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Re:	
Abstract	
Purpose	
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OFDM PHY & MAC PROFILES

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Alvarion

1. Profiles

In this contribution PHY and MAC profiles for OFDM mode are defined. The format of the profile definition, and some of the parameters are taken from [1] and [2].

In addition to the text provided below, it is recommended to incorporate the entire section of 802.16c: 12.1.1 "WirelessMAN-SC MAC System Profiles" with the exception of
- ATM related features
- WirelessMAN-SC PHY related features, like in 12.1.1.4.32-33 SBC-XXX

The following profiles are defined:

Table 146—Profile Definitions

Identifier	Description
profM1	Basic_ATM_MAC_profile
profM2	Basic_packet_MAC_profile
profP1	25_MHz_channel_PHY_profile
profP1f	25_MHz_channel_PHY_profile_–_FDD
profP1t	25_MHz_channel_PHY_profile_–_TDD
profP2	28_MHz_channel_PHY_profile
profP2f	28_MHz_channel_PHY_profile_–_FDD
profP2t	28_MHz_channel_PHY_profile_-_TDD
profM3	WirelessMAN-OFDM Basic packet PMP MAC profile
profM4	WirelessMAN-OFDM Basic packet Mesh MAC profile
profP175M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **1.75 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP3M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **3 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP3M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **3** MHz channel **S**ub-channelization **T**DD PHY profile
profP35M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **3. 5 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP35M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **3. 5 M**Hz channel **S**ub-channelization **T**DD PHY profile
profP5M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **5 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP5M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **5 M**Hz channel **S**ub-channelization **T**DD PHY profile

profP6M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **6 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP6M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **6 M**Hz channel **S**ub-channelization **T**DD PHY profile
profP7M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **7 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP7M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **7 M**Hz channel **S**ub-channelization **T**DD PHY profile
profP10M_SF	WirelessMAN and WirelessHUMAN (-OFDM) **10 M**Hz channel **S**ub-channelization **F**DD PHY profile
profP10M_ST	WirelessMAN and WirelessHUMAN (-OFDM) **10 M**Hz channel **S**ub-channelization **T**DD PHY profile

2. Sub-channelization profiles

This section covers the profiles profPXXM_SF and profPXXM_ST where
XX = 175, 3, 3.5, 5 6 7 10

For editorial simplicity all profiles are defined together. The text has been taken, with modifications, from [1] and [2].

Mandatory features

Licensed and unlicensed bands operation
Channel BW
1.75MHz for ProfP175M_SF
3MHz for ProfP3M_SF and ProfP3M_SF
3. 5MHz for ProfP35M_SF and ProfP35M_ST
5MHz for ProfP5M_SF and ProfP5M_ST
6MHz for ProfP6M_SF and ProfP6M_ST
7MHz for ProfP7M_SF and ProfP7M_ST
10MHz for ProfP10M_SF and ProfP10M_ST

TDD operation for ProfPXXM_ST ,
FDD operation for ProfPXXM_SF ,

BS and SS shall support any frame duration in the allowed range.

Table xxx lists the optional PHY features and designates whether they are required to be implemented in order to comply with this profile

Table xxx

Optional Feature	Required	Conditions/Notes
BTC	No	
CTC	No	
64-QAM	Yes	For DL Only
Sub-channelization	Yes	
STC	No	
Focused contention BW requesting	Yes	

Capability/ Parameter	Profile	Value
Channel Spacing BW	ProfP175M_SF/T	1.75MHz
	ProfP3M_SF/T	3MHz
	ProfP35M_SF/T	3.5MHz
	ProfP5M_SF/T	5MHz
	ProfP6M_SF/T	6MHz
	ProfP7M_SF/T	7MHz
	ProfP10M_SF/T	10MHz
Sampling frequency Fs	ProfP175M_SF/T	2MHz
	ProfP3M_SF/T	3.5MHz
	ProfP35M_SF/T	4MHz
	ProfP5M_SF/T	5.71MHz
	ProfP6M_SF/T	7MHz
	ProfP7M_SF/T	8MHz
	ProfP10M_SF/T	11.43MHz
Symbol Duration Tb	ProfP175M_SF/T	128uS
	ProfP3M_SF/T	73.14uS
	ProfP35M_SF/T	64uS
	ProfP5M_SF /T	44.8uS
	ProfP6M_SF/T	36.57uS
	ProfP7M_SF/T	32uS
	ProfP10M_SF/T	22.4uS
Guard Interval	ProfP175M_SF/T	1/32 1/16
	ProfP3M_SF/T	1/16 1/8
	ProfP35M_SF/T	1/16 1/8
	ProfP5M_SF/T	1/16 1/8
	ProfP6M_SF/T	1/16 1/8
	ProfP7M_SF/T	1/16 1/8
	ProfP10M_SF/T	1/16 1/8
	All	BS may implement either value SS shall implement both values
Minimum SS Tx Power	All	? 17dBm
Minimum BS Tx Power	All	? 22dBm
Minimum SS Tx power range	All	? 50dBm
Minimum BS Tx power range	All	? 10dBm
Tx minimum power Level adjustment step	All	=1dB
Tx power Level minimum relative step accuracy	All	=0.5dB
Tx Spectral flatness Absolute difference between adjacent carriers Absolute difference between average energy in each carrier from the averaged energy measured over all active subcarriers. Carriers –50:-1 1:50 Carriers –100:-51 51:100	All	= 0.12dB = +/- 2dB = +2/-4dB
Spectral mask	All	Local regulation If no specification in local regulation or

