

Project	<b>IEEE 802.16 Broadband Wireless Access Working Group</b> < <a href="http://ieee802.org/16">http://ieee802.org/16</a> >	
Title	<b>Improved Data and Pilot Allocation for Cellular OFDMA Systems with Multiple Antennas</b>	
Date Submitted	<b>2004-06-25</b>	
Source(s)	<p>Wonil Roh, JeongTae Oh, Chan-Byoung Chae, Kyunbyoung Ko, Hongsil Jeong, Sung-Ryul Yun, Seungjoo Maeng, Panyuh Joo, Jaeho Jeon</p> <p>Samsung Electronics Co., Ltd.</p> <p>Wen Tong, Peiyong Zhu, Jianglei Ma, Ming Jia</p> <p>Nortel Networks</p>	<p><a href="mailto:wonil.roh@samsung.com">wonil.roh@samsung.com</a></p> <p>Voice: +82-31-279-3868</p> <p><a href="mailto:wentong@nortelnetworks.com">wentong@nortelnetworks.com</a></p> <p>Voice: +1-613-763-1315</p>
Re:	Contribution supporting TGe WG ballot #14b	
Abstract	Improved Data and Pilot Allocation for Cellular OFDMA Systems with Multiple Antennas	
Purpose	Adoption of proposed changes into P802.16e	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy and Procedures	<p>The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) &lt;<a href="http://ieee802.org/16/ipr/patents/policy.html">http://ieee802.org/16/ipr/patents/policy.html</a>&gt;, including the statement "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard."</p> <p>Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair &lt;<a href="mailto:r.b.marks@ieee.org">mailto:r.b.marks@ieee.org</a>&gt; as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site &lt;<a href="http://ieee802.org/16/ipr/patents/notices">http://ieee802.org/16/ipr/patents/notices</a>&gt;.</p>	

# Improved Data and Pilot Allocation for Cellular OFDMA Systems with Multiple Antennas

*Wonil Roh, JeongTae Oh, Chan-Byoung Chae, Kyunbyoung Ko,  
Hongsil Jeong, Sung-Ryul Yun, Seungjoo Maeng, Panyuh Joo, Jaeho Jeon*

**Samsung Electronics**

*Wen Tong, Peiying Zhu, Jianglei Ma, Ming Jia*

**Nortel Networks**

## 1. Introduction

Current draft standard [1] lacks the efficient methods for data and pilot allocation for OFDMA systems with multiple antennas in the sense that space time coding (STC) operates on the mapped subchannels rather than modulated symbols. When transmit diversity schemes are employed for subchannels that are rather long in time, the channel estimation at the receiver performs poorly. Furthermore, there could be potentially a long latency to decode at the receiver. Furthermore, data and pilot mapping for multiple antennas are not defined for UL in the optional permutation zones.

In this contribution, STC enhancements with multiple antennas at BS and SS for optional zones for downlink and uplink for OFDMA PHY are proposed. Pilots and data allocation methods are described and the transmission schemes for 2 and 4 antenna BS are also suggested for the downlink and the uplink.

