Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**STC (Space-Time Code) Preamble Sequence in OFDM system**	
Date Submitted	**[2003-01-09]**	
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Re:	802.16d-02/01 Call for Contributions on Project 802.16d	
Abstract	This document proposes the method to transmit STC preamble and STC preamble itself in OFDM system with 2 transmit antennas. The proposed sequence has low PAPR of 2.7448dB.	
Purpose	Changing the method to transmit STC preamble and inserting STC Preamble in OFDM system with 2 transmit antennas.	
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STC (Space-Time Code) Preamble Sequence in OFDM System

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1. Introduction

This document proposes the method to transmit STC preamble and STC preamble itself in 256-OFDM mode with 2 Tx. antennas. The proposed method can enhance the performance of channel estimation without changing DL-MAP frame format. The proposed sequence also has low PAPR of 2.7448dB.

2. Necessity of STC Preamble Sequence in OFDM system

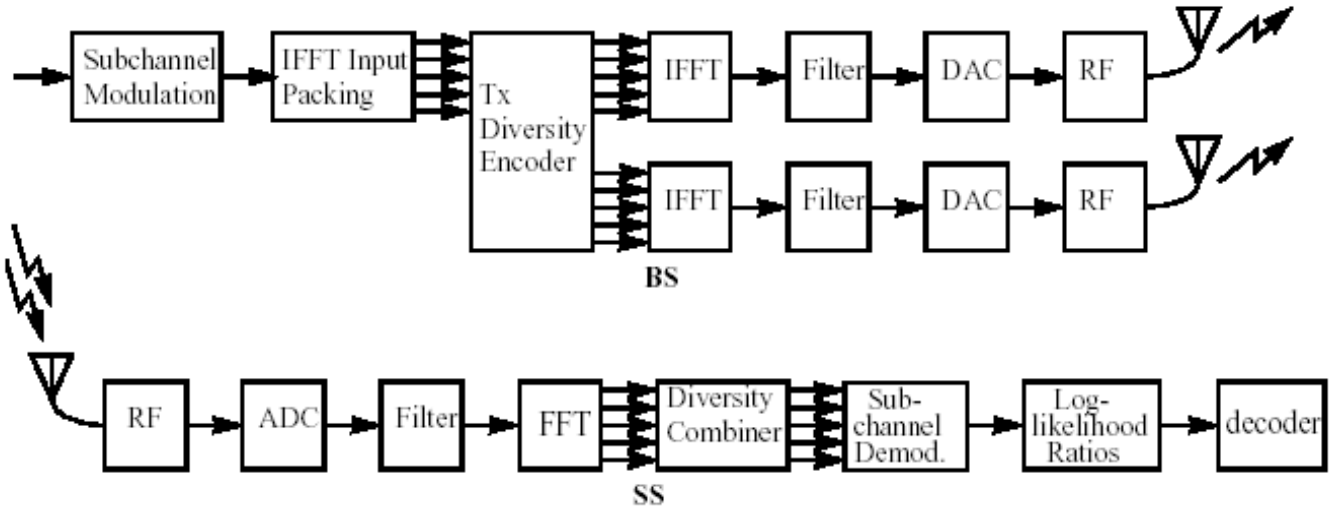

Figure 128ap—Illustration of STC

This document deals with only 256-OFDM mode with 2 Tx. antennas as described above. To initiate the parameters(timing, frequency offset and channel parameters), several preambles are needed. So, there are two kinds of preambles in 256-OFDM mode, one is long preamble and the other is short preamble. The long preamble consists of 4 times 64 ples(S(-100:100)) and short preamble(P(-100:100)). The short preamble consists of 2 times 128 samples, P(-100:100). The 256-OFDM mode with 1 Tx. antenna has the following procedure for synchronization and channel estimation.

- Procedure for initialization (256-OFDM mode with *1 Tx. antenna*)
  1. The first part of long preamble, S(-100:100) is transmitted once for coarse synchronization (timing and frequency offeset estimation).
  2. Short preamble, P(-100:100) is transmitted once for fine synchronization and channel estimation

We have to consider more things about initialization in 256-OFDM mode with 2 Tx. antennas. So to speak, what do we transmit in the second Tx. antenna. In order to know the necessary STC preamble, the DL-MAP STC IE format has to be considered.

