Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	Characteristics of Wireless Metropolitan Area Networks – Follow up to contribution to ITU-R
Date Submitted	**2002-04-22**
Source(s)	José M. Costa Nortel Networks P.O. Box C-3511 Ottawa, Ontario CANADA K1Y 4H7 Voice: +1 613 763-7574 Fax: +1 613 765-1225 costa@nortelnetworks.com
Re:	IEEE Contribution to ITU-R Joint Task Group 6-8-9, Document IEEE L802.16-04/11
Abstract	This documents provides information about the results of the meeting of ITU-R JTG 6-8-9 (Geneva, 22-26 March 2004), in particular the IEEE contribution on Characteristics of Wireless Metropolitan Area Networks.
Purpose	For information of IEEE 802.16 and to propose that further details on Characteristics of Wireless Metropolitan Area Networks be provided to ITU-R JTG 6-8-9 by November 2004.
Notice	
Release	
Patent Policy and Procedures	

Characteristics of Wireless Metropolitan Area Networks – Follow up to contribution to ITU-R

José M. Costa
Nortel Networks

1. Introduction

The purpose of this contribution is to provide a brief report of the results of the IEEE contribution to ITU-R JTG 6-8-9 (Document IEEE L802.16-04/11), which was well received by JTG 6-8-9.

It is also proposed that that further details on Characteristics of Wireless Metropolitan Area Networks be provided to ITU-R JTG 6-8-9 by November 2004.

2. Highlights of ITU-R JTG 6-8-9

ITU-R Joint Task Group 6-8-9 (JTG 6-8-9) held its first meeting from 22 to 26 March 2004 in Geneva. The purpose of JTG 6-8-9 is to prepare draft CPM[1] text on WRC-07 Agenda Item 1.9[2]. Based on the input contributions, the work addressed four areas:

1. Characteristics of terrestrial systems
2. Electronic News Gathering (ENG issues)
3. Methodologies for sharing between space services and terrestrial services
4. Results of studies on sharing between Mobile Satellite Service (MSS) and Mobile Service (MS) components of IMT-2000.

The results are in the chairman's report (ITU-R Doc. 6-8-9/26), which is available from the ITU web site for those with a TIES[3] userid. The following table summarizes the activities of JTG 6-8-9 and the documents of this group are available here:

http://www.itu.int/md/meetingdoc.asp?lang=e&type=sfolders&parent=R03-6.8.9-C

(IEEE 802.16 members without a TIES userid may ask the IEEE 802.16 ITU-R Liaison Officer[4] for a copy of documents required).

[1] Conference Preparatory Meeting (CPM), a meeting held prior to a World Radiocommunication Conference (WRC).

[2] Agenda item 1.9 is "to review the technical, operational and regulatory provisions applicable to the use of the band 2 500-2 690 MHz by space services in order to facilitate sharing with current and future terrestrial services without placing undue constraint on the services to which the band is allocated".

[3] http://www.itu.int/TIES/intro.html

[4] costa@nortelnetworks.com

Ad-hoc group (Chairman)	Mandate	Documents
AH-1 – Characteristics of terrestrial systems (Mr. R. Ferguson, USA)	Prepare a document listing characteristics of terrestrial FS and MS systems.	6-8-9/12, 13, 14, 19, 20, 21, 22
AH-2 – ENG issues (Mr. M. Dupuis, CAN)	Review studies conducted by WP 6P (Doc. 6P/14) and determine elements relevant to JTG 6-8-9; prepare, if necessary, a liaison to WP 6P.	6-8-9/1 (6P/14), 2 (4B/6), 4, 5, 8, 11
AH-3 – Methodologies for sharing between space services and terrestrial services (Mme C. Ganne, France)	Review methodologies to determine which are applicable to various sharing situations and prepare list of elements that need to be developed to complete the studies.	6-8-9/1 (6P/14 – Part dealing with methodology), 2 (6S/346), 2 (8F/915), 12, 19, 20, 22 (Dealing with methodology)
AH-4 – Results of studies on sharing between MSS and MS components of IMT-2000 (Mr. K. Kosaka, Japan)	Review results of studies conducted by SG 8 to determine if any conclusions can be drawn with regards to sharing between MSS and MS and assess need for further studies. Document any conclusive results, if applicable, as draft CPM text.	6-8-9/ 9, 10, 16 (Section 2.1), 18, 22

The IEEE Contribution "Characteristics of Wireless Metropolitan Area Networks" (ITU-R Doc. 6-8-9/21):

was well received by JTG 6-8-9 and, together with other contributions on terrestrial systems characteristics, formed the basis for a Working Document on "Characteristics of terrestrial systems for consideration in studies under Agenda Item 1.9 of WRC-07" (Annex 3 to Doc. 6-8-9/26):

In the ITU-R Working Document, Section 4 on "Characteristics of Wireless Metropolitan Area Networks" is only a placeholder for now. It is proposed that IEEE 802.16 provides text with characteristics of IEEE 802.16 systems in the band 2500 – 2690 MHz, by extracting relevant material from the IEEE 802.16 standard and/or

providing characteristics of typical implementations. The characteristics of other terrestrial systems contained in the ITU-R Working Document may serve as guide for the type of information that is needed.

