Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
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Abstract	
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8.4.1 Introduction

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The WirelessMAN-OFDM PHY is based on OFDM modulation and designed for NLOS operation in the 2–11 GHz frequency bands per 1.2.4. ~~For licensed bands, channel bandwidths allowed shall be limited to the regulatory provisioned bandwidth divided by any power of 2 no less than 1.25 MHz.~~

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8.4.9.2 Transmitter channel bandwidth and RF carrier frequencies

For licensed bands, channel bandwidths allowed shall be limited to the regulatory provisioned bandwidth divided by any power of 2, rounded down to the nearest multiple of 250 kHz, resulting in a channel bandwidth no less than 1.25 MHz.

If the resulting channel bandwidth is an odd multiple of 250 kHz, then for any band for which support is claimed, the RF carrier shall only be tunable to every odd multiple of 125 kHz within that band. If the resulting channel bandwidth is an even multiple of 250 kHz, then for any band for which support is claimed, the RF carrier shall only be tunable to every even multiple of 125 kHz within that band. For FDD systems, support shall be claimed seperately for UL and DL.

For example, if the regulatory provisioned bandwith is 14 MHz between 3400 and 3414 MHz, then the allowed channel bandwidths are those shown in Table 116.bi.1

Table 116.bi.1—Example of channelization for licensed bands

Channelization (MHz)	Center frequencies (MHz)
14 MHz	3407
7 MHz	$3403.5 + n \cdot 0.25 \quad n \in \{0 \ldots 28\}$
3.5 MHz	$3401.75 + n \cdot 0.25 \quad n \in \{0 \ldots 42\}$
1.75 MHz	$3400.875 + n \cdot 0.25 \quad n \in \{0 \ldots 49\}$

For license-exempt bands, see 8.6.1

8.6.2 Transmit spectral mask

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Table 116ct—Transmit spectral mask parameters

Channelization (MHz)	A	B	C	D
20	9.5	10.~~5~~9	19.5	29.5
10	4.75	5.~~2~~45	9.75	14.75

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12.2 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) System Profiles

This subclause defines system profiles for systems operating with the WirelessMAN-OFDM air interface and with the WirelessHUMAN interface where it uses the OFDM PHY.

A system profile consists of five components: a MAC profile, a PHY profile, a RF profile, a duplexing selection and a power class. The defined PHY and MAC profiles are listed in Table 153.

Table 153—Profile Definitions

Identifier	Description
profM3_PMP	WirelessMAN-OFDM basic packet PMP MAC profile
profM3_Mesh	WirelessMAN-OFDM basic packet Mesh MAC profile
profP3_1.75	WirelessMAN-OFDM 1.75 MHz channel basic PHY profile
profP3_3.5	WirelessMAN-OFDM 3.5 MHz channel basic PHY profile
profP3_7	WirelessMAN-OFDM 7 MHz channel basic PHY profile
profP3_3	WirelessMAN-OFDM 3 MHz channel basic PHY profile
profP3_10	WirelessHUMAN(-OFDM) 10 MHz channel basic PHY profile

The transmit power class profiles, as shown in Table 154, are based on the maximum mean transmit power $P_{Tx,max}$ using all non-guard carriers, for which the transmitter requirements as defined in 8.4.8 are met.

Table 154—Power Classes profiles

Identifier	Transmit power performance
profC3_17	$17 \le P_{Tx,\,max} < 20$ dBm
profC3_20	$20 \le P_{Tx,max} < 23$ dBm
profC3_23	$P_{Tx,max} \ge 23$ dBm

The duplexing shall be selected as follows: A system shall implement TDD and/or FDD. A FDD SS system may be implemented as half-duplex. A FDD BS system must respect the half-duplex nature of half-duplex SSs.

Using these conventions, a sample system profile is shown in Table 155. This sample system profile may also be represented by a concatenation of the profile components: profM3_PMP_P3_10_R10_1_TDD_C3_17.

Table 155—Sample system profile

Sample system profile
{
profM3_PMP
profP3_10
profR10_1
TDD
profC3_17
}

12.2.1 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) MAC Profiles

This subclause defines MAC profiles for systems operating with the WirelessMAN-OFDM air interface and with the WirelessHUMAN interface where it uses the OFDM PHY.

12.2.1.1 ProfM3_PMP: Basic Packet PMP MAC System Profile

This profile specifies a set of capability requirements when a system is operating in the mandatory PMP mode. Table 156 lists the optional MAC features and designates whether they shall or may be implemented to comply with this profile.

