Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Relay amble sequence**
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Source(s)	Mike Hart, Yuefeng Zhou, Sunil Vadgama Fujitsu Laboratories of Europe Ltd. Hayes Park Central Hayes, Middx, UB4 8FE, UK Chenxi Zhu Fujitsu Laboratories of America Voice: +44 20 8606 4523 Fax: +44 20 8606 4539 mike.hart@uk.fujitsu.com
Re:	Call for technical proposals 802.16j-06/034.
Abstract	This contribution contains a technical proposal for an amble sequence that can optionally be transmitted by an MR-BS or RS at the start of a R-DL zone or as a relay postamble at the end of the DL subframe. This so called “relay postamble” or “relay zone preamble” can be received by an RS instead of the frame start preamble transmitted in the access link when the RS is transmitting its own frame start preamble.
Purpose	For discussion and approval of inclusion of the proposed text into the P802.16j baseline document.
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Relay amble sequence

Mike Hart, Yuefeng Zhou, Sunil Vadgama, Chenxi Zhu
Fujitsu Laboratories of Europe Ltd. & Fujitsu Laboratories of America

Introduction

Based on the frame structure accepted into the baseline document [1] in meeting #46 it is not practical for a non-transparent RS to receive frame start preamble (a.k.a. access preamble) transmissions during operation due to the fact that they are also required to transmit frame start preambles to support connection of SS as defined in IEEE Std. 802.16.

As a consequence, the introduction of an optional relay amble in the form of either a relay zone preamble or relay postamble used for transmission from an MR-BS or RS has been proposed [2][3]. This proposal defines the set of sequences that can be used for the relay zone preamble or relay postamble, referred generically to as the relay amble throughout the remainder of this contribution.

The relay amble is designed to have properties very similar to the frame start 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. However, it is modified such that an SS/MS will not accidentally receive and interpret a relay amble as a frame start preamble.

Relay amble properties

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

Table 1. Relay amble properties.

Property	Preamble	Relay amble	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 [3].
Location (in subframe)	Fixed (first symbol)	Flexible / Fixed (last symbol in DL subframe)	See [3]. Note relay zone preamble, if present, is always the first symbol in a R-DL zone interval.
Status	M	O	

In summary, the sequence used for the relay amble is the same as the set (or possibly a subset [4]) of sequences used for the preamble. The two differences are that the power of each tone is boosted by +6dB over the unboosted data subcarrier power and the location of the relay amble is either dependent on the location of the R-DL zone or at the end of the subframe. This prevents a simple time domain correlator at the SS from selecting the relay amble over the frame start 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.

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 amble

The MR-BS or RS may transmit a relay amble in the form of a relay zone preamble or relay postamble to facilitate identification of the MR-BS or RS by other RSs.

The subcarrier sets and the series used to modulate the relay amble pilots shall be the same as that defined for the frame start preamble in 8.4.6.1.1. The modulation used for the relay amble 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 amble modulation

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

$$\mathrm{Re}(RA\_PilotsModulated) = 4\left(\frac{1}{2} - w_k\right)$$
$$\mathrm{Im}(RA\_PilotsModulated) = 0 \qquad (137a)$$

References

[1] IEEE 802.16 Relay TG, “Baseline Document for Draft Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems: Multihop Relay Specification”, IEEE 802.16j-06/026r1, 1 December 2006.

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

[3] Hart, M., et al., “Relay amble position”, IEEE C802.16j-07/xxx, IEEE 802.16 meeting #47, London, January 2007.

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