The second meeting of JTG 6-8-9 is tentatively scheduled for 17-21 January 2005 in Geneva, Switzerland, but there is a chance that this may change within the time range December 2004 – January 2005. To be safe, a contribution from IEEE should be ready by November 2004.

IEEE 802.16 should prepare the material and work with IEEE 802.18 for final approval as an IEEE contribution and submission to ITU-R JTG 6-8-9.

3. Proposal

It is proposed that IEEE 802.16 gather information on parameters of typical IEEE 802.16 systems in the band 2500-2690 MHz with a view of developing a future contribution to ITU-R.

INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS

Document 6-8-9/21-E
19 March 2004
English only

Received: 19 March 2004

Institute of Electrical and Electronics Engineers (IEEE)

CHARACTERISTICS OF WIRELESS METROPOLITAN AREA NETWORKS

This contribution was developed by IEEE Project 802, the local and metropolitan area network standards committee ("IEEE 802"), an international standards development committee organized under the IEEE and the IEEE Standards Association ("IEEE-SA")*.

The content herein was prepared by a group of technical and regulatory experts in IEEE 802 and was approved for submission by the IEEE 802.18 radio regulatory technical advisory group, the IEEE 802.16 working group on wireless metropolitan area networks, and the IEEE 802 executive committee, in accordance with the IEEE 802 policies and procedures, and represents the view of IEEE 802.

IEEE 802.16 has developed a standard for broadband wireless access systems, which will enable deployments in various bands, including the 2 500-2 690 MHz band. In particular the following documents include physical layer specifications applicable to systems operating between 2 and 66 GHz and it supports point-to-multipoint and optional mesh topologies.

> **IEEE 802.16-2001** - IEEE standard for local and metropolitan area networks. Part 16: Air interface for fixed broadband wireless access systems.
>
> **IEEE 802.16a-2003** - IEEE standard for local and metropolitan area networks. Part 16: Air interface for fixed broadband wireless access systems - Amendment 2: Medium access control modifications and additional physical layer specifications for 2-11 GHz.

These standards are freely available at this page: http://standards.ieee.org/getieee802/802.16.html

IEEE 802.18 will assess the progress of the studies in ITU-R JTG 6-8-9 in the preparations for WRC-07 and will contribute to the work as required.

IEEE 802 hopes that this contribution will prove useful in stimulating productive discussion in JTG 6-8-9 and will contribute in a positive way to the development of appropriate sharing criteria that will protect the IEEE 802.16 systems operating in the band 2 500-2 690 MHz.

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* **Contact:** Carl Stevenson
Chair, IEEE 802.18 RR-TAG
4991 Shimerville Road
Emmaus, PA 18049 USA

Tel: +1 610-965-8799
US GSM: +1 610-570-6168
Geneva GSM: +41 78 690 7693
E-mail: carl.stevenson@ieee.org

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RADIOCOMMUNICATION STUDY GROUPS

Annex 3 to Document 6-8-9/26-E 30 March 2004 English only

Source: Document 6-8-9/TEMP/4

Annex 3 to JTG 6-8-9 Chairman's Report

CHARACTERISTICS OF TERRESTRIAL SYSTEMS FOR CONSIDERATION IN STUDIES UNDER AGENDA ITEM 1.9 OF WRC-07

Introduction

A list of terrestrial characteristics have been compiled below based on input documents received at the first meeting of JTG 6-8-9. Input documents considered for this compilation are: 6-8-9/12, 13, 14, 19, 20, 21, 22.

Characteristics for Terrestrial Systems

1 Fixed Station Equipment Characteristics

Point-to-point (P-P) FS systems (Source: Doc 6-8-9/12 (WP 9D))

Antenna diameter (m)	3	1.2
Maximum receive antenna gain (dBi)	36	28
Feeder loss (dB)	3	3
Noise figure (dB)	4	4
Elevation angle (degrees)	0	0

Hub-stations Receive Parameters of Point-to-Multipoint (P-MP) FS systems

Fixed base station receive parameters

Characteristics	USA Doc 13	USA Doc 13	9D Doc 12	9D Doc 12	CAN Doc 20	CAN Doc 20
Cell size (km radius)	56[1]	3-10[2]				
Antenna type	Omni or sectored	120˚ sector	Omnidirection	Sectoral	Omnidirection	Sectoral
Max antenna gain (dBi)	19 (including feeder loss)	18 (including feeder loss)	10	15	13	17
Downtilt angle (˚)	.5	1	0	0	0	0
Antenna height (m) HAAT[3]	1000	50				
Polarization	Linear	Linear				
Receiver noise figure (dB)	2.5	3	4	4	4	4
Receiver thermal noise (dBW/MHz)	-141.5	–141				
Trigger for Sharing Studies (Isat/Nth) (dB)	-10	-10				
Adjacent channel selectivity	FDD: varies [4] TDD: varies [4]	FDD: varies [4] TDD: varies [4]				
Feeder Loss			4	4	3	3
Beamwidth in elevation (degrees)					5	7
Beamwidth in Azimuth (degrees)			N/A	90	N/A	90

1) Rural areas.

2) Urban areas.

3) HAAT = Height Above Average Terrain

4) Varies by supplier.

