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Abstract	This document contains the working document for the first P802.16d draft. It contains all text agreed on as per the end of Monday, Jan. 13nd, 2003.
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Proposed working document for first P802.16d draft

Nico van Waes
Nokia Wireless Routers

Draft Amendment to IEEE Standard for
Local and Metropolitan Area Networks

Part 16: Air Interface for Fixed Broadband Wireless Access Systems -

Detailed System Profiles for 2-11 GHz

Sponsor

LAN MAN Standards Committee
of the
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Abstract: This Amendment updates and expands Clause 12 of IEEE Std 802.16-2001,which concerns system profiles that list sets of features and functions to be used in typical implementation cases. The scope of these system profiles is limited to 2-11 GHz. Errors and inconsistencies in IEEE Std802.16-2001 and its amendments IEEE Std802.16a-2003 and IEEE Std802.16c-2002 are also corrected.

Keywords: WirelessMAN™ standards, metropolitan area network, broadband wireless access network, millimeter waves, microwaves

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This document was developed by the IEEE 802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN™ Standard for Wireless Metropolitan Area Networks.

IEEE 802.16 Working Group Officers
Roger B. Marks, *Chair*
Dean Chang, *Secretary*

Primary development was carried out by the Working Group's Task Group d:

TGd Officers
Gordon Antonello, *Chair*
Nico J.M. van Waes, *Chief Technical Editor*

The following members of the IEEE 802.16 Working Group on Broadband Wireless Access participated in the Working Group Letter Ballot in which the draft of this standard was prepared and finalized for IEEE Ballot:

[to be determined]

The following participated as non-members in the Working Group Letter Ballot:

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Detailed System Profiles for 2-11 GHz

NOTE-The editing instructions contained in this amendment/corrigendum define how to merge the material contained herein into the existing base standard IEEE Standard 802.16-2001 and its amendments IEEE 802.16a-2003 and 802.16c-2002 to form the comprehensive standard.

The editing instructions are shown ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using strike through (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

6.2.2.3.37 Mesh Centralized Scheduling (MSH-CSCH) message

[802.16a-2003] In Table 56w change:

if (Grant/Request Flag == ~~1~~0)

6.2.5.1 Unsolicited Grant Service

[802.16-2001] Change:

The Unsolicited Grant Service (UGS) is designed to support real-time service flows that generate fixed size data packets on a periodic basis, such as T1/E1 and Voice over IP without silence suppression. The service offers fixed size grants on a real-time periodic basis, which eliminate the overhead and latency of SS requests and assure that grants are available to meet the flow's real-time needs. The BS shall provide ~~fixed~~ sufficiently sized Data Grant Burst ~~Types~~ IEs to the SS at periodic intervals based upon the Minimum reserved Traffic Rate of ~~to~~ the service flow. In order for this service to work correctly, the Request/Transmission Policy (see 11.4.8.12) setting shall be such that the SS is prohibited from using any contention request opportunities.~~, and the BS shall not provide any unicast request opportunities for that connection. This results in the SS only using unsolicited Data Grant Burst Types for uplink transmission on that connection. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The UGS shall be specified using the following parameters: the Unsolicited Grant Size, the Nominal Grant Interval~~ The key service information elements are the Minimum Reserved Traffic Rate, the Tolerated ~~Grant~~ Jitter, and the Request/Transmission Policy.

6.2.5.2 Real-Time Polling service

[802.16-2001] Change:

The BS shall provide periodic unicast request opportunities. In order for this service to work correctly, the Request/Transmission Policy setting (see 11.4.8.12) shall be such that the SS is prohibited from using any contention request opportunities for that connection. The BS may issue unicast request opportunities as prescribed by this service even if a grant is pending. This results in the SS using only unicast request opportunities in order to obtain uplink transmission opportunities (the SS could still use unsolicited Data Grant Burst Types for uplink transmission as well). All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The key service information elements are the ~~Nominal Polling Interval, the Tolerated Poll Jitter~~Maximum Sustained Traffic Rate, the Minimum reserved Traffic Rate, and the Request/Transmission Policy.

