Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**STC Macro-Diversity Transmission**
Date Submitted	**2004-08-18**
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Re:	IEEE 802.16e D4
Abstract	This contribution proposes STC Macro-Diversity Transmission.
Purpose	To incorporate the changes here proposed into the 802.16e D4 draft.
Notice	
Release	
Patent Policy and Procedures	

STC Macro-Diversity Transmission

1 Introduction

This contribution is related to the IEEE C802.16e-04/165r1 "OFDMA PHY Layer Support for SHO Based Macro-Diversity Transmission" and aims to enhance performance and provide hardware simplicity.
According to current version of the IEEE802.16e standard STC is used for transmit diversity. For STC implementation, 2 or 4 antennas are required in a BS. In this contribution STC macro-diversity transmission is proposed which can reduce the number of antenna by half, therefore decrease hardware complexity. And it can increase diversity gain, therefore the performance enhancement can be expected.
Macro-diversity gain is derived from signal combining operation in soft-handoff region. CTC which could be applied for option of OFDMA system can be easily linked with macro-diversity transmission based on SHO. CTC linked with macro-diversity provides structural advantage as well as coding and diversity gain.

2 STC Macro-Diversity Transmission

Figure 244 in section 8.4.8.1 of IEEE P802.16-REVd/D5-2004 shows an illustration of STC for optional zone in DL. STC can make diversity gain by transmitting signal from more than 2 antennas. But implementation of STC requires 2 or 4 antennas in a BS, so that cost of BS could be increased. The proposed structure in this document is shown as Figure xxx which reduce the number of antenna by half. Also more diversity gain can be achieved using 1 antenna from each BS (2 antennas totally) compared to 2 antennas from one BS because channel coherency of the different BS sites is better than that of the same BS site.

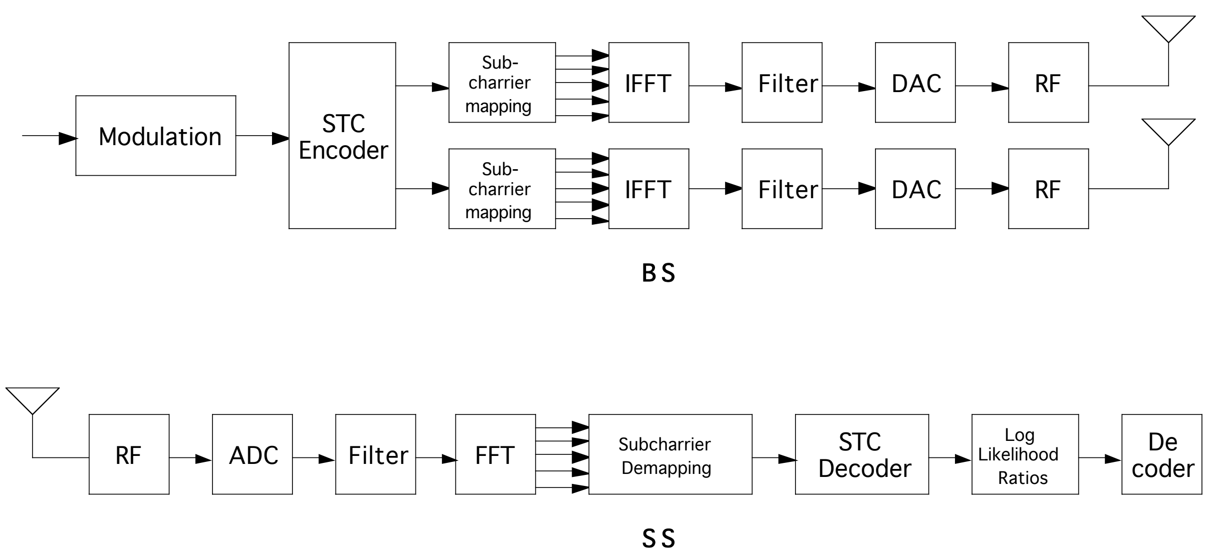

Figure 244 - Illustration of STC for optional zones in DL

Figure 250 in section 8.4.8.1.6 of IEEE P802.16-REVd/D5-2004 shows an illustration of transmit diversity using 4 antennas. Same effect could be applied in case of 4 antennas. Figure yyy shows that the number of antennas can be reduced from 4 to 2. Also more diversity gain can be achieved by just using same number of antennas from different BS compared to from one BS because the channel coherency of the former is better than that of the latter.