Outstations Receive Parameters of P-MP FS systems

Fixed outstation receive parameters

	USA Doc 13	USA Doc 13	9D Doc 12	9D Doc 12
Cell size (km radius)	56	3-10		
Antenna type	Omnidirectional	Omnidirectional	Panel	0.9 mm grid parabolic
Max antenna gain (dBi)	24	7	17	25
Antenna feed loss (dB)	.5	0	2	2
Antenna height (m)	100	1.5		
Polarization	Linear	Linear		
Receiver noise figure (dB)	3	3	4	4
Receiver thermal noise (dBW/MHz)	–141	-141		
Trigger for Sharing Studies (Isat/Nth) (dB)	-10	–10		
Adjacent channel selectivity (ACS)	Typical 40 dB	Typical 40 dB		
Elevation angle (degrees)			0	0

Hub-stations Transmit Parameters of P-MP FS systems

Fixed base station transmit parameters

	USA Doc 13	USA Doc 13
Cell size (km radius)	56	3-10
Maximum transmit power for a 5 MHz channel (dBm) (standards)	50	47
Typical transmit power for a 5 MHz channel (dBm)	47	43
Operating bandwidth (MHz)	5-6	5-6
Antenna type	Omni or 180 Cardiod	120˚ sector
Max antenna gain (dBi) including feeder loss	13	18
Downtilt angle (˚)	.5	1
Antenna height (m) HAAT	1000	50
Polarization	Linear	Linear
Adjacent channel leakage ratio (ACLR)	The maximum out-of-band power is attenuated at the channel edges at least 25 dB relative to the average 6 MHz channel power level, then attenuated along a linear slope from that level to at least 40 dB at 250 kHz above or below the channel edges, then attenuated along a linear slope from that level to at least 60 dB at 3 MHz above the upper and below the lower channel edges, and attenuated at least 60 dB at all other frequencies.	

Outstations Transmit Parameters of P-MP FS systems (USA Doc 13)

Fixed station transmit parameters

Cell size (km radius)	56	3-5	5-10
Average transmit power (dBm)	21	17	21
Average transmit power (dBm) in TDD including 50% activity factor	Activity factor = 3 – 10 dB for TDD	Activity factor = 3 – 10 dB for TDD	
Maximum transmit EIRP (dBm)[1]	68.71	33	
Operating bandwidth (MHz)	5-6	5-6	
Antenna type	Omnidirectional	Omnidirectional	
Max antenna gain (dBi)	17	7	
Antenna feed loss (dB)	.5	0	
Antenna height (m)	100	1.5	
Polarization	Linear	Linear	
ACLR	The maximum out-of band power is attenuated at the channel edges at least 25 dB relative to the average 6 MHz channel power level, then attenuated along a linear slope to at least 40 dB at 250 kHz beyond the nearest channel edge, then attenuated along a linear slope from that level to at least 60 dB at 3 MHz above the upper and below the lower licensed channel edges, and attenuated at least 60 dB at all other frequencies.	The maximum out-of- band power shall be attenuated at the channel edges at least 25 dB relative to the average 6 MHz channel transmitter output power level (P), then attenuated along a linear slope to at least 40 dB or 33+10log(P) dB, whichever is the lesser attenuation, at 250 kHz beyond the nearest channel edge, then attenuated along a linear slope from that level to at least 60 dB or 43+10log(P) dB, whichever is the lesser attenuation, at 3 MHz above the upper and below the lower licensed channel edges, and attenuated at least 60 dB or 43+10log(P) dB, whichever is the lesser attenuation, at all other frequencies	
1) FCC limits (see Section 21.904b.CFR).			

2 **IMT-2000 Characteristics** (Source: Report ITU-R M.2039, Doc 6-8-9/19)

TABLE 2

Characteristics of IMT-2000 mobile stations

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 1]**	**IMT-2000 CDMA Multi-Carrier**[1]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate **See [Ref. 2]**	**3.84 Mchip/s high chip rate** **See [Ref. 2]**			
Carrier spacing	5 MHz ± n _ 0.2 MHz	1.25 MHz (1X)	3.75 MHz (3X)	1.6 MHz ± n _ 0.2 MHz	5 MHz ± n _ 0.2 MHz	30 kHz See [Ref. 14]	200 kHz See [Ref. 7]	1.728 MHz
Duplex method	FDD	FDD	FDD	TDD	TDD	FDD	FDD	TDD
Transmitter power, dBm (typical)[i]	20	20	20	20	20	20	20	10
Transmitter power, dBm (maximum)	24 or 21	24	24	24 or 21	24 or 21	30 See [Ref. 15]	30 See [Ref. 8]	24
Antenna gain (dBi)	0	0	0	0	0	0	0	0
Antenna height (m)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Access techniques	CDMA[iii]	CDMA	CDMA	TDMA/CDMA	TDMA/CDMA	TDMA See [Ref. 15]	TDMA[ii]	MC/TDMA[iv]
Data rates supported	Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 10 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]	Up to 625.35 kbit/s on forward link and up to 433.35 kbit/s on reverse link Higher data rates up to 2 457 kbit/s are supported by technology enhancements (HRPD), See [Ref. 24]	Up to 2 084.55 kbit/s on forward link and up to 1 354.95 kbit/s on reverse link	Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 2.8 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]	Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 10.2 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]	13.0 kbit/s (π/4 DQPSK) 19.95 kbit/s (8-PSK downlink) 18.6 kbit/s (8-PSK uplink)	144 kbit/s See [Ref. 9] 384 kbit/s	1.152 Mbit/s 32 kbit/s/ timeslot (> 2 Mbit/s with aggregated time slots and 8 level modulation)