		unlicensed bands use given below
Relative constellation error QPSK rate ½ QPSK rate ¾ 16 QAM rate ½ 16QAM rate ¾ 64 QAM rate 2/3[1] 64 QAM rate ¾	All	 = -19.4dB = -21.4dB = -26.2dB = -28.4dB = -30dB for SS = -32.7dB for BS = -32dB for SS = -34.4dB for BS
Rx Linearity IP3	All	? -10dBm, when the system is set to minimum gain
Max input damage level	All	? -0dBm, when the system is set to maximum gain
BS Rx max input level for BER<10^{-6}[2]	All	Sensitivity level for full BW + 20dB.
SS Rx max input level for BER<10^{-6} QAM64	All	-40 dBm
BS Receiver sensitivity, 4 Sub-channels used: QPSK rate ½ QPSK rate ¾ 16 QAM rate ½ 16QAM rate ¾ 64 QAM rate 2/3 64 QAM rate ¾		 = -90dBm+10*log10 (BW/1.75MHz) = -87dBm+10*log10 (BW/1.75MHz) = -83dBm+10*log10 (BW/1.75MHz) = -81dBm+10*log10 (BW/1.75MHz) = -77dBm+10*log10 (BW/1.75MHz) = -75dBm+10*log10 (BW/1.75MHz)
BS Receiver sensitivity 2 sub-channels used: QPSK rate ½ QPSK rate ¾ 16 QAM rate ½ 16QAM rate ¾ 64 QAM rate 2/3 64 QAM rate ¾		 = -93dBm+10*log10 (BW/1.75MHz) = -90dBm+10*log10 (BW/1.75MHz) = -86dBm+10*log10 (BW/1.75MHz) = -84dBm+10*log10 (BW/1.75MHz) = -80dBm+10*log10 (BW/1.75MHz) = -78dBm+10*log10 (BW/1.75MHz)
BS Receiver sensitivity for 1 sub-channel QPSK rate ½ QPSK rate ¾ 16 QAM rate ½ 16QAM rate ¾ 64 QAM rate 2/3 64 QAM rate ¾		 = -96dBm+10*log10 (BW/1.75MHz) = -93dBm+10*log10 (BW/1.75MHz) = -89dBm+10*log10 (BW/1.75MHz) = -87dBm+10*log10 (BW/1.75MHz) = -83dBm+10*log10 (BW/1.75MHz) = -81dBm+10*log10 (BW/1.75MHz)

[1] The required constellation error for QAM 64 were relaxed relative to the requirements in 8.4.8.12. The motivations are

a. In 8.4.8.1.2 The relative constellation error were set 10dB higher than required SNR. For QAM64 2/3 and ¾ the constellation error was –32.7dB and –34.4 dB respectively. These figures were based on required SNR of 22.7 dB and 24.4dB, which is very pessimistic.

b. A trade off between implementation complexity and performance. By relaxing the constellation errors to –30dB and –32dB the degradation is increased by 0.3dB.

[2] BS needs to support a small Rx dynamic range. The SS adjusts its transmit power so it will be received at the appropriate power level of the BS. SS needs to support a large input dynamic range.

SS Receiver sensitivity 1 QPSK rate ½ QPSK rate ¾ 16 QAM rate ½ 16QAM rate ¾ 64 QAM rate 2/3 64 QAM rate ¾		 = -90dBm+10*log10 (BW/1.75MHz) = -87dBm+10*log10 (BW/1.75MHz) = -83dBm+10*log10 (BW/1.75MHz) = -81dBm+10*log10 (BW/1.75MHz) = -77dBm+10*log10 (BW/1.75MHz) = -75dBm+10*log10 (BW/1.75MHz)
1st adjacent channel rejection at BER=10^{-6} for 3dB degradation 16QAM rate ½ 64 QAM rate ¾	All	 11dB 4dB
2nd adjacent channel rejection at BER=10^{-6} for 3dB degradation 16QAM rate ½ 64 QAM rate ¾	All	 30dB 23dB
BS frequency absolute accuracy Not including aging Including aging	All	 +/- 4ppm +/- 6ppm
BS frequency and symbol clock locked on same source	All	yes
SS relative frequency accuracy	All	1% of subcarrier spacing
SS timing accuracy RMS	All	1/128 of Tb.
TTg/ RTg	All	TBD

Mask for unlicensed and other bands

The proposed masks are similar to those of IEEE802.16a section 8.6.2. The masks are scaled to support other bandwidths.

The mask of 802.16a was modified around point B (5.25MHz @ BW=10MHz). This is to allow the relaxation of the spectral requirements, as demonstrated below.