6.2.5.3 Non-Real-Time Polling service

[802.16-2001] Change:

The BS shall provide timely unicast request opportunities. In order for this service to work correctly, the Request/Transmission Policy setting (see 11.4.8.12) should be such that the SS is allowed to use contention request opportunities. This results in the SS using contention request opportunities as well as unicast request opportunities and unsolicited Data Grant Burst Types. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The key service elements are ~~Nominal Polling Interval,~~ Minimum Reserved Traffic Rate, Maximum Sustained Traffic Rate, Request/Transmission Policy, and Traffic Priority.

6.2.13.2 Service flows

[802.16-2001] Change footnote 12:

12 To say that QoS Parameter Set A is a subset of QoS Parameter Set B the following shall be true for all QoS Parameters in A and B:
if (a smaller QoS parameter value indicates less resources, e.g., Maximum Traffic Rate)
A is a subset of B if the parameter in A less than or equal to the same parameter in B
if (a larger QoS parameter value indicates less resources, e.g., Tolerated ~~Grant~~ Jitter)
A is a subset of B if the parameter in A is greater than or equal to the same parameter in B
~~if (the QoS parameter specifies a periodic interval, e.g., Nominal Grant Interval)~~
~~A is a subset of B if the parameter in A is an integer multiple of the same parameter in B~~
if (the QoS parameter is not quantitative, e.g., Service Flow Scheduling Type)
A is a subset of B if the parameter in A is equal to the same parameter in B

6.2.13.8.4 Dynamic Service Change (DSC)

[802.16-2001] Change

A BS shall have only one DSC transaction outstanding per service flow. If it detects a second transaction initiated by the SS, the BS shall abort the transaction that the SS initiated and allow the BS-initiated transaction to complete.

The following service flow parameters may not be changed, and shall not be present in the DSC-REQ or DSC-RSP messages:

- Service Flow Scheduling Type
- Request/Transmission Policy
- Convergence Sublayer Specification
- Fixed-Length versus Variable-Length SDU Indicator
- SDU Size (ATM services only)
- ATM switching (ATM Services only)

8.4.2.2 Derived parameter definitions

[802.16a-2003] Replace "Carrier Spacing" equation with:

— Carrier Spacing: $\Delta f = F_s / N_{FFT}$

8.4.2.4 Parameters of transmitted signal

[802.16a-2003] change in Table 116ac:

1:{-88,...,-76},{-50,...,-39},{1,...,13},{64,...,75}
2:{-63,…,-51},{-25,...,-14},{26,...,38},{89,...,100}
3:{-100,…,-89},{-38,...,-26},{14,...,25},{51,...,63}
4:{-75,…,-64},{-13,...,-1},{39,...,50},{76,...,88}
1&3:{-100,…,-76},{-50,...,-26},{1,...,25},{51,...,75}
2&4:{-75,…,-51},{-25,...,-1},{26,...,50},{76,...,100}

8.4.3.1 Randomization

[802.16a-2003] Change:

Data randomization is performed on ~~data transmitted~~ each burst of data on the DL and UL. The randomization is performed on each allocation (DL or UL), which means that for each allocation of a data block (subchannels on the frequency domain and OFDM symbols on the time domain) the randomizer shall be used independently. If the amount of data to transmit does not fit exactly the amount of data allocated, padding of 0xFF ('1' only) shall be added to the end of the transmission block, up to the amount of data allocated minus one byte, which shall be reserved for the introduction of a 0x00 tail byte by the FEC.

8.4.3.2.1 Concatenated Reed-Solomon / convolutional code (RS-CC)

[802.16a-2003] Change:

The encoding is performed by first passing the data in block format through the RS encoder and then passing it through a convolutional encoder. A single 0x00 tail byte is appended to the end of each ~~allocation~~ burst. This tail byte shall be appended after scrambling. In the RS encoder, the redundant bits are sent before the input bits, keeping the 0x00 tail byte at the end of the allocation.