TABLE 2 (*continued*)

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 1]**	**IMT-2000 CDMA Multi-Carrier**[1]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate **See [Ref. 2]**	**3.84 Mchip/s high chip rate** **See [Ref. 2]**			
Modulation type	HPSK[v]	QPSK/BPSK	QPSK/BPSK	QPSK/8PSK	QPSK	π/4-DQPSK 8-PSK	GMSK 8-PSK	GMSK (BT = 0.5) (+ multi-level modulation options)
Emission bandwidth	See [Ref. 1]	See [Ref. 22]	See [Ref. 22]	See [Ref. 2]	See [Ref. 2]	See [Ref. 17]		See [Ref. 5]
–3 dB							0.12 MHz See [Ref. 10], 0.12 MHz See [Ref. 11]	
–20 dB							0.18 MHz See [Ref. 10], 0.18 MHz See [Ref. 11]	
–60 dB							0.40 MHz See [Ref. 10], 0.60 MHz See [Ref. 11]	
Receiver NF, (worst case)	9 dB	9 dB	9 dB	9 dB	9 dB	9 dB	9 dB	10 dB
Thermal noise in specified bandwidth[vi]	–108 dBm in 3.84 MHz	–113 dBm	–108 dBm	–113 dBm in 1.28 MHz	–108 dBm in 3.84 MHz	–128 dBm[vii]	–121 dBm[viii]	–113 dBm in 1.152 MHz
Receiver thermal noise level	–99 dBm in 3.84 MHz	–125 dBm[ix] –113 dBm –104 dBm[x]	–125 dBm[xi] –113 dBm –99 dBm[xii]	–104 dBm in 1.28 MHz	–99 dBm in 3.84 MHz	–119 dBm	–112 dBm	–102 dBm in 1.728 MHz
Receiver bandwidth	See [Ref. 1]	See [Ref. 22]	See [Ref. 22]	See [Ref. 2]	See [Ref. 2]	See [Ref. 18]	See [Ref. 12]	See [Ref. 5]

TABLE 2 (*continued*)

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 1]**	**IMT-2000 CDMA Multi-Carrier**[1]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate **See [Ref. 2]**	**3.84 Mchip/s high chip rate** **See [Ref. 2]**			
–3 dB								
–20 dB								
–60 dB								
E_b/N_o for $P_e = 10^{-3}$		See [Ref. 22]	Performance not available			7.8 dB	8.4 dB	11 dB (non-coherent detection)
Receiver reference sensitivity[xiii] $\hat{I}_{or}$	–117 dBm in 3.84 MHz	–104 dBm total received power in fully loaded system. Single 9 600 bit/s traffic channel is at –119.6 dBm in AWGN for 0.5% FER	–99 dBm total received power in fully loaded system Single 9 600 bit/s traffic channel is at –119.6 dBm in AWGN for 0.5% FER	–108 dBm in 1.28 MHz	–105 dBm in 3.84 MHz	–113 dBm See [Ref. 19]	–102 dBm See [Ref. 9]	–94 dBm typical (spec.: –86 dBm for speech and generally –83 dBm)
Interference threshold[xiv]	–105 dBm in 3.84 MHz	–110 dBm in 1.25 MHz	–105 dBm in 3.75 MHz	–110 dBm in 1.28 MHz	–105 dBm in 3.84 MHz	No equivalent	See [Ref. 13]	–105 dBm typical (–97 dBm for specification speech)
Transmitter ACLR	See [Ref. 1]	See [Ref. 22][xv]	See [Ref. 22][xvi]	See [Ref. 2]	See [Ref. 2]			See [Ref. 5]
1st adjacent channel	33 dB @ ± 5 MHz	31.6 dB @ ± 3.75 MHz	–33 dBc in 3.84 MHz @ ± 3.08 MHz	33 dB @ ± 1.6 MHz	33 dB @ ± 5 MHz			
2nd adjacent channel	43 dB @ ± 10 MHz	48.2 dB @ ± 8.75 MHz	–43 dBc in 3.84 MHz @ ± 8.08 MHz	43 dB @ ± 3.2 MHz	43 dB @ ± 10 MHz			

TABLE 2 (*end*)

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 1]**	**IMT-2000 CDMA Multi-Carrier**[1]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate **See [Ref. 2]**	**3.84 Mchip/s high chip rate** **See [Ref. 2]**			
Transmitter spurious emissions	See [Ref. 1]	See [Ref. 22]	See [Ref. 22]	See [Ref. 2]	See [Ref. 2]			See [Ref. 5]
Receiver ACS	33 dB	64 dB[xvii]	50 dB	33 dB	33 dB			
Receiver blocking levels	See [Ref. 1]	See [Ref. 22]	See [Ref. 22]	See [Ref. 2]	See [Ref. 2]			See [Ref. 5]