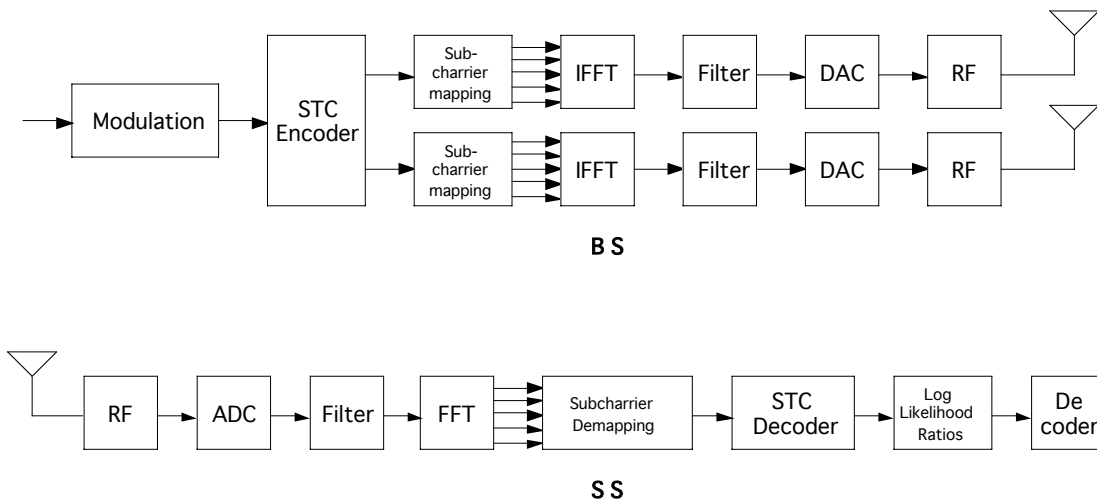
## 2. Data and Pilot Allocation

### 2.1. Optional FUSC and AMC for Downlink

*[Replace the section 8.4.8.3 in page 96 of [1] as follows]*

#### 8.4.8.3 STC for the optional zones in the downlink

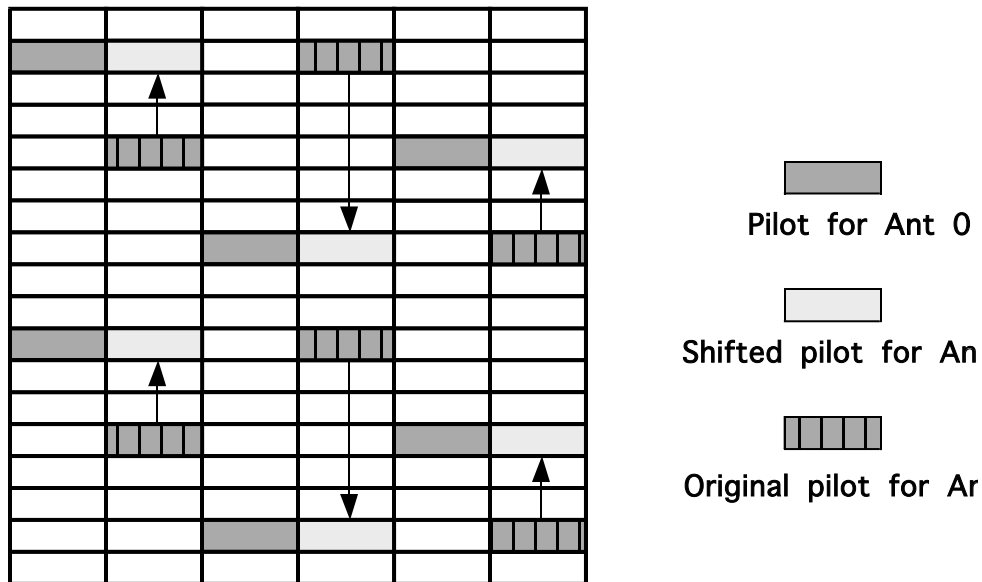
Two optional zones for the downlink, the optional FUSC and the optional AMC zones, are described in 8.4.6.1.2.3 and 8.4.6.3 [2], respectively. STC may be used to improve system performance for these zones and an example of transmit diversity (TD) with 2 tx and 1 rx is shown in Figure aaa.



[Figure aaa - Illustration of STC for optional zones in DL](#)

**8.4.8.3.1 Allocation of pilot subcarriers**

[For 2-antenna BS, all pilots in the even symbols shall be allocated for antenna 0 whereas all pilots in the odd symbols shall be allocated for antenna 1. The positions of pilots in the odd symbols are further switched with those of data subcarriers whose locations coincide with pilots in the previous symbol. This is shown in Figure bbb.](#)



[Figure bbb - Pilot allocation for 2-antenna BS for the optional FUSC and the optional AMC zones](#)