In Figure the spectrum of an OFDM waveform with BW=10MHz is shown vs. the spectral mask. The OFDM signal is distorted by a power amplifier (Rapp model p=2) with an input back-off of 8dB. It can be seen the inter-modulation skirts violate the 802.16a mask, around 5MHz. The modification prevents the violation.

Table XXX mask for unlicensed bands

Point	A	B	C	D
Frequency	0.95*BW	1.09*BW	1.95*BW	2.95*BW
Amplitude	0dB	-25dB	-32dB	-50dB

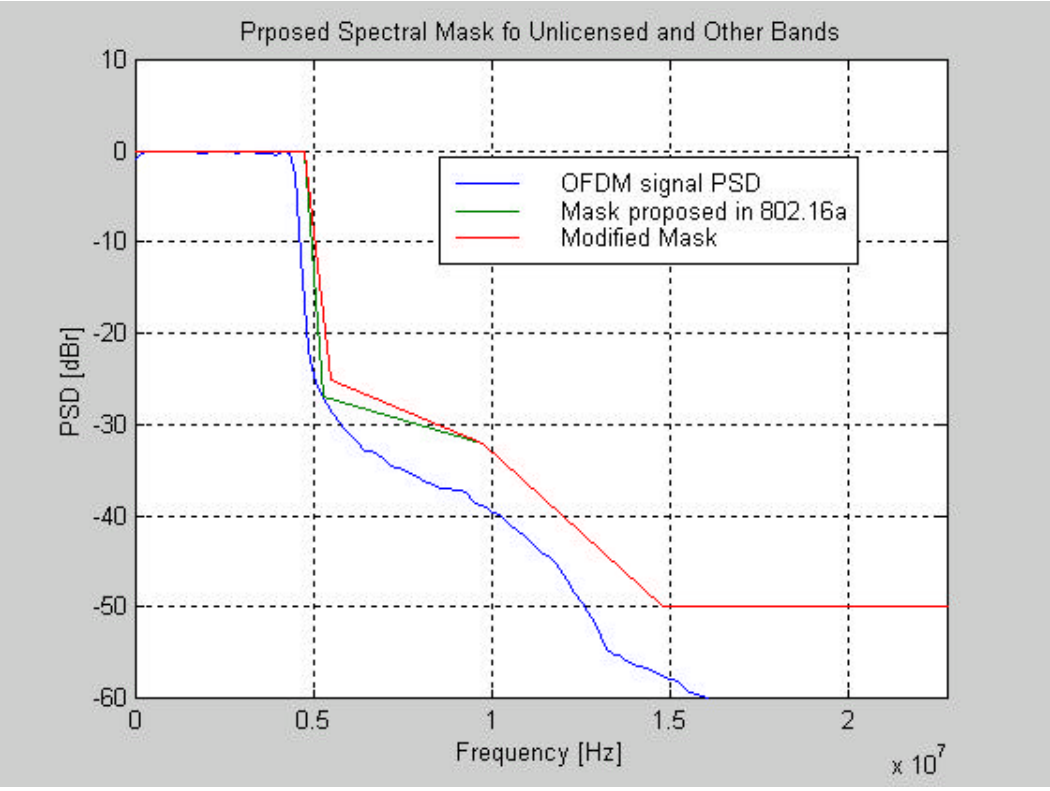

Figure 1: Spectral Masks for BW=10MHz

3. WirelessMAN-OFDM Basic packet PMP MAC profile

The following list is adapted from table 5 in [2].

Feature	Required?	Conditions / Notes
IPv4 us age as default in Registration	Yes	
Packet convergence sub-layer	Yes	
Classification of incoming packets	Yes	
Payload header suppression	Yes	
Provisioned connections	Yes	
Multicast polling groups	Yes	
Multicast polling	Yes	
Concatenation functionality	Yes	
Fragmentation functionality	Yes	
Packing functionality	Yes	
CRC functionality	Yes	
ARQ functionality	Yes	
Dynamic change of services	Yes	
Unsolicited grant service functionality	Yes	
Real-Time Polling services	Yes	
Best effort services	Yes	
Non-Real-Time Polling services	Yes	
Unframed FDD	No	
Framed FDD	Yes	
TDD	Yes	
RSSI	Yes	
3-DES EDE with 128-bit key (type 1)	Yes	
RSA with 1024-bit key	Yes	
ATM convergence sub-layer	No	

Feature	Required?	Conditions / Notes
Support of PVCs	No	
VC switched connections	No	
VP switched connections	No	

—Support of ARQ functionality is mandatory as a capability, but may be turned on or off on a per connection basis.
ARQ parameters defaults shall be set to:
—ARQ Window Size = 64
—ARQ Retry Timeout = 10 MAC frame sizes
—ARQ Fragment Lifetime = 10 MAC frame sizes
—ARQ RX Purge Time Timeout = 100 MAC frame sizes.
—ARQ Sync Loss Timeout = 100 MAC frame sizes
—ARQ Deliver in Order = 1

4. Reference

[1] IEEE C802.16d-03/24, Profiles for WirelessMAN-OFDM andWirelessHUMAN(-OFDM) (WiMax)

[2] BRAN32d021, OFDM Profiles for HIPERMAN (and assorted changes) Date: 2003-02-09 (Nokia)