

# WiMAX - PHYSICAL LAYER

The WiMAX physical layer is based on orthogonal frequency division multiplexing. OFDM is the transmission scheme of choice to enable high-speed data, video, and multimedia communications and is used by a variety of commercial broadband systems, including DSL, Wi-Fi, Digital Video Broadcast-Handheld *DVB-H*, and MediaFLO, besides WiMAX.

OFDM is an elegant and efficient scheme for high data rate transmission in a non-line-of-sight or multipath radio environment.

## Adaptive Modulation and Coding in WiMAX

WiMAX supports a variety of modulation and coding schemes and allows for the scheme to change on a burst-by-burst basis per link, depending on channel conditions. Using the channel quality feedback indicator, the mobile can provide the base station with feedback on the downlink channel quality. For the uplink, the base station can estimate the channel quality, based on the received signal quality.

Following is a list of the various modulation and coding schemes supported by WiMAX.

	Downlink	Uplink
<b>Modulation</b>	BPSK, QPSK, 16 QAM, 64 QAM; BPSK optional for OFDMA-PHY	BPSK, QPSK, 16 QAM; 64 QAM optional
<b>Coding</b>	<p><b>Mandatory:</b> convolutional codes at rate 1/2, 2/3, 3/4, 5/6</p> <p><b>Optional:</b> convolutional turbo codes at rate 1/2, 2/3, 3/4, 5/6; repetition codes at rate 1/2, 1/3, 1/6, LDPC, RS-Codes for OFDM-PHY</p>	<p><b>Mandatory:</b> convolutional codes at rate 1/2, 2/3, 3/4, 5/6</p> <p><b>Optional:</b> convolutional turbo codes at rate 1/2, 2/3, 3/4, 5/6; repetition codes at rate 1/2, 1/3, 1/6, LDPC</p>

## PHY-Layer Data Rates

Because the physical layer of WiMAX is quite flexible, data rate performance varies based on the operating parameters. Parameters that have a significant impact on the physical-layer data rate are channel bandwidth and the modulation and coding scheme used. Other parameters, such as number of subchannels, OFDM guard time, and oversampling rate, also have an impact.

Following is the PHY-layer data rate at various channel bandwidths, as well as modulation and coding schemes.

Channel Bandwidth	3.5MHz	1.25MHz	5MHz	10MHz				
PHY mode	256 OFDM	128 OFDMA	512 OFDMA	1,024 OFDMA				
Oversampling	8/7	28/25	28/25	28/25				
Modulation & Code Rate	PHY-Layer Data Rate (kbps)							
	DL	UL	DL	UL	DL	UL	DL	UL
BPSK, 1/2	946	326	Not applicable					
QPSK, 1/2	1,882	653	504	154	2,520	653	5,040	1,344
QPSK, 3/4	2,822	979	756	230	3,780	979	7,560	2,016
16 QAM, 1/2	3,763	1,306	1,008	307	5,040	1,306	10,080	2,688
16 QAM, 3/4	5,645	1,958	1,512	461	7,560	1,958	15,120	4,032

64 QAM, 1/2	5,640	1,938	1,512	461	7,560	1,938	15,120	4,052
64 QAM, 2/3	7,526	2,611	2,016	614	10,080	2,611	20,160	5,376
64 QAM, 3/4	8,467	2,938	2,268	691	11,340	2,938	22,680	6,048
64 QAM, 5/6	9,408	3,264	2,520	768	12,600	3,264	25,200	6,720

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