Table 156—Optional feature requirements profM3_PMP

Optional Feature	Required?	Conditions/Notes
Packet convergence sublayer Payload header suppression Ipv4 Ethernet	Yes No Yes Yes	
ATM convergence sublayer	No	
Provisioned connections	No	
Classification of packets on incoming physical port	No	
Multicast polling groups Multicast polling	No	
CRC functionality	Yes	Elective per connection
Dynamic services	Yes	
Unsolicited grant service functionality	Yes	
Real-Time Polling services	No	
Best effort services	Yes	
Non-Real-Time Polling services	Yes	
TEK encryption algorithms: 3-DES EDE with 128-bit key (type 1) RSA with 1024-bit key	 No Yes	
Undecodable initial ranging feature	Conditional	Required for SS. Not required for BS.
ARQ	No	
Mesh	No	if used, apply profM4
AAS	No	
DFS	Conditional	Required when intended for license exempt bands. Not required when intended for licensed bands.

— Support of ARQ is defined as the minimum capability to support 8 simultaneous ARQ connections

12.2.1.1.1 Conventions for MAC Management Messages

The following rules shall be followed when reporting parameters in MAC Management messages:

— Service Class Names should not be used.
— No TLVs besides Error Encodings and HMAC Tuples shall be reported back in DSA-RSP and DSC-RSP messages.
— No TLVs besides HMAC Tuples shall be reported back in DSA-ACK messages.

— DSC-REQ messages shall not contain Request/Transmission Policy, Fixed vs. Variable Length SDU Indicator, SDU Size, ATM Switching, or Convergence Sublayer Specification TLVs.

12.2.1.1.2 MAC Management Message Parameter Transmission Order

TLVs within MAC Management messages shall be ordered as follows. Parameters for optional features shall occur after those listed for support of mandatory features. Features that are defined optional, but are mandated by the implemented Profile, if any, shall be ordered as optional. Both mandatory and optional TLVs shall subsequently be sequenced in order of increasing Type value. Parameters with defined default values should be omitted if the desired value coincides with the default one.

12.2.1.2 ProfM3_Mesh: Basic Packet Mesh MAC System Profile

This profile specifies a set of capability requirements when a mesh enabled system is operating in the optional mesh mode. Table 157 lists the optional MAC features and designates whether they shall or may be implemented to comply with this profile.

Table 157—Optional feature requirements profM3_Mesh

Optional Feature	Required?	Conditions/Notes
Packet convergence sublayer Payload header suppression Ipv4 Ethernet	Yes No Yes Yes	
ATM convergence sublayer	No	
Provisioned connections	No	
Classification of packets on incoming physical port	No	
Multicast polling groups Multicast polling	N/A	
CRC functionality	Yes	
Dynamic services	Yes	
Unsolicited grant service functionality	N/A	
Real-Time Polling services	N/A	
Best effort services	Yes	
Non-Real-Time Polling services	N/A	
TEK encryption algorithms: 3-DES EDE with 128-bit key (type 1) RSA with 1024-bit key	 No Yes	
Undecodable initial ranging feature	N/A	
ARQ	Yes	
AAS	No	
DFS	Conditional	Required when intended for license exempt bands. Not required when intended for licensed bands.

— Support of ARQ functionality is mandatory as a capability, but may be turned on or off on a per packet basis. ARQ shall be used when the reliability bit in the Mesh CID is set to 1, and shall not be used otherwise. ARQ parameters shall be set to:
  —ARQ Window Size = 64_{DEC}
  —ARQ Retry Timeout = $\lceil 2 \cdot T_F \rceil_{\text{DEC}}$, with T_F the PHY dependent frame duration in µs.
  —ARQ Fragment Lifetime = = $\lceil T_F / 2 \rceil_{\text{DEC}}$, with T_F the PHY dependent frame duration in µs.
  —ARQ RX Purge Time Timeout = $\lceil 2 \cdot T_F \rceil_{\text{DEC}}$, with T_F the PHY dependent frame duration in µs.
  —ARQ Sync Loss Timeout = 0
  —ARQ Deliver in Order = 0

12.2.1.2.1 MAC Management message applicability

For a mesh-enabled system, the messages below and the corresponding functionality are always mandatory to implement:

MSH-NCFG
MSH-NENT
MSH-DSCH
MSH-CSCH
MSH-CSCF
REG-REQ
REG-RSP
PKM-REQ
PKM-RSP
SBC-REQ
SBC-RSP
TFTP-CPLT
TFTP-RSP
RES-CMD

For a mesh enabled system, the following messages and the corresponding functionality are mandatory/optional whenever they are correspondingly optional/mandatory for a PMP system:

ARQ-Feedback

When operating in the mesh mode, the messages below and the corresponding functionality are not used (they are however implemented to support the mandatory PMP mode).