8.4.3.3 Interleaving

[802.16a-2003] Change:

All encoded data bits shall be interleaved by a block interleaver with a block size corresponding to the number of coded bits per the ~~specified allocation~~ allocated subchannels per OFDM symbol, N_{cbps}. The interleaver is defined by a two step permutation. The first ensures that adjacent coded bits are mapped onto nonadjacent carriers. The second permutation insures that adjacent coded bits are mapped alternately onto less or more significant bits of the constellation, thus avoiding long runs of lowly reliable bits.

[802.16a-2003]Change:

Table 116al—Bit interleaved block sizes

Modulation	Coded Bits per Bit Interleaved Block (N_{cbps})		
	Default (4 subchannels)	2 subchannels	1-subchannel
QPSK	384	192	9~~8~~6
16 QAM	768	384	192
64 QAM	1152	~~768~~576	~~384~~288

[802.16a-2003] Change:

The first bit out of the interleaver shall map to ~~b_0~~ the msb in the constellation.

8.4.3.4.1 Data modulation

[802.16a-2003] Change:

After bit interleaving, the data bits are entered serially to the constellation mapper. Gray-mapped QPSK and 16QAM as shown in Figure 128ai shall be supported, whereas the support of 64QAM is optional. The constellations as shown in Figure 128ai shall be normalized by multiplying the constellation point with the indicated factor *c* to achieve equal average power. For each modulation, b_0 denotes the lsb.

[802.16a-2003] Change:

The constellation-mapped data shall be subsequently modulated onto ~~the~~ all allocated data carriers in order of increasing frequency offset index. The first symbol out of the data constellation mapping shall be modulated onto the allocated carrier with the lowest frequency offset index ~~$-N_{used}/2$.~~

8.4.3.5 Example OFDM UL RS-CC encoding

[802.16a-2003] Replace Interleaved Data and Carrier Mapping with:

Interleaved Data (Hex)

EE 73 2F A7 38 26 2A 66 BB F4 98 A7 38 46 B6 FB 59 90 7C ED CD 8D FA D5 23 AC EE 14 8F AD D0 67 B8 68 A7 D4 D3 10 23 8D C0 63 BB F2 06 2B 4F E0

Carrier Mapping (carrier index: I value Q value)

