Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**128 FFT Sizes for OFDMA PHY**
Date Submitted	**[2004-05-19]**

Source(s)		
	Hassan Yaghoobi,	**Voice: 408-545-6162, mailto:hassan.yaghoobi@intel.com**
	Randall Schwartz,	**Voice: 408-545-9876, mailto:randall.c.schwartz@intel.com**
	Jose Puthenkulam	**Voice: 503 264-6121, mailto:jose.p.puthenkulam@intel.com**
	Intel Corporation CHP3-105 350 East Plumeria Dr. San Jose, CA 95134	
	Jeong-Heon Kim, Jiho Jang, Panyuh Joo, Jaeho Jeon, Soon Young Yoon	**jeongheon.kim@samsung.com** **jiho.jang@samsung.com** **panyuh@samsung.com** **jhjeon@samsung.com** **soon.young.yoon@samsung.com**
	Samsung Electronics Co., Ltd. Dong Suwon P.O.Box 105 416, Maetan-3dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea 442-	

Re:	Working Group Review of P802.16e/D2
Abstract	
Purpose	To propose enhancements to the OFDMA PHY in P802.16e/D2 draft for better performance in narrow channel bandwidths.
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	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,

Procedures	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>.

Scalable OFDMA PHY Expansion

1 Introduction

In this contribution we propose enhancements to the WirelessMAN OFDMA PHY, so that it can perform more optimally in narrow channel bandwidths of smaller than 5 MHz while keeping the sub-carrier spacing fixed in line with the concept of Scalable OFDMA option in P802.16e/D2. The following are some of the parameters that are required to meet the requirements from service providers. The contribution covers expansion of Scalable FFT size set to include 128 FFT size for DL FUSC and PUSC sub-channelization, UL, Optional FUSC, Optional PUSC, Optional AMC sub-channelization formats.

2 Proposed Text Changes

[Add the following tables in section 8.4.6.1.2 after Table 272c and rename Tables 272d-f to 272e-g]

Table 272d— 128-FFT OFDMA downlink carrier allocations

Parameter	Value	Comments
Number of DC Subcarriers	1	Index 64
Number of Guard Subcarriers, Left	11	
Number of Guard Subcarriers, Right	11	
Number of Used Subcarriers (Nused)	106	Number of all subcarriers used within a symbol, including all possible allocated pilots and the DC carrier.
Pilots		
VariableSet #0	2	0,24, 48, 72,96
VariableSet #1	2	12,36,60,84
ConstantSet #0	1	N/A
ConstantSet #1	1	N/A
Number of data subcarriers	96	
Number of data subcarriers per subchannel	48	
Number of Subchannels	2	
PermutationBase		1,0

[Add the following tables in section 8.4.6.1.2 after renamed Table 272g as suggested above]

Table 272j— 128-FFT OFDMA downlink carrier allocations - PUSC

Parameter	Value	Comments
Number of DC Subcarriers	1	index 64
Number of Guard Subcarriers, Left	21	
Number of Guard Subcarriers, Right	22	
Number of Used Subcarriers (Nused) including all possible allocated pilots and the DC carrier.	85	Number of all subcarriers used within a symbol
Renumbering sequence	2, 3, 1, 5, 0, 4	used to renumber clusters before allocation to subchannels:
Number of carriers per cluster	14	Number of all subcarriers used within a symbol
Number of clusters	6	
Number of carries per subchannel	48	
Number of subchannels	3	

[Add the following tables after Table 247b]

Table 247c—128-FFT OFDMA uplink subcarrier allocations

Parameter	Value	Comments
Number of DC Subcarriers	1	index 64
Number of Guard Subcarriers, Left	15	
Number of Guard Subcarriers, Right	16	
Number of Used Subcarriers (Nused) including all possible allocated pilots and the DC carrier.	97	Number of all subcarriers used within a symbol
PermutationBase0	2,0,3,1	used to allocate tiles to subchannels
Number of carriers per tile	4	Number of all subcarriers used within a tile
Number of tiles	24	
Number of tiles per subchannel	6	
Number of subchannels	4	

Optional downlink FUSC

Table xxx. Optional 128-FFT OFDMA downlink carrier allocations

Parameters	Value	Comments
Number of DC Subcarriers	1	
Number of Guard Subcarriers, Left	9	
Number of Guard Subcarriers, Right	10	
Number of Used Subcarriers (N_{used}) (including all possible allocated pilots and the DC carrier)	109	
Number of Pilot Subcarriers	12	
Pilot Subcarrier Index	9k+3m+1, for k=0,1,……,11 and m=[symbol index] mod 3	Symbol index 0 is the first symbol from which the diversity subchannelization is applied.
Number of Data Subcarriers	96	
Number of Data Subcarriers per Subchannel	48	

Table yyy-1. Basic permutation sequences for diversity subcarrier allocations

FFT size	Ns	Basic permutation sequences		
128	2	GF(2)	P_1	1
			P_2	1

Optional uplink PUSC

Table zzz. Optional 128-FFT OFDMA uplink subcarrier allocations

Parameters	Value
Number of DC Subcarriers	1
Number of Guard Subcarriers, Left	9
Number of Guard Subcarriers, Right	10
Number of Used Subcarriers (N_{used}) (including all possible allocated pilots and the DC carrier)	109
Number of Subchannels	6
Number of Tiles	36
Number of Subcarriers per Tile	3
Tiles per Subchannel	6
Number of Data Subcarriers per Subchannel	48

Optional AAS and AMC subchannels

Table zzz. 128-FFT OFDMA AMC carrier allocations

Parameters	Value	Comments
Number of DC Subcarriers	1	
Number of Guard Subcarriers, Left	9	
Number of Guard Subcarriers, Right	10	
Number of Used Subcarriers (N_{used}) (including all possible allocated pilots and the DC carrier)	109	
Number of Pilot Subcarriers	12	
Pilot Subcarrier Index	9k+3m+1, for k=0,1,……,11 and m=[symbol index] mod 3	Symbol of index 0 is the first AMC data symbol in the downlink or uplink.
Number of Data Subcarriers	96	
Number of Bands	3	
Number of Bins per Band	4	
Number of Data Subcarriers per Subchannel	48	

References

[1] IEEE P802.16-REVe/D2-2004 Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Band.