Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**OFDMA PHY Enhancements for Ranging**
Date Submitted	**[2004-03-13]**
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Re:	Working Group Review of P802.16-REVd_D3
Abstract	
Purpose	To propose enhancements to the OFDMA PHY in 802.16REVd_D3 draft for better ranging performance in a broad set of channel widths.
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OFDMA PHY Ranging Enhancements

Introduction

In this contribution we propose enhancements to the WirelessMAN OFDMA PHY in the ranging operation.

OFDMA Ranging

In the OFDMA PHY, 4 ranging modes are defined-initial ranging, periodic ranging, bandwidth request (BR) ranging and hand off (HO) ranging. These 4 ranging modes are differentiated by code and time slot. Initial ranging and HO ranging time slot is allocated to the first two OFDMA symbol period in the up-link frame and periodic ranging and BR ranging time slot is the immediately following one OFDMA symbol period. Users are allowed to collide on these ranging channels by random ranging access with randomly selected code. Minimum number of tones for ranging is 32 and all of the above ranging channels use the same frequency band blocks defined in the CQI subchannelization. Except the frequency band, all the other ranging parameters (number of code, number of bits for each code) are system parameter determined at the initial system deployment. The frequency band is cell specific parameters determined in the CQI subchannelization. There shall be no difference in the number of bits for the code and number of tones used for each of 4 ranging modes.

Initial-ranging and HO ranging transmissions

The initial ranging transmission shall be used by any SS that wants to synchronize to the system channel for the first time while and HO ranging transmission shall be used by any SS that wants to synchronize to other BS while in the HO process. An initial ranging and HO ranging transmission shall be performed during first two consecutive symbols in the up link frame using minimum of 32 tones The same ranging code is transmitted on the ranging channel during each symbol, with no phase discontinuity between the two symbols. A time-domain illustration of the initial ranging and HO ranging is shown in Figure 1.

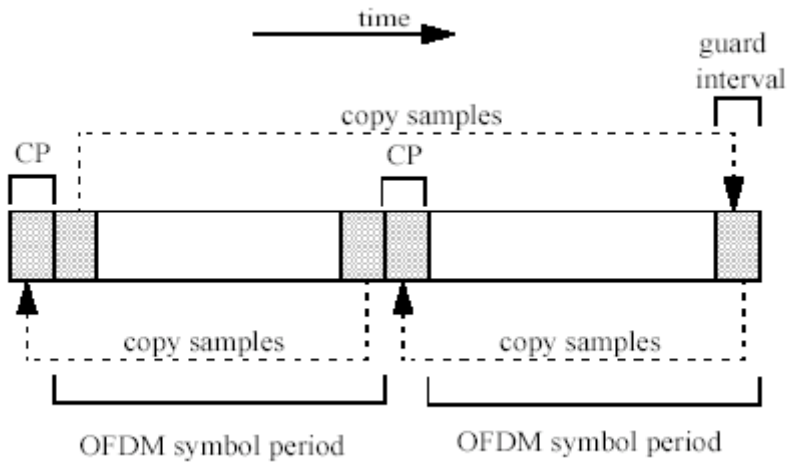

Figure 1 – Initial and HO ranging transmission for OFDMA

Periodic-ranging and bandwidth-request transmissions

Periodic ranging transmissions are sent periodically for system periodic ranging. Bandwidth requests transmissions are for requesting uplink allocations from the BS. These transmissions shall be sent only by SS that have already synchronized to the system.

To perform either a periodic ranging or bandwidth request transmission, the SS shall modulate randomly selected one ranging code on the minimum of 32 ranging tones for a period on one OFDMA symbol immediately following initial ranging symbols in the uplink frame. A time-domain illustration of the periodic ranging or bandwidth-request transmission is show in Figure 2.

