REPORT ITU-R M.2116

Characteristics of broadband wireless access systems operating in the land mobile service for use in sharing studies

(Questions ITU-R 1/8 and ITU-R 7/8)

(2007)

1 Introduction

This Report provides characteristics for a number of terrestrial broadband wireless access (BWA)[1] systems, including mobile and nomadic applications, operating, in the mobile service for use in sharing studies between these terrestrial BWA systems and other fixed or mobile systems.

2 Characteristics

Annex 1 contains technical and operational characteristics of mobile BWA[2] systems to be used for sharing studies for both mobile stations and base stations. It should be recognized that the footnotes in the Table provide important information on the derivation of particular values and any limits to their applicability for sharing studies. Therefore, these footnotes should be taken into account wherever referenced.

3 IMT-2000 radio interfaces

Terrestrial IMT-2000 systems[3] meet the definition of BWA found in Recommendation ITU-R F.1399. In addition to the characteristics found in Annex 1, sharing characteristics of IMT-2000 systems in the 2 GHz range can be found in Report ITU-R M.2039 – Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses, and are not duplicated herein. These systems should also be considered in sharing analysis involving BWA systems[4].

Systems beyond IMT-2000 will also meet the criteria to be considered BWA, and as these systems are developed their characteristics should also be considered for sharing studies with BWA systems. Systems beyond IMT-2000 may be incorporated into future revisions of this Report directly or by reference.

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1 "Wireless access" and "BWA" are defined in Recommendation ITU-R F.1399.

2 BWA radio interface standards can be found in Recommendation ITU-R M.1801. Radio interface standards for broadband wireless access systems, including mobile and nomadic operations, in the mobile service operating below 6 GHz.

3 IMT-2000 radio interface standards are described in Recommendation ITU-R M.1457: Detailed specification of the radio interfaces of international mobile telecommunications-2000 (IMT-2000).

4 Recommendation ITU-R M.1823 provides values for some systems applicable to BWA.

4 RLAN characteristics

In addition to the characteristics found in Annex 1, characteristics of RLAN systems can be found in Recommendation ITU-R M.1450 – Characteristics of broadband radio local area networks, and are not duplicated herein.

Annex 1

Table 1 contains technical and operational characteristics for use in sharing studies and Table 2 contains a list of acronyms and abbreviations.

TABLE 1

Technical and operational characteristics for use in sharing studies

Parameter	IEEE 802.16e[1]		HC-SDMA[2]		Next-generation PHS[3]		T1.716/717[4]		ATIS.0700001.2004[5]		T1.723[6]	
	BS	MS	BS	MS	BS	MS	BS	MS	BS	MS	BS	MS
System												
Nominal channel BW (MHz)	5 {1a}		0.625 {1b}		10 {1c}		2 × 5 to 2 × 20 MHz (in 3.5 or 5 MHz increments)		5		1.25	
Carrier frequency	2 500 – 2 690 MHz		<4 GHz{2a}		<6 GHz{2b}		<6 GHz {2b}		<6 GHz {2b}		<2 GHz	
Emission type	Digital		Digital		Digital		Digital		Digital		Digital	
Deployment type	Cellular		Cellular		Cellular		Cellular		Cellular		Cellular	
Modulation type	BPSK, QPSK, 16-QAM, 64-QAM	BPSK, QPSK, 1-QAM, 64-QAM	BPSK, QPSK, 8-PSK, 12-QAM, 16-QAM, 24-QAM	BPSK, QPSK, 8-PSK, 12-QAM, 16-QAM	BPSK, QPSK, 16-QAM, 32-QAM, 64-QAM, 256-QAM	BPSK, QPSK, 16-QAM, 32-QAM, 64-QAM, 256-QAM	QPSK	QPSK	QPSK, 8PSK, 64-QAM	QPSK, 8PSK 16-QAM	QPSK	BPSK, QPSK
Duplex method	TDD		TDD		TDD		FDD		TDD		FDD	
Access technique	TDMA/OFDMA		TDMA/FDMA/SDMA		TDMA/OFDMA		CDMA		CDMA		CDMA	
No. of sectors	3 {3a}	Not applicable	3 {3b}	Not applicable	1 or more	Not applicable	Typical-ly 3	Not applicable	Typical-ly 3	Not applicable	Typical-ly 3	Not applicable
Reuse factor	1:1, 1:3		1:1 {4a}		1:1		1:1, 1:3		1:1{4a}		1:1	
Antennas per sector	Not specified		12 {5a}	1	4 or more	1 or more	Not specified	Not specified	Not specified	1	Not specified	1
Co-located antenna minimum coupling loss (dB) {6}	30	Not applicable	30	Not applicable	30	Not applicable	30	Not applicable	30	Not applicable	30	Not applicable