-100:-1 -1, -99:-1 1, -98:-1 -1, -97:-1 1, -96:1 -1, -95:-1 -1, -94:1 1, -93:-1 -1, -92:1 1, -91:-1 1,
-90:-1 -1, -89:-1 -1, -88:-1 1, -87:-1 1, -86:1 -1, -85:-1 -1, -84:pilot= 1 0, -83:1 1, -82:-1 -1, -81:-1 1,
-80:1 1, -79:1 1, -78:-1 1, -77:1 -1, -76:-1 1, -75:1 1, -74:-1 1, -73:-1 1, -72:-1 1, -71:1 -1,
-70:-1 1, -69:1 -1, -68:-1 1, -67:-1 1, -66:-1 -1, -65:-1 1, -64:-1 -1, -63:-1 -1, -62:-1 -1, -61:1 -1,
-60:pilot=-1 0, -59:1 1, -58:-1 1, -57:1 -1, -56:-1 1, -55:1 1, -54:-1 1, -53:-1 1, -52:1 -1, -51:-1 -1,
-50:1 1, -49:-1 -1, -48:-1 1, -47:1 1, -46:1 -1, -45:1 1, -44:1 -1, -43:-1 1, -42:-1 1, -41:-1 -1,
-40:1 -1, -39:-1 1, -38:-1 -1, -37:-1 -1, -36:pilot=1 0, -35:-1 1, -34:-1 -1, -33:1 -1, -32:1 -1, -31:-1 1,
-30:1 -1, -29:-1 1, -28:1 -1, -27:1 1, -26:1 1, -25:1 -1, -24:-1 -1, -23:-1 -1, -22:1 1, -21:-1 -1,
-20:-1 1, -19:-1 -1, -18:1 -1, -17:-1 -1, -16:1 1, -15:-1 -1, -14:1 -1, -13:-1 1, -12:pilot=-1 0, -11:1 1,
-10:-1 -1, -9:1 -1, -8:-1 -1, -7:-1 -1, -6:-1 1, -5:-1 1, -4:-1 -1, -3:1 -1, -2:1 -1, -1:1 -1,
0:0 0, 1:1 1, 2:-1 1, 3:1 1, 4:-1 -1, 5:-1 1, 6:-1 1, 7:-1 -1, 8:1 1, 9:-1 -1,
10:-1 1, 11:-1 -1, 12:pilot=1 0, 13:-1 1, 14:1 1, 15:1 -1, 16:1 -1, 17:1 1, 18:-1 1, 19:1 1,
20:-1 -1, 21:-1 -1, 22:-1 1, 23:-1 1, 24:-1 -1, 25:1 -1, 26:-1 -1, 27:1 -1, 28:1 1, 29:1 1,
30:1 -1, 31:-1 1, 32:1 -1, 33:-1 -1, 34:-1 1, 35:-1 -1, 36:pilot=1 0, 37:-1 1, 38:1 1, 39:1 -1,
40:-1 1, 41:-1 1, 42:1 1, 43:-1 1, 44:-1 1, 45:1 -1, 46:-1 -1, 47:-1 -1, 48:1 -1, 49:1 -1,
50:1 1, 51:-1 -1, 52:1 -1, 53:1 1, 54:-1 -1, 55:1 1, 56:1 -1, 57:1 1, 58:1 1, 59:1 1,
60:pilot=1 0, 61:-1 1, 62:1 1, 63:-1 -1, 64:-1 1, 65:1 1, 66:-1 -1, 67:1 -1, 68:-1 -1, 69:1 1,
70:1 1, 71:1 1, 72:1 -1, 73:-1 1, 74:1 1, 75:-1 -1, 76:-1 1, 77:-1 -1, 78:-1 1, 79:-1 -1,
80:-1 -1, 81:-1 -1, 82:1 1, 83:-1 1, 84:pilot=1 0, 85:1 1, 86:1 1, 87:1 -1, 88:-1 1, 89:1 1,
90:-1 1, 91:-1 1, 92:-1 -1, 93:1 -1, 94:1 1, 95:-1 -1, 96:-1 -1, 97:-1 -1, 98:-1 1, 99:1 1, 100:1 1

8.4.3.6 Preamble structure and modulation

8.4.4.1 PMP

[802.16a-2003] Change:

~~A UL PHY PDU consists of only one burst, which is made up of a short preamble and an integer number of OFDM symbols. The burst PHY parameters of an UL PHY PDU are specified by a 4-bit UIUC in the ULMAP. The UIUC encoding is defined in the UCD messages. Note the difference between a PHY PDU and a Burst.~~ A UL PHY PDU starts with a short preamble followed by only one burst. The burst consists of an integer number of OFDM symbols. The PHY parameters of the burst are specified by a 4-bit UIUC in the ULMAP. The UIUC encoding is defined in the UCD messages. Note the difference between a PHY PDU and a Burst.

A DL PHY PDU starts ~~from~~with a long preamble, which is used for PHY synchronization. The preamble is followed by a FCH burst. The FCH burst is one OFDM symbol long and is transmitted using QPSK rate 1/2 with the mandatory coding scheme. The FCH contains the DL_Frame_Prefix to specify the burst profile and length of the DL burst #1. The Rate_ID encoding is defined in Table 116am. A DL-MAP message shall immediately follow the DL_Frame:Prefix. An UL-MAP message shall immediately follow the DL-MAP message. Note that in the case of the remainder of the FCH being smaller than the size of the two messages combined they will ‘spill’ over into DL Burst #1. UCD and DCD messages may be transmitted following the DL-MAP and UL-MAP messages. ~~The FCH burst may also contain short MAC control messages, such as, DCD and/or UCD. It may also contain (partial) map messages.~~ Although the DL burst #1 contains broadcast MAC control messages, it is not necessary to use the most robust well-know modulation/coding. A more efficient modulation/coding may be used if it is supported and applicable to all the SSs of a BS. With exception of the maps, no MAC PDUs shall be split over multiple consequtive bursts with different burst profiles.