1 The IMT-2000 minimum performance requirements recorded here for IMT-2000 CDMA multicarrier are defined in the band class 6 (i.e. 2 GHz band) requirements in [Ref. 22]. This is also relevant to the technology enhancements (HRPD) requirements contained in [Ref. 24].

i May not be appropriate for all scenarios, for example when calculating aggregate interference from all users in a cell.

ii TDMA, comprising 8 timeslots (577 µs) per single TDMA frame (4.615 ms). For user packet data service, 1-4 timeslots per frame may be used by mobile stations having multi-slot classes that do not require simultaneous transmission and reception, i.e. classes for which a duplexer is not required.

iii Desired signal at sensitivity, $I/N = -6$ dB for a 10% loss in range applicable to cases where interference effects a limited number of cells. In other cases, e.g. international coordination with BSS sound in the 2.5 GHz band a trigger value of $I/N = -10$ dB is appropriate.

iv Ten frequency channels with 24 time slots (32 kbit/s) per frame. The frame length is 10 ms.

v Hybrid Phase Shift Keying: a method peculiar to IMT-2000 CDMA Direct Spread in which the peak to average ratio is reduced in comparison to a QPSK signal by mixing the orthogonal variable spreading factor (OSVF) with both information sources as real signals, i.e. those destined for I and Q modulation components, and then shifting one component by 90 degrees to produce an equivalent imaginary signal and then utilizing gain control on the Q channel to preserve orthogonality.

vi 10Log(kTb) + 30 (dBm), where k = Boltzman's constant = 1.38e-23, T = reference temperature = average Earth temperature = 277 K, b = noise equivalent bandwidth (Hz).

vii In the receiver bandwidth.

viii In the receiver bandwidth.

ix In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate (153.6 kbit/s) for data services.

x In the receiver bandwidth.

xi In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate (153.6 kbit/s) for data services.

xii In the receiver bandwidth.

xiii For a 10^{-3} raw bit error rate, $\hat{I}_{or}$, the received power spectral density (integrated in a bandwidth of (1 + _) times the chip rate and normalized to the chip rate) of the downlink signal as measured at the UE antenna connector.

xiv *I/N* = –6 dB for a 10% loss in range applicable to cases where interference effects a limited number of cells. In other cases, e.g. sharing with BSS (sound) in the 2 630-2 655 MHz band, a value of *I/N* = –10 dB is appropriate.

xv Currently [Ref. 22], [Ref. 23] and [Ref. 24] do not contain explicit 1X mobile station or base station ACLR requirements. Nevertheless, the 1X spectrum emission limits described in [Ref. 22] already provide protection of adjacent channels. A lower bound for the effective ACLR can be calculated by integrating the maximum allowed 1X emissions over a 3.84 MHz integration bandwidth centred at the specified frequency offset are considered. Results summarized in this Table are calculated by assuming a 24 dBm mobile station output power, and a one 43 dBm output power base station. The actual 1X ACLR value in practical implementations will be considerably better since the emission limits (i.e. flat mask, no slope) in the region of the second adjacent channel do not realistically model a power amplifier emissions roll-off.

xvi The requirements at offsets of 3.08 and 8.08 MHz are equivalent to ACLR requirements of 33 and 43 dB from a 3X mobile station transmitter into a 3X or IMT-DS mobile station receiver offset by 5 and 10 MHz respectively. With regard to base stations, [Ref. 21] currently does not contain an explicit ACLR requirement for base stations. Nevertheless, the 1X spectrum emission limits described in [Ref. 21] already provide protection of adjacent channels. A lower bound for the effective ACLR can be calculated by integrating the maximum allowed emissions of three neighbouring IMT-MC 1x channels over a 3.84 MHz integration bandwidth centred at the specified frequency offset. Results summarized in this Table are produced assuming three adjacent 38 dBm output power 1X base stations; the aggregate output power over the 5 MHz of assigned channels is 43 dBm.

xvii The test equipment ACLR (i.e. in-band emissions contributions) effectively limits the mobile station ACS that can be tested.