DL-MAP
DCD
DSA-ACK
DSA-REQ
DSA-RSP
DSC-ACK
DSC-REQ
DSC-RSP
DSD-RSP
DSX-RVD
UCD
UL-MAP
CLK-CMP
DBPC-REQ
DBPC-RSP
DREG-CMD
MCA-REQ
MCA-RSP
RNG-REQ
RNG-RSP

Generally, the following procedures are different for a mesh node and a PMP node:

Synchronization
Network entry
Scheduling

12.2.1.1.2.2 MAC Management Message Parameter Transmission Order

TLVs within MAC Management messages shall be ordered as follows. Parameters for optional features shall occur after those listed for support of mandatory features. Features that are defined optional, but are mandated by the implemented Profile, if any, shall be ordered as optional. Both mandatory and optional TLVs shall subsequently be sequenced in order of increasing Type value. Parameters with defined default values should be omitted if the desired value coincides with the default one.

12.2.2 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) Physical Layer Profiles

This subclause defines PHY profiles for systems operating with the WirelessMAN-OFDM and WirelessHUMAN(-OFDM) air interface.

The following set of parameters are common to all defined PHY profiles and shall be complied with in order to comply with each individual profile.

Table 158 lists the optional PHY features and designates whether they shall or may be implemented.

Table 158—Optional PHY feature requirements

Optional Feature	Required?	Conditions/Notes
BTC	No	
CTC	No	
64-QAM	No	
sub-channelization	No	
STC	No	
Focused contention BW requesting	No	
T_g/T_b	Conditional	BS shall be capable of using at least one value. SS shall be capable of using entire set

Table 159 lists the minimum performance basic requirements for all defined profiles.

Table 159—Minimum Performance basic requirements

Capability	Minimum Performance
Tx Dynamic range SS BS	 ≥ 30 dB ≥ 10 dB
Tx Power Level minimum adjustment step	≤ 1 dB
Tx Power Level minimum relative step accuracy	≤ +/- 0.5 dB
Tx Spectral flatness Absolute difference between adjacent carriers: Deviation of average energy in each carrier from the measured energy averaged over all 200 active tones: Carriers -50 to -1 and +1 to +50: Carriers -100 to -50 and +50 to +100:	 ≤ 0.06 dB ≤ +/-2dB ≤ +2/-4dB
Spectral mask (OOB)	Local regulation
Tx relative constellation error: QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -19.4 dB ≤ -21.2 dB ≤ -26.4 dB ≤ -28.2 dB ≤ -32.7 dB ≤ -34.4 dB
Rx linearity IIP3	≥ -10 dBm

Table 159—Minimum Performance basic requirements *(continued)*

Capability	Minimum Performance
Rx max. input level on-channel reception tolerance	≥ -30 dBm
Rx max. input level on-channel damage tolerance	≥ 0 dBm
1st adjacent channel rejection at BER=10^{-6} for 3 dB degradation C/I 16QAM-3/4 64QAM-3/4 (if 64-QAM supported)	 ≥ 11 dB ≥ 4 dB
non-adjacent channel rejection at BER=10^{-6} for 3 dB degradation C/I 16QAM-3/4 64QAM-3/4 (if 64-QAM supported)	 ≥ 30 dB ≥ 23 dB
TTG and RTG	≤ 5 µs
Reference frequency tolerance BS Mesh system	 ≤ +/- 4 ppm ≤ +/- 20 ppm

12.2.2.1 ProfP3_1.75: WirelessMAN-OFDM PHY profile for 1.75 MHz channelization

Mandatory features:

— Licensed band usage only
— Channel bandwidth *BW* = 1.75 MHz
— BS shall select Frame duration from code set PMP:{4,7,12}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.

Systems implementing profP3_1.75 shall meet the minimum performance requirements listed in Table 160:

Table 160—Minimum Performance requirements for profP3_1.75

Capability	Minimum Performance
T_b	= 128 µs
BER performance threshold, BER=10^{-6} QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -90 dBm ≤ -87 dBm ≤ -83 dBm ≤ -81 dBm ≤ -77 dBm ≤ -75 dBm
Reference frequency tolerance SS to BS synchronization tolerance	 156.25 Hz
Reference time tolerance	≤ $(T_g/T_b)/2$ µs

12.2.2.2 ProfP3_3.5: WirelessMAN-OFDM PHY profile for 3.5 MHz channelization

Mandatory features:

— Licensed band usage only
— Channel bandwidth *BW* = 3.5 MHz
— BS shall select Frame duration from code set PMP:{4,7,12}, Mesh:{8}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.