[802.16a-2003] Change:

HCS

An 8-bit Header Check Sequence used to detect errors in the DL Frame Prefix. The generator polynomial is $g(D)= D^8 + D^2 + D + 1$. The transmitter shall take the RateID and Length bytes and divide them by g(x) and use the remainder as HCS code. At the receiver dividing the DL Frame Prefix by g(x) then gives remainder 0 if correct. (Example: RateID=1 and Length=204 symbols: Encode the byte sequence [0x10 0xCC] and obtain 0x3D as the HCS byte.)

8.4.5.1 DL-MAP PHY Synchronization Field

[802.16a-2003] Change section 8.4.5.1 to:

The PHY Synchronization Field of the DL-MAP message is structured as follows.

Table 116am—OFDM PHY synchronization field

Syntax	Size	Notes
Synchronization_field {		
Frame Duration Code	8 bits	
Frame Number	24 bits	
~~**Allocation_Start_Time**~~	~~32 bits~~	
}		

Frame Duration Code
The frame duration Code values are specified in Table 116ao.

Frame Number
The frame number is incremented by 1 MOD 2^{24} each frame.

~~**Allocation_Start_Time**~~
~~Effective start time of the DL allocation defined by the DL-MAP in units of PSs. This start time is relative to the start of the frame in which the DL-MAP message is transmitted. The minimum value specified for this parameter shall correspond to the length of the DL-MAP.~~

[802.16a-2003] Renumber 8.4.5 "Control Mechanisms" through 8.4.10 as 8.4.6 through 8.4.11.

8.5.4.3 DL Frame Prefix

[802.16a-2003] Change:

The FCH is transmitted at the beginning of each frame. It is a data structure that contains the DL-MAP message and may additionally include the UL-MAP, DCD or UCD messages. The first FEC block of the DL frame shall contain information about the FCH and beginning of the DL-MAP, as shown in Figure 128aw. The DL Frame prefix is always transmitted using the burst profile QPSK-1/2 with the mandatory coding scheme and power boosted with +6dB.

[802.16a-2003] Change:

Table 116an—OFDMA DL Frame Prefix

Syntax	Size	Notes
DL_Frame_Prefix_Format() {		
Rate_ID	4 bits	
Boosting	2 bits	00: normal (not boosted); 01: +6dB; 10: -6dB; 11: not used.
Reserved	~~4~~2 bits	
DL_Information_Message_Rectangle() {		
No_OFDM_Symbols	10 bits	
No_subchannels	6 bits	
}		
Prefix_CS	8 bits	
}		

[802.16a-2003] Change:

Rate_ID:
Enumerated field that describes the modulation/coding of the DL-MAP message. Encoding values of the Rate_ID field are defined in Table 116am.

Boosting
Indication whether the carriers for this allocation are power boosted.

8.5.5.2 DL-MAP Information Element format

[802.16a-2003] Change:

Table 116ao—OFDMA DL-MAP_Information_Element format

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4 bits	
if (UIUC == 15) {		
Extended DIUC dependent IE	variable	AAS_DL_IE()
} else {		
OFDM Symbol offset	~~10~~9 bits	
Subchannel offset	~~6~~5 bits	
Boosting	2 bits	00: normal (not boosted); 01: +6dB; 10: -6dB; 11: reserved.
No. OFDM Symbols	10 bits	
No. Subchannels	6 bits	
}		
}		

[802.16a-2003] Change:

Subchannel offset

The lowest index OFDM subchannel used for carrying the burst, starting from subchannel 0.

Boosting

Indication whether the carriers for this allocation are power boosted.

