Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**WirelessMAN-SCa PHY Extensions for Mobility**	
Date Submitted	**2003-05-08**	
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Re:	Response to 4/14/2003 call for contributions on 802.16e Task Group Review of document 802.16e-03/07r1.	
Abstract	Provides WirelessMAN-SCa PHY extensions and burst profile elements intended to enhance mobile operation while maintaining compatibility with 802.16a	
Purpose	To provide normative text on extensions that may be incorporated into the next update of the 802.16e-03/07r1 draft document.	
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WirelessMAN-SCa PHY Extensions for Mobility

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1. Background and Motivation

Document C80216e-03_19r2 provided UL and DL link budget analyses for the WirelessMAN-SCa PHY in both mobile and pedestrian environments. A large range asymmetry to the detriment of the UL was predicted in both environments. Furthermore, this UL range disadvantage will likely be exacerbated if the SS runs on battery power and attempts to use a smaller power amplifier. For this reason, we provide burst profile extensions to the WirelessMAN-SCa PHY that should improve the link symmetry without modifying the fundamental compatibility and coexistence of mobile and 802.16a fixed SS users.

2. Outline

The following paragraphs contain normative text amendments that would add a simple Direct Sequence Spreading extension to the WirelessMAN-SCa PHY. This spreading mode is constructed by repetition-coding bits coming out of the FEC, randomizing them with a PN sequence, and then mapping the randomized bits to BPSK symbols. We propose that this mode have mandatory support on the UL, so that a worst-location mobile SS may communicate with the BS at the edge of its DL range. Since the UL is TDMA and controlled by burst profiles assigned by the BS, this extension should not adversely affect coexistence between fixed and mobile 802.16a users.

Note that all subsequent mention of insertion points, including clause, page, table, and figure references, are derived from document P802.16a/D7-2000.

3. Normative Text

Push clause 8.3.1.2 and all subsequent 8.3.1.x clauses down by down by one to 8.3.1.3, ... etc., and insert a new clause 8.3.1.2.

8.3.1.2 Direct sequence spreading

The capability to perform direct sequence spreading is mandatory on the UL but optional on the DL. All direct sequence spreading shall use the spread BPSK modulation format.

8.3.1.2.1 Spread BPSK modulation

Spread BPSK is a modulation format. Its selection is made by the burst profile encoding for modulation type.

The input to a spread BPSK modulator is a serial stream of bits derived from the FEC encoder output. Spread BPSK modulation shall only be matched with FEC code rates defined for conventional (non-spread) BPSK. Table 116e lists these code rates for the mandatory concatenated FEC.

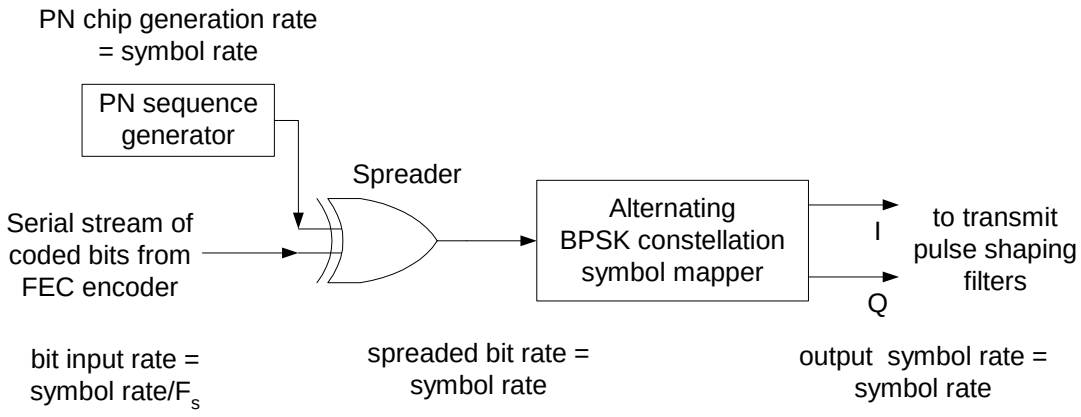

Figure 1—Spread BPSK processing

Figure 1 illustrates the generation of spread BPSK-modulated data with a spreading factor of F_s. Each input bit shall be held for F_s symbol clocks as it is XORed with F_s consecutive outputs of a PN sequence generator operating at the symbol rate. The XOR output shall feed a symbol mapper that alternates mapping assignments between two orthogonal BPSK constellations. These constellations are illustrated in Figure 2. BPSK MAP0 shall be used for even-indexed symbols, while BPSK MAP1 shall be used for odd-indexed bits. The first symbol to be mapped in a spread BPSK allocation shall be considered even.

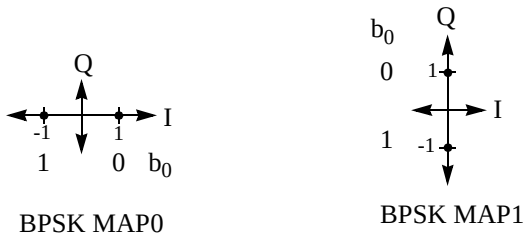

Figure 2—Spread BPSK Constellation maps

Only spreading factors from the set $F_s = 2^n, 0 \le n \le n_{max}$, where $n_{max} = 6$ shall be used. If a device supports spreading, it must support all of the defined spreading factors. Support of spreading on the UL is mandatory. The spreading factor used by a burst is specified within its burst profile encoding for modulation type.