Systems implementing profP3_3.5 shall meet the minimum performance requirements listed in Table 161:

Table 161—Minimum Performance requirements for profP3_3.5

Capability	Minimum Performance
T_b	= 64 μ s
BER performance threshold, BER=10^{-6} QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -87 dBm ≤ -85 dBm ≤ -80 dBm ≤ -78 dBm ≤ -74 dBm ≤ -72 dBm
Reference frequency tolerance SS to BS synchronization tolerance Mesh to Mesh synchronization tolerance	 ≤ 312.5 Hz ≤ 468.75 Hz
Reference time tolerance	≤ $(T_g/T_b)/2$ μ s

12.2.2.3 ProfP3_7: WirelessMAN-OFDM PHY profile for 7 MHz channelization

Mandatory features:

— Licensed band usage only
— Channel bandwidth *BW* = 7 MHz
— BS shall select Frame duration from code set PMP:{4,7,12}, Mesh:{3}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.

Systems implementing profP3_7 shall meet the minimum performance requirements listed in Table 162:

Table 162—Minimum Performance requirements for profP3_7

Capability	Minimum Performance
T_b	= 32 μ s
BER performance threshold, BER=10^{-6} QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -84 dBm ≤ -82 dBm ≤ -77 dBm ≤ -75 dBm ≤ -71 dBm ≤ -69 dBm
Reference frequency tolerance SS to BS synchronization tolerance Mesh to Mesh synchronization tolerance	 ≤ 625 Hz ≤ 937.5 Hz
Reference time tolerance	≤ $(T_g/T_b)/2$ μ s

12.2.2.4 ProfP3_3: WirelessMAN-OFDM PHY profile for 3 MHz channelization

Mandatory features:

— Licensed band usage only
— Channel bandwidth BW = 3 MHz
— BS shall select Frame duration from code set PMP:{4,7,12}, Mesh:{8}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.

Systems implementing profP3_3 shall meet the minimum performance requirements listed in Table 163:

Table 163—Minimum Performance requirements for profP3_3

Capability	Minimum Performance
T_b	= $73\frac{1}{7}$ μ s
BER performance threshold, BER=10^{-6} QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -88dBm ≤ -86 dBm ≤ -81 dBm ≤ -79 dBm ≤ -75 dBm ≤ -73 dBm
Reference frequency tolerance SS to BS synchronization tolerance Mesh to Mesh synchronization tolerance	 ≤ 273.44 Hz ≤ 410.16 Hz
Reference time tolerance	≤ $(T_g/T_b)/2$ μ s

12.2.2.5 ProfP3_10: WirelessHUMAN PHY profile for 10 MHz channelization

802.16 usage only

Mandatory features:

— License-exempt band usage only
— Channel bandwidth *BW* = 10 MHz
— TDD operation
— BS shall select Frame duration from code set PMP:{4,7,12}, Mesh:{3}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.
— DFS capability
  — Ability to detect primary users with received signal strength in excess of -67 dBm
  — Ability to switch channel within 300 μ s

Systems implementing profP3_10 shall meet the minimum performance requirements listed in Table 164:

Table 164—Minimum Performance requirements for profP3_10

Capability	Minimum Performance
T_b	= 22.4 μ s
Spectral mask (IB): f_0 +/- 0 MHz f_0 +/- 4.75 MHz f_0 +/- 5.25 MHz f_0 +/- 9.75 MHz f_0 +/- 14.75 MHz	Linear interpolation between points: 0 dBr 0 dBr -27 dBr -32 dBr -50 dBr
BER performance threshold, BER=10^{-6} QPSK-1/2 QPSK-3/4 16QAM-1/2 16QAM-3/4 64QAM-2/3 (if 64-QAM supported) 64QAM-3/4 (if 64-QAM supported)	 ≤ -83 dBm ≤ -81 dBm ≤ -76 dBm ≤ -74 dBm ≤ -69 dBm ≤ -68 dBm
Reference frequency tolerance SS to BS synchronization tolerance Mesh to Mesh synchronization tolerance	 ≤ 892.5 Hz ≤ 1339 Hz
Reference time tolerance	≤ $(T_g/T_b)/2$ μ s

12.2.3 WirelessMAN-OFDM RF profiles

For licensed bands, no explicit RF profiles are defined. A compliant system shall adhere to the requirements of 8.4.9.2 for the specified supported bands.

12.2.3.1 RF profiles for 10 MHz channelization

12.2.3.1.1 profR10_1

Mandatory features:

— RF channels: : $5000 + n \cdot 5$ MHz, $\forall n \in \{55, 57, 59, 61, 63, 65, 67\}$
— Spectral mask: See 8.6.2

12.2.3.1.2 profR10_2

Mandatory features:

— RF channels: : $5000 + n \cdot 5$ MHz, $\forall n \in \{148, 150, 152, 154, 156, 158, 160, 162, 164, 166\}$
— Spectral mask: See 8.6.2

12.2.3.1.3 profR10_3

Mandatory features:

— RF channels: : $5000 + n \cdot 5$ MHz, $\forall n \in \{147, 149, 151, 153, 155, 157, 159, 161, 163, 165, 167, 169\}$
— Spectral mask: See 8.6.2