TABLE 1 (*continued*)

Parameter	IEEE 802.16e[1]		HC-SDMA[2]		Next-generation PHS[3]		T1.716/717[4]		ATIS.0700001.2004[5]		T1.723[6]	
	BS	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**
Radiation pattern	Horizontal {7c} Vertical {7d}	Not specified	Adaptive {7b}	Omnidi-rectional {7a}	Omnidi-rectional {7a}	Omnidi-rectional {7a}	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
Transmitter												
Average power (dBm)	36 {8a}	20 {8a}	24.2 {8b}	20	40 {8a}	23 {8a}	36	20	24.2 {8b}	20	43	26
TDD activity factor (dB) {9}	3		–1.76 {9a}	–4.77 {9b}	3		Not applicable		Variable 0 to –4.77		Not applicable	
Antenna gain (dBi)	18 {10a}	0 to 6 {10a}	15	0	12 or more	0 to 4	18 {10a}	0 to 6 {10a}	18 (10a)	0 to 6 (10a)	17 (10a)	0 to 6 (10a)
Antenna height AGL (m)	15 to 30 {11a}	≤1.5	15 to 45	≤1.5	15 to 45	1.5	15 to 30 {11b}	≤ 1.5	15 to 30 {11b}	≤ 1.5	15 to 30	≤ 1.5
Misc. losses (dB)	2 {12a}	0	1 {12b}	0	2 {12b}	0	2 {12b}	0	2 {12b}	0	<2 {12b}	0
Adjacent Channel Leakage Ratio (ACLR) (dB)	{13a}		{13b}		{13d}		{13e}		{13e}		{13f}	
ACLR_1 (dB)	53.5	33	53.5 {13c}	45	40	23	40 {13c}	33	40 {13c}	33	40 {13c}	33
ACLR_2 (dB)	66	51	66 {13c}	50	60	33	50 {13c}	43	50 {13c}	43	50 {13c}	43
Receiver												
Antenna gain (dBi)	18 {10a}	0 to 6 {10a}	15	0	12 or more	0 to 4	18 {10a}	0 to 6 {10a}	18	From 0 to 6 {10a}	17	0 to 6
Antenna height (AGL) (m)	15 to 30 {11a}	≤1.5	15 to 45	≤1.5	15 to 45	1.5	15 to 30 {11b}	≤ 1.5	15 to 30	≤ 1.5	15 to 30	≤ 1.5
Misc. losses (dB)	0 {12a}	0	1 {12b}	0	2 {12b}	0	0 {12a}	0	0 {12a}	0	0 {12a}	0
Noise figure (dB)	3	5	5	7	5	7	4	7	4	7	4	7

TABLE 1 (*end*)

Parameter	IEEE 802.16e[1]		HC-SDMA[2]		Next-generation PHS[3]		T1.716/717[4]		ATIS.0700001.2004[5]		T1.723[6]	
	BS	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**	**BS**	**MS**
Thermal noise density (dBm/Hz)	–174		–174		–174		–174		–174		–174	
Adjacent Channel Selectivity (ACS) (dB)	{14a}				{14b}							
ACS_1 (dB)	70	40	46	47	42	30	46	33	46	33	46	33
ACS_2 (dB)	70	59	46	60	42	30	56	43	56	43	56	43
Interference criterion, *I*/*N* (dB) {15}	–6 or –10	–6 or –10	{15a}	{15a}	–6 or –10	–6 or –10	–6 or –10	–6 or –10	–6 or –10	–6 or –10	–6 or –10	–6 or –10
Required SINR (dB) {16}	{16a}	{16a}	1-17	0-14	{16a}	{16a}	{16a}	{16a}	{16a}	{16a}	{16a}	{16a}
Max. tolerable interference power (dBm) {17}	–110 or –114	–108 or –112	{17a}	Not applicable	–105 or –109	–103 or –107	–108 or –112	–105 or –109	–108 or –112 {17b}	–105 or –109 {17b}	–108 or –112 {17b}	–105 or –109 {17b}
Nominal reference sensitivity (dBm)	Not applicable	Not applicable	–109.8 {18a}	–108.5 {18b}	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

NOTE 1 – Numbers in {} refer to the Notes below.