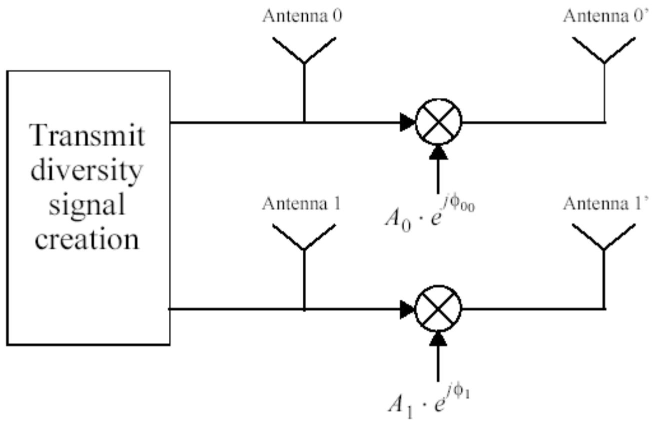

Figure 250 — Illustration of Transmit diversity using 4 antennas

As a result STC macro-diversity transmission could reduce the complexity of BS and achieve more diversity gain.

3 SHO Based Macro-Diversity Transmission Scenario Linked with CTC

This contribution could be applied only when CTC, which is optional, is used. Macro-diversity gain can be generated if a number of signals from multiple BSs are combined in certain ways. CTC and macro-diversity can be easily linked together and it provides structural advantage as well as coding and diversity gain. CTC encoder includes its constituent encoder and CTC-interleaver. The output of CTC encoder is composed of both coded data with CTC-interleaving and without CTC-interleaving. In this contribution CTC-interleaved and non-CTC-interleaved data data will be transmitted from each BS. MSS in SHO Zone could receive CTC-interleaved data from one BS and non-CTC-interleaved data from another BS. This scenario can provide structural advantage of CTC encoder in BS and decoder in MSS. In order to inform MSS decode correctly, HO_Linked_with_CTC_Anchor_BS_DL_MAP_IE is used in anchor BS with CTC subpacket ID which indicate that transmitted data is CTC-interleaved or not. MSS demodulates signals respectively from each BS, and decodes the packet with CTC-interleaved and non-CTC-interleaved data which are from each BS. The relative delays within active BSs need not be smaller than prefix because MSS has respective demodulator for each BS. BSs in the active set concurrently transmit the CTC-interleaved and non-CTC-interleaved data with the same CID and use the same data randomizer, but the different permutation can be used.

4 Proposed Changes in Document

[Insert the following text before section 8.4.9]

8.4.8.10 STC Macro-Diversity Transmission

Figure xxx shows an illustration of STC macro-diversity transmission. BS1 transmits only the half signal to be transmitted from antenna 1 to SS and BS 2 transmits the other half signal. The total amount of signal processing in all BSs is same as that of normal case without STC macro-diversity. But hardware complexity for example antennas can be reduced by half. Also diversity gain can be increased by better channel coherency between different BSs.

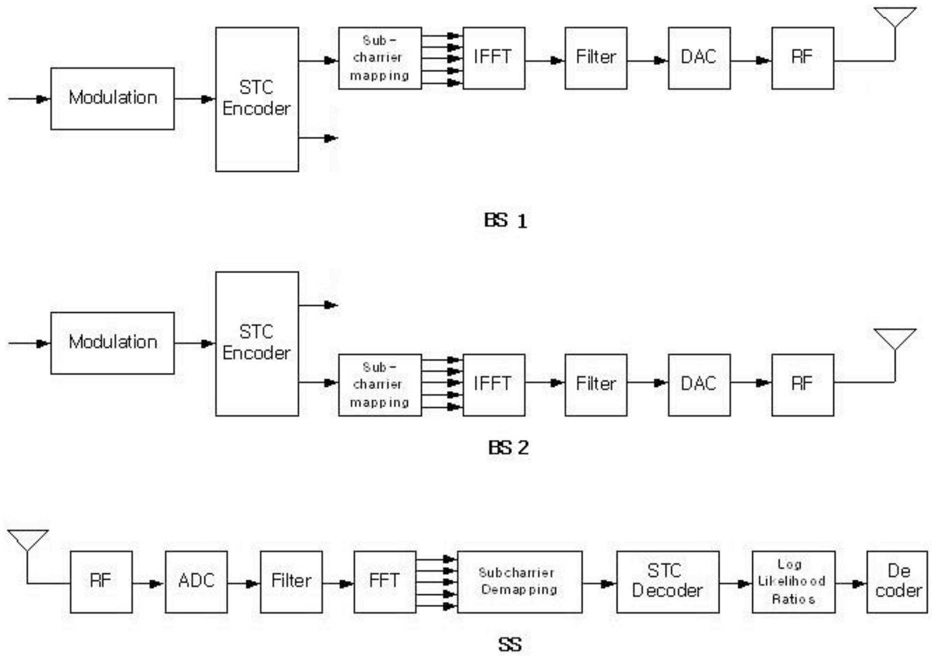

Figure xxx - Illustration of STC for optional zones in DL

Figure yyy shows an illustration of STC macro-diversity transmission using 2 antennas in each BS. It gives hardware complexity reduction, for example the number of antenna could be reduced by half. And diversity gain can be increased compared to the case without macro-diversity.