TABLE 3

Characteristics of IMT-2000 base stations

Parameter	IMT-2000 CDMA Direct Spread See [Ref. 3, 6]			IMT-2000 CDMA Multi-Carrier[1]						IMT-2000 CDMA TDD (time-code) 1.28 Mchip/s low chip rate See [Ref. 4]			IMT-2000 CDMA TDD (time-code) 3.84 Mchip/s high chip rate See [Ref. 4]			IMT-2000 TDMA Single-Carrier[xviii]			IMT-2000 FDMA/TDMA (frequency-time) See [Ref. 5]
Carrier spacing	5 MHz ± n _ 0.2 MHz			1.25 MHz (1X)			3.75 MHz (3X)			1.6 MHz ± n _ 0.2 MHz			5 MHz ± n _ 0.2 MHz			30 kHz		200 kHz	1.728 MHz
Duplex method	FDD			FDD			FDD			TDD			TDD			FDD		FDD	TDD
Cell type	Macro	Micro	Pico	Macro	Micro	Pico	Macro	Micro	Pico	Macro	Micro	Pico	Macro	Micro	Pico	Macro	Micro	Pico	Omni
Transmitter power dBm[xix]	43	38	24	40	tbd	tbd	40	tbd	tbd	43	tbd	tbd	43	tbd	tbd	40	tbd	tbd	24
Antenna gain[2] (dBi/120 deg. sector)	17	5	0	17	tbd	tbd	17	tbd	tbd	17	5	0	17	5	0	17	tbd	tbd	Max. 12 Norm. 0
Antenna height (m)	30	5	1.5	30	tbd	tbd	30	tbd	tbd	30	5	1.5	30	5	1.5	30	tbd	tbd	1.5-10 (typ. 2.5)
Tilt of antenna (deg. down)	2.5	0	0	2.5	tbd	tbd	2.5	tbd	tbd	2.5	0	0	2.5	0	0	2.5	tbd	tbd	tbd
Access techniques	CDMA			CDMA			CDMA			TDMA/CDMA			TDMA/CDMA			TDMA		TDMA	MC/TDMA
Data rates supported	Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 10 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]			Up to 625.35 kbit/s on forward link and up to 433.35 kbit/s on reverse link Higher data rates up to 2 457 kbit/s are supported by technology enhancements (HRPD), See [Ref. 23]			Up to 2 084.55. kbit/s on forward link and up to 1 354.95 kbit/s on reverse link			Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 2.8 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]			Pedestrian: 384 kbit/s, Vehicular: 144 kbit/s, Indoors: 2 Mbit/s Higher data rates up to 10.2 Mbit/s are supported by technology enhancements (HSDPA), See [Ref. 25]			30 kbit/s 44 kbit/s		384 kbit/s	1.152 Mbit/s 32 kbit/s/timeslot (> 2 Mbit/s with aggregated time slots and 8 level modulation)
Modulation type	QPSK			QPSK/BPSK 8PSK/16QAM[xxi]			QPSK/BPSK			QPSK/8PSK			QPSK			π/4-DQPSK 8-PSK		GMSK 8-PSK	GMSK (BT = 0.5) (+ multi-level modulation options)
Emission bandwidth	See [Ref. 3]			See [Ref. 21]			See [Ref. 21]			See [Ref. 4]			See [Ref. 4]						See [Ref. 5]
–3 dB																0.03 MHz		0.18 MHz	
–20 dB																0.03 MHz		0.22 MHz	

TABLE 3 (*continued*)

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 3, 6]**	**IMT-2000 CDMA Multi-Carrier**[1]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**[xviii]		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate See [Ref. 4]	**3.84 Mchip/s high chip rate See [Ref. 4]**			
–60 dB						0.04 MHz	0.24 MHz	
Receiver noise figure (worst case)	5 dB for macro BS	5 dB	5 dB	7 dB for macro BS	5 dB for macro BS	5 dB	5 dB	10 dB
Receiver thermal noise level	–103 dBm in 3.84 MHz for macro BS	–129 dBm –117 dBm[xxii] –108 dBm[xxiii]	–129 dBm –117 dBm[xxiv] –103 dBm[xxv]	–106 dBm in 1.28 MHz for macro BS	–103 dBm in 3.84 MHz for macro BS	–125 dBm[xxvi]	–117 dBm[xxvii]	–103 dBm in 1.152 MHz
Receiver bandwidth	< 5 MHz (See [Ref. 3])	See [Ref. 21]	See [Ref. 21]	< 1.6 MHz (See [Ref. 4])	< 5 MHz (See [Ref. 4])			See [Ref. 5]
–3 dB						0.03 MHz	0.18 MHz	
–20 dB						0.04 MHz	0.25 MHz	
–60 dB						0.09 MHz	0.58 MHz	
E_b/N_o for $P_e = 10^{-3}$	See [Ref. 3]	See [Ref. 21]	performance not available			7.8 dB	8.4 dB	11 dB (non-coherent detection)
Receiver reference sensitivity[xxviii]	–121 dBm[xxix] for macro BS –111 dBm for micro BS –107 dBm for pico BS	–119 dBm for fundamental channel in AWGN	–119 dBm for fundamental channel in AWGN	–110 dBm for macro and micro BS –96 dBm for pico BS	–109 dBm for macro and micro BS –95 dBm for pico BS	–117 dBm	–108 dBm	–94 typical (spec.: –86 dBm for speech and generally –83 dBm)
Interference threshold for macro BS 1[xxx]	–109 dBm in 3.84 MHz See note[xxxi]	–114 dBm in 1.25 MHz	–109 dBm in 3.75 MHz	–112 dBm in 1.28 MHz	–109 dBm in 3.84 MHz	–131 dBm	–123 dBm	–105 dBm typical (–97 dBm for speech specificat.)
Transmitter ACLR for macro/micro/ pico BS	See [Ref. 3, 6]	See [Ref. 21][xv]	See [Ref. 21][xvi]	See [Ref. 4]	See [Ref. 4]			
1st adjacent	45 dB @ ± 5 MHz	50.8 dB @ ± 3.75 MHz	49.3 dB @ ± 5 MHz	40 dB @ ± 1.6 MHz	45 dB @ ± 5 MHz			
2nd adjacent	50 dB @ ± 10 MHz	67.2 dB @ ± 8.75 MHz	62.2 dB @ ± 10 MHz	45 dB @ ± 3.2 MHz	55 dB @ ± 10 MHz			
Transmitter spurious emissions	See [Ref. 3, 6]	See [Ref. 21]	See [Ref. 21]	See [Ref. 4]	See [Ref. 4]			
Macro BS receiver ACS (relative	–52 dBm (46 dB)[xxxi]	–53 dBm	–49 dBm	–55 dBm (46 dB)[xxxi]	–52 dBm (46 dB)[xxxi]			