[For 4-antenna BS, pilot pattern shall first be changed as in the 2-antenna BS case, and then the neighboring two subcarriers shall be further punctured for antenna 2 and 3 as is shown in Figure ccc.](#)

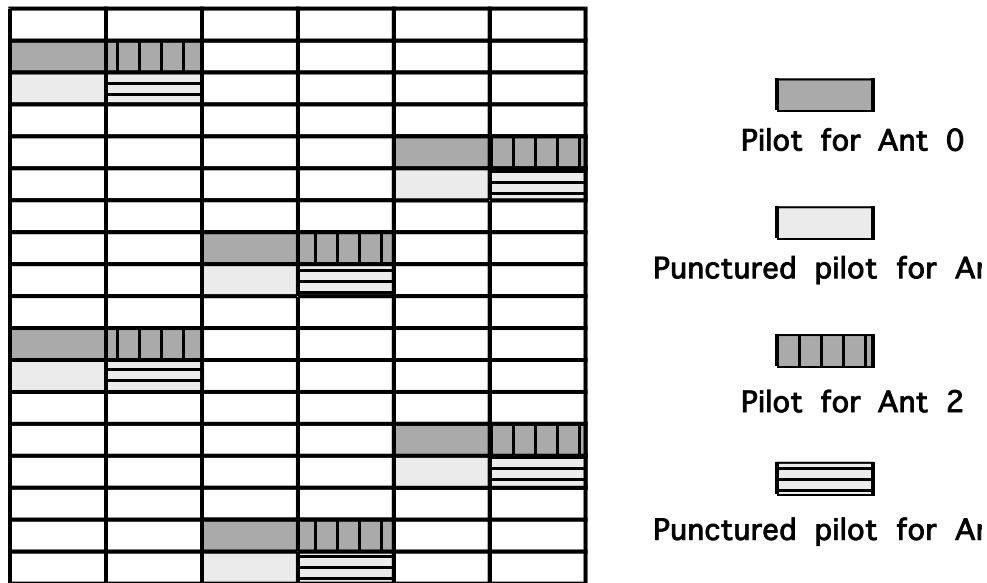


Figure ccc - Pilot allocation for 4-antenna BS for the optional FUSC and the optional AMC zones

### 8.4.8.3.2 Allocation of data subchannels

In the optional FUSC zone with transmit diversity (TD) mode, the data subchannels shall be allocated for two consecutive OFDMA symbols. For the optional AMC zone and TD mode, the data subchannels shall be either 1x6 (1 bin in 6 symbols) or 3x2 (3 bins in 2 symbols) bin combination.

## 2.2. Optional PUSC and AMC for Uplink

### 2.2.1. Specific Text Changes

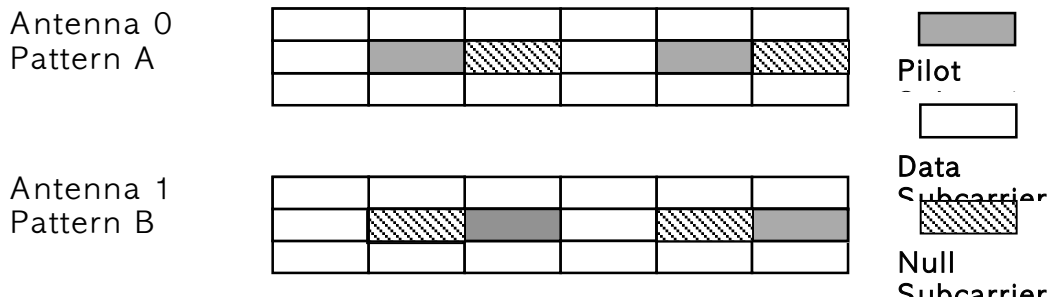
*[Add a new section 8.4.8.4]*

#### 8.4.8.4 STC for the optional zones in the uplink

Two optional zones in the uplink, the optional PUSC and the optional AMC zones, are described in 8.4.6.2.5 and 8.4.6.3[2], respectively. STC may be used to improve system performance for these zones. Furthermore, two single transmit antenna SS's can perform collaborative spatial multiplexing onto the same subcarrier.