(1) IEEE 802.16e, an amendment to IEEE 802.16-2004, forms the basis of WiMAX™ for mobile applications. Note that the ACLR and ACS values used for the IEEE 802.16e system in this report are intended only for coexistence studies and apply to channels close to a FDD/TDD boundary. These values are not minimum performance requirements, which have not yet been specified.

(2) ANSI ATIS 0700004-2005, High capacity – Spatial division multiple access (HC-SDMA) is commercially known as the iBurst™ system.

(3) A-GN4.00-01-TS, PHS MoU Technical specifications.

(4) T1.716/7-2000 (R2004) air interface standard for broadband direct sequence CDMA for fixed wireless PSTN access – layer 1/layer.

(5) ANSI ATIS-0700001.2004 MCSB physical, MAC/LLC, and network layer specification.

(6) T1.723-2002 I-CDMA spread spectrum systems air interface standard.

Notes to Table 1:

{1a} While other nominal channel bandwidths are allowed in the standard, 5 MHz is chosen as a typical configuration for the frequency band of interest.

{1b} The HC-SDMA standard uses a 625 kHz carrier bandwidth. For a 5 MHz channel bandwidth, deployment of multiple 625 kHz carriers is assumed.

{1c} While other nominal channel bandwidths are allowed in the standard, this marked value is chosen as a typical configuration for the frequency band of interest.

{2a} While the standard supports various carrier frequency ranges below 4 GHz, the frequency dependant characteristics in this table are typical for the 1-3 GHz frequency range.

{2b} While the standard supports various carrier frequency ranges below 6 GHz, the frequency dependant characteristics in this table are typical for the 1-3 GHz frequency range .

{3a} Number of sectors ranges from 1 (omnidirectional) to higher numbers such as 6. For the sake of sharing studies, three-sectored sites are being considered.

{3b} Number of sectors ranges from 1 (omnidirectional) to higher numbers such as 3. For the sake of sharing studies, three-sectored sites are being considered.

{4a} System can support reuse of less than 1 through spatial division multiple access wherein up to four users can simultaneously share the same carrier/time slot combination. Reuse 1 is considered in the sharing study.

{5a} The HC-SDMA system utilizes a multi-antenna architecture with multiple antennas per sector.

{6} For co-located base stations, this parameter captures the minimum coupling loss between two systems. *Note:* Higher values are achievable. For example, Report ITU-R M.2045 suggests that a coupling loss of up to 70 dB is achievable with a few metres of antenna separation. In real deployment conditions, a coupling loss of up to 45 dB may be achievable.

{7a} This is the typical pattern; however, it should be noted that the radiation pattern will depend on the operator's deployment scenarios and equipment suppliers.

{7b} HC-SDMA systems are deployed with adaptive multi-antenna arrays. Therefore, the BS antenna array radiation pattern varies in time and space depending on changes in the relative configuration of desired and interfering signals.

{7c} See 3GPP TR 25.892 v2.0.0 2004-06.

{7d} See Recommendation ITU-R M.1646/ Recommendation ITU-R F.1336-1.

{8a} TX power reported is typical and higher values may be available based on region. TX power is the RF power averaged during the transmit burst, without considering traffic statistics or lowered-power operation or UL/DL ratio.

{8b} Average power per antenna per carrier. Equivalent isotropic radiated power for victim systems should be computed statistically based on the average power per antenna and array geometry.

{9} A function of UL/DL ratio of the TDD mode, this parameter is not applicable to FDD operation.

{9a} BS transmit duty cycle expressed in dB.

{9b} MS transmit duty cycle expressed in dB.

{10a} Base station antenna gains are typical of wide area terrestrial cellular deployments and are consistent with the values provided by ETSI. Mobile subscriber station antenna gain ranges from 0 dBi, for PDA and other handheld terminals, to 6 dBi, for laptops.

{11a} Previous ITU-R studies on sharing of IMT-2000 systems (Reports ITU-R M.2030 and ITU-R M.2045) use 30 m as a base station antenna height. Assuming the same height of 30 m for 802.16 systems would create the worst case situation for coexistence with IMT-2000 by creating the possibility of main-beam coupling of interfering systems. It should be, however, noted that a base station height of 15 m is considered a more typical number for 802.16 systems.

{11b} Previous ITU-R studies on sharing of IMT-2000 systems (Reports ITU-R M.2030 and ITU-R M.2045) use 30 m as a base station antenna height.

{12a} Miscellaneous losses account for cable/connector losses in the TX path. In the RX path, these losses are assumed to be avoided by using tower-top LNA.