The current text of 8.4.5.2.4 in 802.16a/D7 is as follows:

*"**8.4.5.2.4 DL-MAP STC IE format***

In the DL-MAP, an STC enabled BS(see 8.4.6) may transmit DIUC=15 with the STC_IE() to indicate that subsequent allocations shall be STC encoded. No preceding DL allocations shall be STC encoded and all subsequent DL allocations until the end of the frame shall be STC encoded.

Table 116aw—OFDM STC Information Element format

Syntax	Size	Notes
STC_Information_element() {		
extended DIUC	4 bits	STC = 0x01
}		

The duration of the DIUC=15 STC_IE() allocation is always exactly one OFDM symbol. From the start of the frame up to this allocation, only one antenna shall be used. During this allocation, the short preamble (see 8.4.3.6) shall be transmitted from the other antenna. After this allocation, the BS shall transmit from both its antennas until the end of the frame."

The performance of channel estimation in antenna 0 can be improved by changing the method to transmit the short preamble as follows:

- *Proposed method to transmit STC preamble*
  1. From the start of the frame to this allocation, only one antenna shall be used.
  2. During this allocation, the short preamble using odd carriers shall be transmitted from antenna 0.
  3. Simultaneously, the short preamble using even carriers shall be transmitted from antenna 1.

  ✓ Effects

  - The interpolation for channel estimation of antenna 0 is not needed, so the performance of channel estimation in antenna 0 can be enhanced.
  - This method does not change DL-MAP STC IE format

3. Proposed Text Change for DL-MAP STC IE format

The following text replaces section '8.4.5.2.4 DL-MAP STC IE format' on page 170 in 802.16a/D7.

8.4.5.2.4 DL-MAP STC IE format

In the DL-MAP, an STC enabled BS(see 8.4.6) may transmit DIUC=15 with the STC_IE() to indicate that subsequent allocations shall be STC encoded. No preceding DL allocations shall be STC encoded and all subsequent DL allocations until the end of the frame shall be STC encoded.

Table 116aw—OFDM STC Information Element format

Syntax	Size	Notes
STC_Information_element() {		
extended DIUC	4 bits	STC = 0x01
}		

The duration of the DIUC=15 STC_IE() allocation is always exactly one OFDM symbol. From the start of the frame up to this allocation, only one antenna shall be used. *During this allocation, the short preamble using odd carriers(see 8.3.4.6) shall be transmitted from antenna 0 and simultaneously the short preamble using even carriers(see 8.3.4.6) from antenna 1.* After this allocation, the BS shall transmit from both its antennas until the end of the frame.

4. Inserting STC Short Preamble using odd carriers

add in line 36 page162 in 802.16a/D7

The STC short preamble using odd carriers is given by $P_{odd}(-100:100)$

$P_{odd}(-100:100) = \{0,-1,0,-1,0,+1,0,-1,0,+1,0,-1,0,+1,0,+1,0,-1,0,-1,$
$0,+1,0,+1,0,-1,0,+1,0,-1,0,+1,0,-1,0,-1,0,+1,0,+1,$
$0,+1,0,+1,0,-1,0,+1,0,-1,0,+1,0,-1,0,-1,0,+1,0,+1,$
$0,-1,0,-1,0,+1,0,-1,0,+1,0,+1,0,+1,0,-1,0,-1,$
$0,-1,0,-1,0,+1,0,+1,0,+1,0,+1,0,-1,0,+1,0,+1,$
$0,-1,$
$0,-1,0,+1,0,-1,0,+1,0,-1,0,+1,0,+1,0,-1,0,-1,0,-1,$
$0,-1,0,+1,0,+1,0,+1,0,+1,0,+1,0,-1,0,+1,0,+1,0,-1,$
$0,-1,0,+1,0,+1,0,+1,0,+1,0,+1,0,-1,0,+1,0,+1,0,-1,$
$0,-1,0,+1,0,+1,0,+1,0,+1,0,+1,0,-1,0,+1,0,+1,0,+1,$
$0,+1,0,-1,0,-1,0,-1,0,-1,0,-1,0,+1,0,-1,0,-1,0\}$
$*\text{sqrt}(2)*\text{sqrt}(2)$

$P_{odd}(-100:100)$ has low PAPR of 2.7448dB.

5. Conclusion

This document proposes the method to transmit STC preamble and $P_{odd}(-100:100)$, STC short preamble using odd carriers in 256-OFDM mode with 2 Tx. antennas. The proposed method can enhance the performance of channel estimation without changing DL-MAP frame format. The proposed sequence also has low PAPR of 2.7448dB.

6. References

[1] IEEE 802.16a/D7