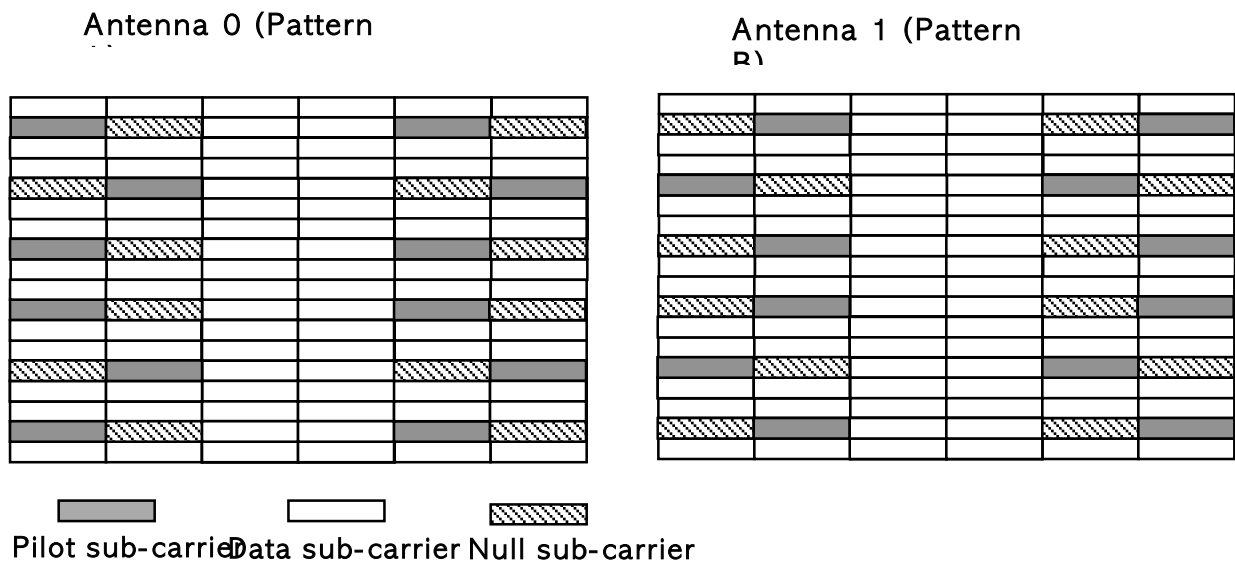
##### 8.4.8.4.1 Allocation of pilot subcarriers

For 2-antenna SS and the optional PUSC, pilots for each antenna shall be allocated as shown in Figure ddd.



[Figure ddd - Uplink pilot allocation for 2-antenna BS for the optional PUSC zones](#)

[For 2-antenna BS and the optional AMC, all pilots in the 1<sup>st</sup>, 2<sup>nd</sup>, 5<sup>th</sup> and 6<sup>th</sup> symbols shall be allocated for antenna 0, 1. This is shown in Figure eee.](#)



[Figure eee - Uplink pilot allocation for 2-antenna BS for the optional AMC zones](#)

[Two single transmit antenna MSSs can perform collaborative spatial multiplexing onto the same subcarrier. In this case, one MSS should use uplink pilot allocation with pattern-A, and the other MSS should use the uplink pilot allocation with pattern-B.](#)

**[8.4.8.4.2 Allocation of data subchannels](#)**

[In the uplink optional PUSC zone with transmit diversity \(TD\) mode, the data subchannels shall be allocated for mini subchannel \(type 01\) as shown in Figure ddd. For the optional AMC zone with TD mode, the data subchannels shall be either 1x6 \(1 bin in 6 symbols\) or 3x2 \(3 bins in 2 symbols\) bin combination.](#)

**References:**

[1] IEEE P802.16e/D3 Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands

[2] IEEE P802.16-REVd/D5-2004 Draft IEEE Standards for local and metropolitan area networks part 16: Air interface for fixed broadband wireless access systems