

Enhanced MIMO support for Cellular OFDMA Systems using Midambles

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number: S80216e-04/290r2

Date Submitted: 2004-08-31

Source:

Sriram Mudulodu, K. Giridhar, Erik Lindskog, Kamlesh Rath,
Aditya Agrawal, Bob Lorenz, Babu Mandava, A. Paulraj

Beceem Communications, Inc.

Sung-Eun Park, Wonil Roh, Seung-Hoon Choi, JeongTae Oh,
Chan-Byoung Chae, Kyunbyoung Ko, Hongsil Jeong, Sung-Ryul Yun,
Seungjoo Maeng, Panyuh Joo, Jaeho Jeon, Jerry Kim, Soonyoung Yoon

Samsung Electronics Co., Ltd.

Yossi Segal, Itzik Kitroser, Yigal Leiba, Eli Shasha, Zion Hadad

Runcom Technologies Ltd.

Wen Tong, Peiying Zhu, Jianglei Ma, Ming Jia, Hang Zhang,
Mo-Han Fong

Nortel Networks

Jason Hou, Jing Wang, Sean Cai, Dazi Feng, Yonggang Fang

ZTE San Diego Inc.

Anand Dabak, Srinath Hosur, David Magee

Texas Instruments

Venue: Session #33

Voice: +1-408-387-5019

E-mail: smudulodu@beceem.com

Voice: +82-31-279-5249

E-mail: se.park@samsung.com

Voice: +972-3-9528440

E-mail: yossis@runcom.co.il

Voice: (613)-763-1315

E-mail: wentong@nortelnetworks.com

Voice: 858-554-0387

E-mail: jhou@ztesandiego.com

Voice:

E-mail: hosur@ti.com

Base Document: C80216e-04/290r2

Purpose: Adoption of proposed changes into P802.16e-D5

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.

IEEE 802.16 Patent Policy:

The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <<http://ieee802.org/16/ipr/patents/policy.html>>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." 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 <<mailto:chair@wirelessman.org>> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <<http://ieee802.org/16/ipr/patents/notices>>.

Enhanced MIMO support for Cellular OFDMA Systems using Midambles

August 31, 2004

Introduction

- Goal: To improve channel estimation and tracking in MIMO OFDMA systems
- The preamble is transmitted from a single antenna in the current draft for 802.16e
- First symbol of MIMO zone of the DL sub-frame
- Simple PN sequence, low PAPR, good cross-correlation property
- Support for various FFT sizes and 2,3,4 Tx antennas in both FUSC and PUSC
- Purely optional and no impact on SISO SS

Midamble Structure

- FUSC or optional FUSC
 - The transmit antennas use non-overlapping subcarriers
 - DC carrier is nulled prior to transmission.
- Number of BS antennas is 2 : Antenna n transmits on subcarriers, $-(N_{\text{used}}/2)+n+2k$
- Number of BS antennas is 3 or 4 : Antenna n transmits on subcarriers, $-(N_{\text{used}}/2)+n+4k$

where:

N_t is the number of transmit antennas

n is the antenna index $1, \dots, N_t-1$

k is the sub-carrier running index

Midamble Structure

- Example: $N_t = 4$

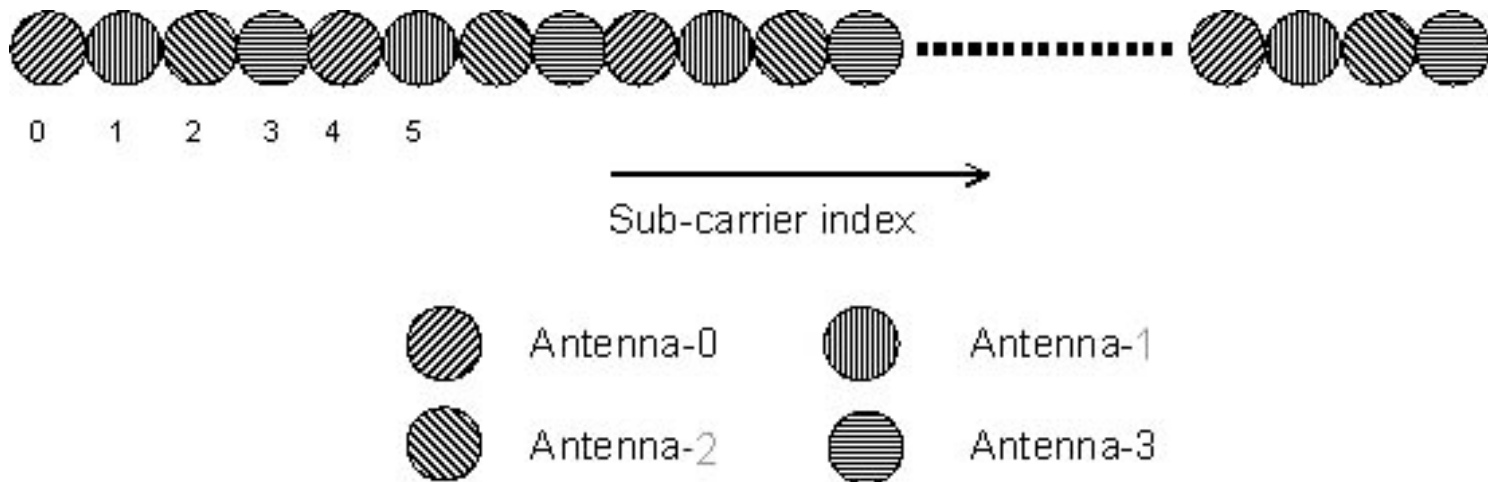


Figure xxxx. Midamble FUSC structure (frequency domain)