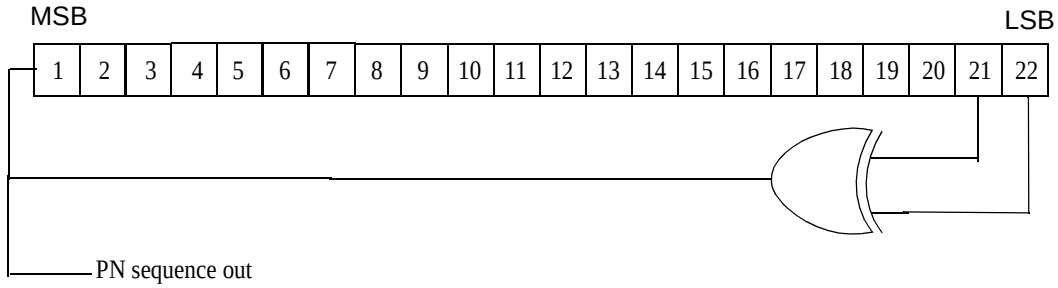

Figure 3—Spreading PN sequence generator

The spreading PN sequence generator shall be constructed from the Linear Feedback Shift Register (LFSR) illustrated in Figure 3. The characteristic polynomial for this LFSR is $1 + X^{21} + X^{22}$.

The PN sequence generator shall be preset at the beginning of a spread BPSK burst with one of the seeds listed in Table 1 . Seed 0 is the default setting. Selection of any seed other than Seed 0 requires use of the burst profile encoding for spreading parameters.

A recommended practice within a coordinated cell plan is for each BS to select a single, distinct, and non-default seed, and direct the use of this same seed for all spread BPSK bursts.

Table 1—Spreading PN sequence generator seeds

Seed Label	Seed (Binary) MSB LSB	Seed (Hex)
0	1 0 1 0 1 1 0 0 1 0 1 1 1 1 0 0 1 1 0 1 0 0	2B2F34
1	1 0 1 1 1 1 1 0 1 0 0 1 0 0 1 1 1 1 0 1 1 1	2FA4F7
2	0 0 1 1 1 0 0 0 0 1 1 0 0 0 1 0 1 0 1 1 1 1	E18AF
3	1 0 1 0 1 1 0 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1	2B1999
4	1 1 1 0 1 1 0 0 1 1 1 1 0 0 0 1 0 0 1 1 1 1	3B3C4F
5	1 0 1 1 0 1 1 1 1 1 1 0 0 1 1 0 0 1 1 0 1 1	2DF99B

Table 1—Spreading PN sequence generator seeds

Seed Label	Seed (Binary) MSB LSB	Seed (Hex)
6	1 0 0 0 1 0 0 1 0 0 0 1 0 1 1 1 1 0 0 0 0 0	2245E0
7	0 1 0 0 0 0 1 1 0 1 1 1 1 0 0 0 1 0 1 1 0 0	10DE2C
8	0 1 0 0 1 0 1 0 0 0 0 0 0 0 1 0 0 1 1 0 1 1	12809B
9	0 0 1 0 0 0 0 0 0 1 0 0 1 0 1 1 1 0 1 0 1 1	812EB
10	0 0 1 0 1 1 0 1 1 0 0 0 1 0 1 1 1 0 1 0 1 0	B62EA
11	1 0 0 1 1 1 1 1 0 1 1 1 1 0 0 0 1 1 1 1 0 0	27DE3C
12	0 1 1 0 0 1 0 1 0 0 1 1 0 1 1 1 1 0 0 1 1 0	194DE6
13	1 0 0 0 0 1 0 0 1 0 1 1 1 1 0 1 0 1 1 0 1 0	212F5A
14	0 0 1 1 0 1 0 1 0 0 1 0 0 1 0 0 1 1 1 0 0 0	D4938
15	1 0 0 0 0 1 1 0 1 1 1 0 0 0 0 0 0 0 0 0 0 1	21B801

Note that spread BPSK with a spreading factor of F_s divides the throughput by F_s on top of all other rate reductions such as FEC encoding and mapping to a BPSK symbol constellation.

For Table 123a, clause 11.1.1.2 page 244 line 12, in the 'Value (variable length)' column of the Modulation Type entry, modify

4 msb bits: ... 5 = BPSK, 5-15 = reserved

to

4 msb bits: ... 5 = BPSK, 6-12 = Spread BPSK with F_s = 0-6, 13-15= reserved

(Note that there is actually a typo in document P802.16a/D7-2000, reflected above, that '5 = BPSK, 5-15 = reserved')

For Table 123a, clause 11.1.2.2 page 244 line 65, add another row entry at the bottom of the table with the following parameters:

Name: Spreading Parameters

Type: 25

Length: 1

Value (variable length): 0-15 = PN sequence generator seed labels 0-15, 16-255 = reserved

For Table 125a, clause 11.1.2.2 page 247 line 12, in the 'Value (variable length)' column of the Modulation Type entry, modify

4 msb bits: ... 5 = BPSK, 5-15= reserved

to

4 msb bits: ... 5 = BPSK, 6-12 = Spread BPSK with F_s = 0-6, 13-15= reserved

(Note that there is actually a typo in document P802.16a/D7-2000, reflected above, that '5 = BPSK, 5-15 = reserved')

For Table 125a, clause 11.1.2.2 page 248 line 61, add another row entry at the bottom of the table with the following parameters:

Name: Spreading Parameters

Type: 28

Length: 1

Value (variable length): 0-15 = PN sequence generator seed labels 0-15; 16-255 = reserved

For table in 11.4.1.2.5.1, page 254, line 26, modify

bits#6-7:reserved; shall be set to 0.

to

bit#6: spreading

bit#7: reserved; shall be set to 0.