8.5.5.3 UL-MAP Information Element format

[802.16a-2003] Change:

Table 116bp—OFDMA UL-MAP Information Element format

Syntax	Size	Notes
UL-MAP_Information_Element() {		
CID	16 bits	
UIUC	4 bits	
if (UIUC == 4) {		
CDMA_Allocation_IE()	52 bits	
else if (UIUC == 15) {		
Extended UIUC dependent IE	variable	Power_Control_IE() or AAS_UL_IE()
} else {		
OFDM Symbol offset	~~9~~10 bits	
Subchannel offset	~~5~~6 bits	
~~**Boosting**~~	~~2 bits~~	~~00: normal (not boosted); 01: +6dB; 10: -6dB; 11: not used.~~
No. OFDM Symbols	9 bits	
No. Subchannels	5 bits	
Reserved	2 bits	
}		
}		

~~**Boosting**~~

~~Indication whether the carriers for this allocation are power boosted.~~

10.1 Global Values

[802.16-2001] Insert additional rows shown in Table 118 as shown in Table 118b:

Table 118b—Parameters and constants

System	Name	Time reference	Minimum value	Default value	Maximum value
SS	SBC Request Retries	Number of retries on SBC Request	3	3	16
SS	TFTP-CPLT Retries	Number of retries on TFTP-CPLT	3	3	16
SS	T22	Wait for TFTP-RSP	10 ms	200 ms	200 ms

11.4.1.2.7 WirelessMAN-OFDM/OFDMA FFT sizes

[802.16a-2003] Change:

~~This field indicates the types of transmit diversity supported by a SS for UL transmission.~~ This field indicates the FFT sizes supported by the SS. For each FFT size, a~~A~~ bit value of 0 indicates “not supported” while 1 indicates “supported”.

11.4.1.2.8 WirelessMAN-OFDM Focused Contention Support

[802.16a-2003] Change:

~~This field indicates the types of transmit diversity supported by a SS for UL transmission.~~ This field indicates whether the SS supports Focused Contention (see 8.4.5.3.3). A bit value of 0 indicates “not supported” while 1 indicates “supported”.

11.4.8.11 Service flow scheduling type

[802.16-2001] Change (note that changes encompass changes in 802.16c-2002):

Type	Length	Value	Scope
[24/25].15	1	0: *reserved* 1: for Undefined (BS implementation-dependent[a]) 2: for Best Effort 3: for Non-Real-Time Polling Service 4: for Real-Time Polling Service 5: *reserved* 6: for Unsolicited Grant Service 7: through 255 are reserved for future use	DS~~x~~A-REQ DS~~x~~A-RSP DS~~x~~A-ACK

[a]aThe specific implementation-dependent scheduling service type could be defined in a message of Type 24.43 (Vendor-specific QoS Parameters).

11.4.8.12 Request/transmission policy

[802.16-2001] Change:

Type	Length	Value	Scope
[24/25].16	1	Bit #0 – Service flow shall not use broadcast bandwidth request opportunities. Bit #1– Reserved. Bit #2 – The service flow shall not piggyback requests with data. Bit #3 – The service flow shall not fragment data. Bit #4 – The service flow shall not suppress payload headers (convergence sublayer parameter) Bit #5 – The service flow shall not pack multiple SDUs (or fragments) into single MAC PDUs. Bit #6 – The service flow shall not include CRC in the MAC PDU. All other bit positions are reserved.	DS~~x~~A-REQ DS~~x~~A-RSP DS~~x~~A-ACK

11.4.8.15 Fixed-length versus variable-length SDU indicator

[802.16-2001] Change:

Type	Length	Value	Scope
[24/25].24	1	0 = variable-length SDUs 1 = fixed-length SDUs default = 0	DS~~x~~A-REQ DS~~x~~A-RSP DS~~x~~A-ACK

11.4.8.16 SDU size

[802.16-2001] Change:

Type	Length	Value	Scope
[24/25].25	4	Number of bytes. default = 49ms	DS~~x~~A-REQ DS~~x~~A-RSP DS~~x~~A-ACK

[802.16-2001] Insert 11.4.9.4.4.

11.4.9.4.4 ATM Classifier Error Parameter Set

This encoding shall be identical to the encoding for the Classifier Error Parameter Set for packet services specified in section 11.4.9.3.3.