Parameter	**IMT-2000 CDMA Direct Spread** **See [Ref. 3, 6]**	**IMT-2000 CDMA Multi-Carrier**[I]		**IMT-2000 CDMA TDD (time-code)**		**IMT-2000 TDMA Single-Carrier**[xviii]		**IMT-2000 FDMA/TDMA (frequency-time)** **See [Ref. 5]**
				1.28 Mchip/s low chip rate See [Ref. 4]	**3.84 Mchip/s high chip rate See [Ref. 4]**			
ACS)								

TABLE 3 (*end*)

Parameter	IMT-2000 CDMA Direct Spread See [Ref. 3, 6]	IMT-2000 CDMA Multi-Carrier[1]		IMT-2000 CDMA TDD (time-code)		IMT-2000 TDMA Single-Carrier[xviii]		IMT-2000 FDMA/TDMA (frequency-time) See [Ref. 5]
				1.28 Mchip/s low chip rate See [Ref. 4]	(3.84 Mchip/s high chip rate) See [Ref. 4]			
Micro BS receiver ACS (relative ACS)	–42 dBm (46 dB)[xxxi]	tbd	Tbd	–41 dBm (46 dB)[xxxi]	–38 dBm (46 dB)[xxxii]			
Pico BS receiver ACS (relative ACS)	–38 dBm (46 dB)[xxxi]	tbd	Tbd	–41 dBm (46 dB)[xxxi]	–38 dBm (46 dB)[xxxi]			
Receiver blocking levels	See [Ref. 3, 6]	See [Ref. 21]	See [Ref. 21]	See [Ref. 4]	See [Ref. 4]			

1 The IMT-2000 minimum performance requirements recorded here for IMT-2000 CDMA multicarrier are defined in the band class 6 (i.e. 2 GHz band) requirements in [Ref. 21]. This is also relevant to the technology enhancements (HRPD) requirements contained in [Ref. 23].

2 Feeder losses are not included in the values and should be considered in the sharing/compatibility issues.

xviii IMT-2000 TDMA single carrier consists of three components: enhancements to the 30 kHz channels (designated as 136+) for advanced voice and data capabilities, a 200 kHz carrier component for high speed data (384 kbit/s) accommodating high mobility (designated as 136HS outdoor), and a 1.6 MHz carrier component for very high speed data (2 Mbit/s) in low mobility applications (designated as 136HS indoor). The combined result constitutes the IMT-2000 radio interface referred to as IMT-2000 TDMA single carrier.

xix May not be appropriate for all scenarios.

xx The reference pattern is specified in Recommendation ITU-R F.1336-1 with (k = 0.2).

xxi Both HRPD and IMT-2000 CDMA multicarrier revision C support 8PSK and 16QAM on the forward packet channel.

xxii In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate for data services.

xxiii In the receiver bandwidth.

xxiv In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate for data services.

xxv In the receiver bandwidth.

xxvi In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate for data services.

xxvii In bandwidth equal to data rate: for IMT-2000 CDMA multicarrier, values are given for 9 600 bit/s speech services and nominal supported rate for data services.

xxviii For a 10^{-3} raw bit error rate, theoretical E_b/N_o.

xxix The thermal noise figure for a WCDMA receiver is –108 dBm based on kTf where k is Boltzmann's constant (1.38E-23), T is the temperature in Kelvin, and f is the bandwidth in Hertz. For a noise figure of 4 dB (typical value for a base station receiver), the thermal noise becomes –104 dBm. However, receiver sensitivity depends on the service (i.e. voice, packet, etc.). For example, the voice (DTCH 32) sensitivity for the base station receiver is –121 dBm for BER < 0.001.

xxx I/N = –6 dB for a 10% loss in range applicable to cases where interference effects a limited number of cells. In other cases, e.g. sharing with BSS (sound) in the 2 630-2 655 MHz band a value of I/N = –10 dB is appropriate.

xxxi The tolerable I/N thresholds are as follows: coordinated use (–6 dB), agreement trigger (–10 dB), licence exempt (–20 dB).

xxxii The absolute ACS values are the test values as specified in 3GPP TS25.104 and TS 25.105. The following conversion formula: ACS_relative = ACS_test – Noise_floor – $10*\log_{10}(10^{M/10}-1)$, can be used to derive relative ACS values, Where M is the margin expressed in dB used in the ACS test, which is the useful signal level above the reference sensitivity level. For both IMT-2000 CDMA direct spread and IMT-2000 CDMA TDD (time code), M = 6 dB. ACS relative values are often used in sharing studies.

References (in Tables 2 and 3)

[1] 3GPP TS 25.101 v5.5.0 (2002-12) 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; "UE Radio Transmission and Reception (FDD) (Release 5)".

