4.3.3.

[Insert new subclause 8.4.9.4.3.3:]

8.4.9.4.3.3 Relay midamble modulation

The pilots in the RM on the R-DL shall follow the instructions in 8.4.6.1.1.3, and shall be modulated according to Equation (137a):

$$\mathrm{Re}\left(RMPilotsModulated\right) = 4\left(\frac{1}{2} - w_k\right) \qquad (137a)$$

$$\mathrm{Im}\left(RMPilotsModulated\right) = 0$$

References

[1] Hart, M, et al., “Frame structure for multihop relaying support”, IEEE C802.16j-06/138, IEEE 802.16 meeting #46, Dallas, November 2006.

[2] Viorel, D., “Re-organisation of the PN sequence for RS access”, IEEE C802.16j-06/150, IEEE 802.16 meeting #46, Dallas, November 2006.