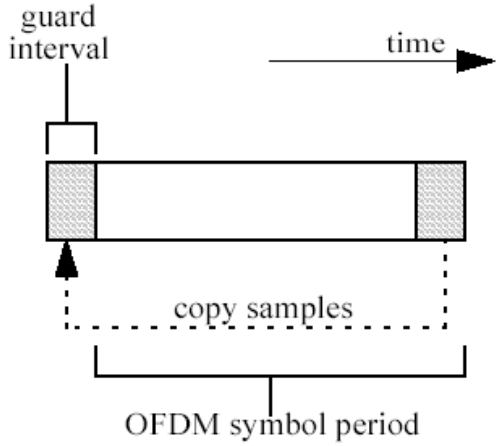

Figure 2 – Periodic ranging or bandwidth request transmission for OFDMA

Ranging codes

The binary codes are the pseudonoise codes produced by the PRBS described in figure 15.. The codes for each ranging channel (initial, HO, BR and periodic) is generated by the polynomial $1 + x^1 + x^4 + x^7 + x^{15}$ and the PN mask for cell identification is generated by a M-sequence generator. The binary ranging codes are subsequences of the pseudonoise sequence appearing at its output. The length of each ranging code is minimum 32 bits to maximum 256 bits.

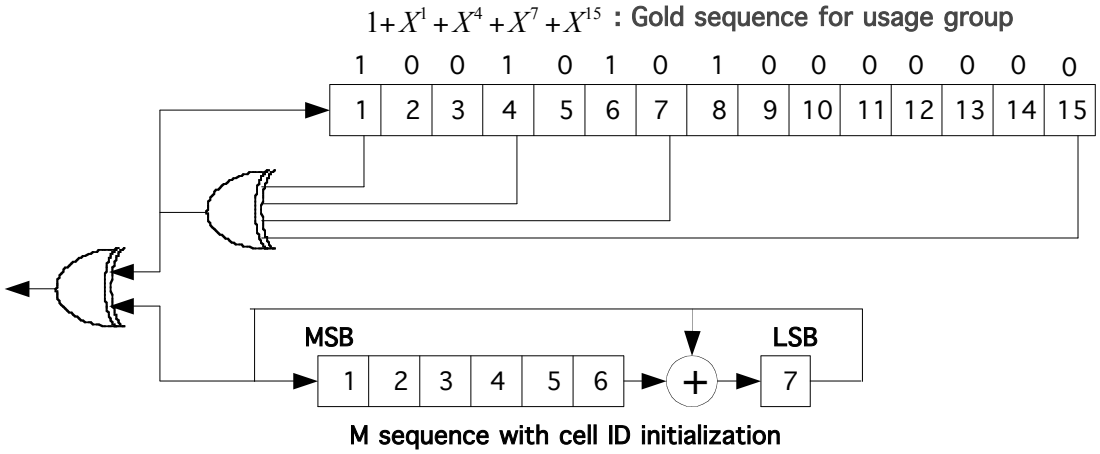

Figure 3 – PRBS for ranging code generation

The first K 256 bit code obtained by clocking the PN generator as specified is used for initial ranging. The next L ranging code produced by taking the output of the $(256xK+1)^{th}$ to $(256x(K+L)^{th}$ clock of the PRBS is used for HO ranging. Following the HO ranging code, the next M codes each of length 256 bits are used for periodic ranging and the next N codes are used for bandwidth requests. Each ranging code is masked by the cell specific code before transmission. This masking code is a M-sequence depicted in Figure 3. The M-sequence generator register is initialized by 7 bits cell identification number. The cell identification number is a system parameter which is indicated in the SICH.

Actual number of bits (minimum 32 bits to maximum 256 bits) used for the ranging is a system parameter fixed at the system deployment. The number of tones (hence the number of code bits) used for ranging as well as the number of code for the ranging is determined at the initial system deployment.

-The first K codes produced (length 256 bits) is for initial ranging

-The next L code produced is for HO ranging

-The next M codes produced are for periodic ranging

-The next N codes produced are for bandwidth request

The BS can separate colliding codes for periodic ranging and bandwidth request.

SS transmits the ranging code with the power adjustment by open loop power control. This will make the BS received signals' power from each SS approximately the same, hence improving the detection probability of the ranging code.