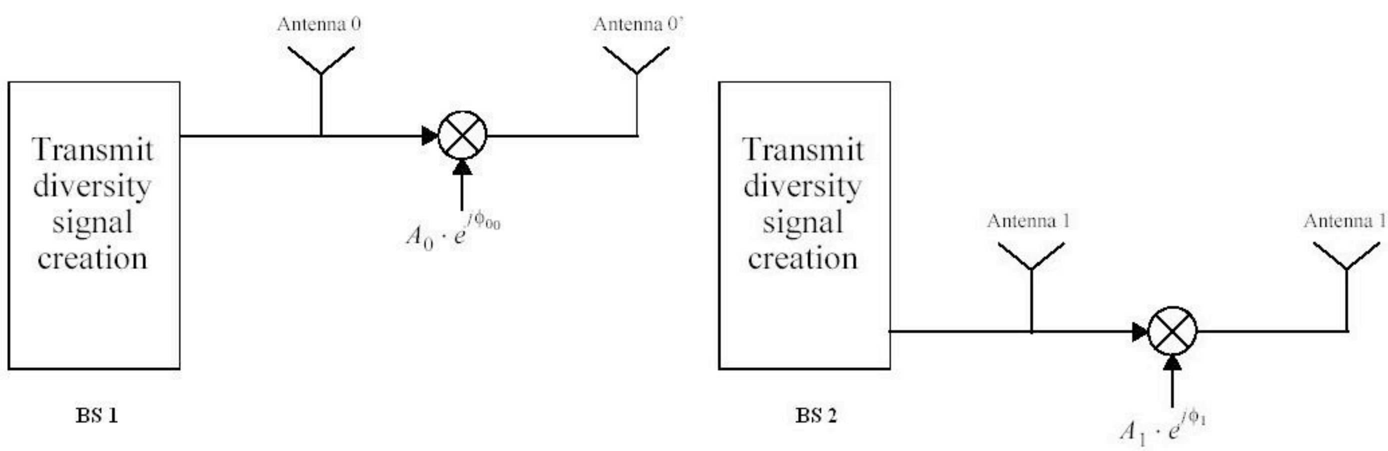

Figure yyy - Illustration of STC for optional zones in DL

[Modify the Table 277a in section 8.4.5.3.4]

8.4.5.3.4 Space-Time Coding (STC)/Zone switch IE format for DL

Table 277a **OFDMA downlink STC_ZONE IE format**

Syntax	Size	Notes
STC_ZONE_ IE () {		
Extended DIUC	4 bits	STC/ZONE = 0x01
Length	4 bits	Length
Permutation	2 bits	00 = PUSC permutation 01 = FUSC permutation 10 = Optional FUSC permutation 11 = Optional adjacent subcarrier permutation
Use All SC indicator	1 bits	0 = Do not use all subchannels 1 = Use all subchannels
STCTransmit	2 bits	0b00 = 2 antennas 0b01 = 3 antennas 0b10 = 4 antennas 0b11 = FHDC using 2 antennas
Matrix indicator	2 bits	Antenna STC/FHDC matrix (see 8.4.8) 00 = Matrix A 01 = Matrix B 10 = Matrix C (applicable to 4 antennas only) 11 = reserved
IDcell	6 bits	
Macro-Diversity	1 bit	0 = Do not use Macro-Diversity 1 = Use Macro-Diversity
Reserved	2bits	Shall be set to zero
}		

[Modify the table 284a in section 8.4.5.3.13]

8.4.5.3.13 HO_Anchor_BS_DL_MAP_IE

This MAP IE is in the DL-MAP of active non-anchor BS and indicates the burst from Anchor BS.

Table 284c HO Anchor Active DL MAP IE

Syntax	Size	Notes
HO Anchor Active DL MAP IE () {		
Extended DIUC	4 bits	HO Anchor Active MAP IE = 0x0C
Length	4 bits	Length
for (each bursts) {	16 bits	
Anchor Preamble	8 bits	Preamble of anchor BS
Anchor CID	16 bits	Basic CID in anchor BS
DIUC	4 bits	
OFDMA symbol offset	8bits	

Subchannel offset	6bits	
No. OFDMA symbols	7bits	
No. Subchannels	6bits	
Boosting	3bits	000: normal (not boosted); 001: +6dB; 010: - 6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;
Repetition coding indication	2bits	00 - No repetition coding 01 - Repetition coding of 2 used 10 - Repetition coding of 4 used 11 - Repetition coding of 6 used
SPID	2bits	CTC subpacket ID
}		
}		