Midamble Structure

- PUSC
 - The subchannel permutations and grouping remains same as for the data subchannel
 - Instead all the subcarriers are used as pilots.
- Midamble_Carrier_Set : $-(N_{\text{used}}/2) + n + N_t k$

where:

N_t is the number of transmit antennas
 n is the antenna index $1, \dots, N_t - 1$
 k is the sub-carrier running index

Midamble Structure

- Example: $N_t = 4$

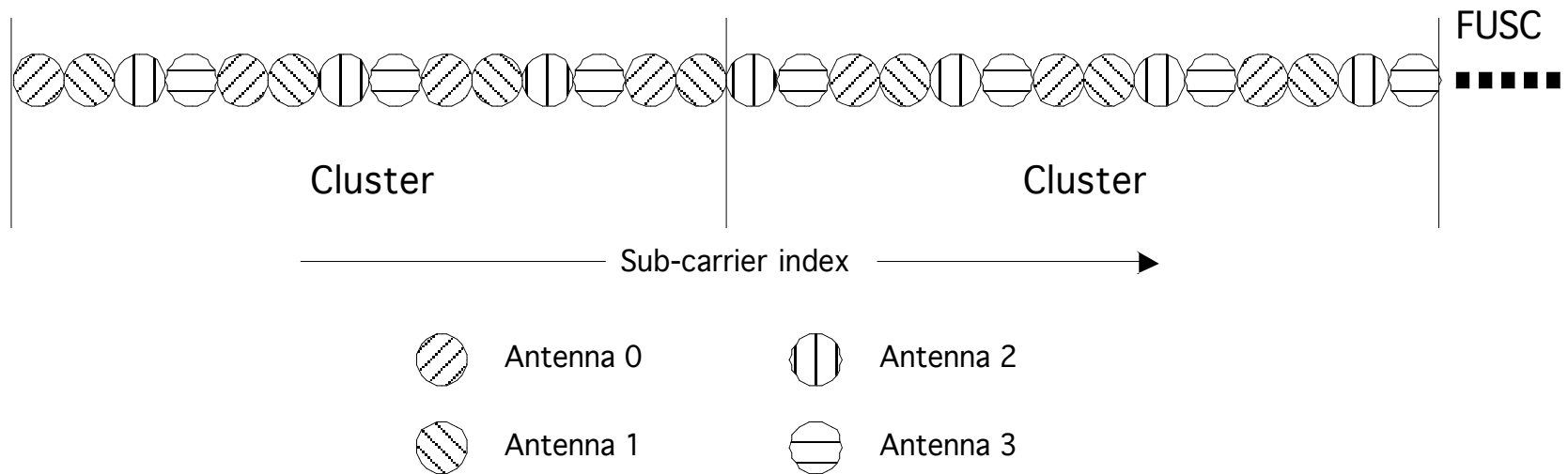


Figure yyyy. Midamble PUSC structure (frequency domain)

Midamble Sequence

- FUSC or optional FUSC

$$q_{ID_{cell}}[m] = \begin{cases} R(8 * \left\lfloor \frac{m}{9} \right\rfloor + m \bmod 9), & \text{where } m \bmod 9 = 0, 1, \dots, 7 \\ T\left(\left\lfloor \frac{m}{9} \right\rfloor\right), & \text{where } m \bmod 9 = 8 \end{cases} \quad m = 0, 1, \dots, \frac{N_{used}}{2 * \left\lfloor \frac{N_t}{2} \right\rfloor} - 1$$

$$R_1(r) = H_{128}(ID_{cell} + 1, \prod_{\left\lfloor \frac{r}{128} \right\rfloor} (r \bmod 128)), \quad r = 8 * \left\lfloor \frac{m}{9} \right\rfloor + m \bmod 9 = 0, 1, \dots, N_r - 1$$

$$R_2(r) = B_{ID_{cell} + 1} \mathcal{G}_{\prod(r)}, \quad r = 8 * \left\lfloor \frac{m}{9} \right\rfloor + m \bmod 9 = 0, 1, \dots, N_r - 1$$

- The sequence $T(k)$ is determined by IDcell and should be chosen to achieve low PAPR

Midamble Sequence

- PUSC
 - The midamble sequence for PUSC shall be obtained from the corresponding sequence used in the FUSC or optional FUSC for the relevant FFT size and number of antennas.
 - For PUSC, however, all the used subcarriers shall further be clustered and divided into different segments as in the data traffic region