{12b} Miscellaneous losses account for cable/connector losses in the TX and RX path.

{13a} Defined as the ratio of the on-channel transmitted power to the power transmitted in adjacent channels as measured at the output of the receiver filter, ACLR represents the interference power into a receiver operating in the adjacent channel(s). ACLR_*n* in the table are ACLR values at *n* 5-MHz channels away calculated with a receiver filter bandwidth of 4.5 MHz. The IEEE 802.16e standard does not specify ACLR information. These are values provided by the WiMAX Forum specifically with regard to 2 500-2 690 MHz frequency band and are still subject to further study that can lead to a revision of the Report.

{13b} Defined as the ratio of the on-channel transmitted power to the power transmitted in adjacent channels, ACLR represents the interference power into a receiver operating in the adjacent channel(s). ACLR_*n* in the table are ACLR values at *n* 5-MHz away. Values are quoted as dBc per 625 kHz.

{13c} ACLR values dependent on filter roll off and number of carriers.

{13d} Defined as the ratio of the on-channel transmitted power to the power transmitted in adjacent channels, ACLR represents the interference power into a receiver operating in the adjacent channel(s). ACLR_*n* in the table are ACLR values at *n* 10-MHz away. Values are quoted as dBc per 1 MHz.

{13e} Defined as the ratio of the on-channel transmitted power to the power transmitted in adjacent channels, ACLR represents the interference power into a receiver operating in the adjacent channel(s). ACLR_*n* in the table are ACLR values at *n* 5-MHz away.

{13f} Defined as the ratio of the on-channel transmitted power to the power transmitted in adjacent channels, ACLR represents the interference power into a receiver operating in the adjacent channel(s). ACLR_*n* in the table are ACLR values at *n* 1.25-MHz away.

{14a} The IEEE 802.16e standard does not specify ACS information. The values shown were submitted by the WiMAX Forum specifically with regard to the 2 500-2 690 MHz frequency band. The ACS values are based on anticipated performance by some of the industry, as provided by the WiMAX Forum. A number of other BWA technologies have considerably lower ACS values.

{14b} The ACS values are based on anticipated performance by some of the industry, as provided by the PHS MoU Group. These values are with the following conditions: modulation type BPSK and BER of 10 015^{-5}.

{15} The *I*/*N* of –10 dB, corresponding to about half a dB impact on the receiver sensitivity, is a stringent criterion which is recommended in certain cases including in some ITU-R Recommendations. The number of –6 dB, corresponding to 1 dB impact on the receiver sensitivity, however, is also recommended in Recommendation ITU-R F.758-3.

{15a} *I*/*N* is not required since the information is provided by the SINR.

{16} Required SINR (dB) measured after array processing/equalization dependent on modulation class.

{16a} Not required because maximum tolerable interference power is specified.

{17} Numbers are based on *I*/*N* of –6 dB or –10 dB respectively (see {16a}).

{17a} Active interference selectivity is used for this system instead of maximum tolerable interference power. Multi-antenna HC-SDMA systems can achieve 20-30 dB active interference rejection, which can be used to address both intra-system and inter-system interferers.

{17b} Assumes equal interference across all carriers.

{18a} The base station nominal reference sensitivity for Mod Class 0 = –109.8 dBm. The reference sensitivity level of the base station shall be no greater than 1.2 dB above the nominal limits specified for each Mod Class (i.e. Mod Class 0 through Mod Class 8) for FER = 10^{-2}.

{18b} This user terminal nominal reference sensitivity for Mod Class 0 = 108.5 dBm. The reference sensitivity level of the UT (user terminal) shall be no greater than 1 dB higher than the nominal limits specified for each Mod Class (i.e. Mod Class 0 through Mod Class 8) at FER = 10^{-2}.

TABLE 2

Acronyms and abbreviations

ACLR	Adjacent channel leakage ratio
ACS	Adjacent channel selectivity
AGL	Above ground level
ATIS	Alliance for telecommunications industry solutions
BPSK	Binary phase shift keying
BS	Base station
BWA	Broadband wireless access
DL	Down link
FDD	Frequency division duplex
FER	Frame error ratio
HC-SDMA	High capacity-spatial division multiple access
IEEE	Institute of Electrical and Electronic Engineers
MS	Mobile station
PHS	Personal handyphone system
PSK	Phase shift keying
QAM	Quadrature amplitude modulation
QPSK	Quadrature phase shift keying
SINR	Signal to interference-plus-noise ratio
TDD	Time division duplex
Tx	Transmitter
UL	Up-link
UT	User terminal