[2] 3GPP TS 25.102 v5.3.0 (2002-12): 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; "UE Radio Transmission and Reception (TDD) (Release 5)".

[3] 3GPP TS 25.104 v6.0.0 (2002-12): 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; "BS Radio Transmission and Reception (FDD) (Release 6)".

[4] 3GPP TS 25.105 v5.3.0 (2002-12): 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; "BS Radio Transmission and Reception (TDD) (Release 5)".

[5] Final Draft ETSI EN 300 175-2 v1.6.0 (2001-04): "Digital Enhanced Telecommunications (DECT) Common Interface (CI) part 2: Physical Layer".

[6] 3GPP TR 25.951 v1.5.0 (2003-02): 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks, "FDD Base Station Classification (Release 6)".

[7] TR45 technical specification, TIA/EIA-136-290); "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", clause 2.

[8] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", clause 4.1.1.2 refers to Power Class II mobile station.

[9] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", clause 6.2 specifies data rates and reference sensitivity. Reference sensitivity listed for 144 kbit/s at a 10% block erasure rate (BLER).

[10] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", Table A3a: Modulation and noise spectrum mask due to GMSK modulation. Measurement bandwidth is 30 kHz.

[11] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", Table A3b: Modulation and noise spectrum mask due to 8-PSK modulation. Measurement bandwidth is 30 kHz.

[12] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", clause 5.1:

[13] TR45 technical specification, TIA/EIA-136-290; "RF Minimum performance requirements 136HS Outdoor and 136HS Indoor Bearers", clause 6.3:

[14] TR45 technical specification, SP-4027-270b); "Mobile Station Minimum Performance", Clause 2.3.1.3.1.

[15] TR45 technical specification, SP-4027-270b); "Mobile Station Minimum Performance", Clause 1.4 and Clause 3.2.2. Refers To Power Class Ii Mobile Station.

[16] TR45 technical specification, TIA/EIA 136-131; "Digital Traffic Channel Layer 1", Clause 1.3.

[17] TR45 technical specification, SP-4027-270b; "Mobile Station Minimum Performance", Clause 3.4.1.1.3.

[18] TR45 technical specification, SP-4027-270b; "Mobile Station Minimum Performance", Clause 2.3.2.4.3:

[19] TR45 technical specification, SP-4027-270b; "Mobile Station Minimum Performance", Clause 2.3.1.1.3.

[20] 3GPP TS 25.942; 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; "RF System Scenarios", clause 4.1.1.2. Body loss expectation is that values are similar for all technologies. Footnote retained for information purposes.

[21] TR45 technical specification, TIA-97-E; "Recommended minimum performance Standards for cdma2000® spread spectrum base stations".

[22] TR45 technical specification, TIA-98-E; "Recommended minimum performance Standards for cdma2000® spread spectrum mobile stations".

[23] TR45 technical specification, TIA-864-E; "Recommended minimum performance Standards for cdma2000® High Rate Packet Data Access Network".

[24] TR45 technical specification, TIA-866-E; "Recommended minimum performance Standards for cdma2000® High Rate Packet Data Access Terminal".

[25] 3GPP TS 25.308 v5.4.0 (2003-03); 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; "High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2 (Release 5)".

IMT-2000 Characteristics (Source: Doc 20 (Canada))

IMT-2000 Mobile Station Characteristics

Maximum Noise Figure	9 dB
Noise Floor	-135 dB(W/MHz)
Antenna Gain	0 dBi
Polarization	Linear
I/N to be used as a trigger value for sharing studies	-10 dB

IMT-2000 Base Station Characteristics

Typical Noise Figure	5 dB
Noise Floor	-139 dB(W/MHz)
Feeder Loss	2 dB
Polarization	Linear
Typical Antenna	120° Sector
Maximum Antenna Gain	18 dBi
Down-tilt Angle	2.5°
I/N to be used as a trigger value for sharing studies	-10 dB

3 Equipment characteristics for non-IMT-2000 mobile systems (Source: Doc 13 (USA))

Non-IMT-2000 mobile base station characteristics

Non-IMT-2000 mobile base station receive parameters

Cell size (km radius)	3-10
Antenna type	120˚ sector
Max antenna gain (dBi) including feeder loss	18
Downtilt angle (˚)	1
Antenna height (m) HAAT	50
Polarization	Linear
Receiver noise figure (dB)	3
Receiver thermal noise (dBW/MHz)	–141
Trigger for Sharing Studies (Isat/Nth) (dB)	-10
ACS	FDD: varies * TDD: varies *
*Varies by supplier	

TABLE 3.1.2

Non-IMT-2000 mobile base station transmit parameters

Cell size (km radius)	3-10
Maximum transmit power for a 5 MHz channel (dBm) (standards)	47
Typical transmit power for a 5 MHz channel (dBm)	43
Operating bandwidth (MHz)	5-6
Antenna type	120˚ sector
Max antenna gain (dBi) including feeder loss	18
Downtilt angle (˚)	1
Antenna height (m) HAAT	50
Polarization	Linear

Non-IMT-2000 CPE characteristics

Non-IMT-2000 mobile station receive parameters

Cell size (km radius)	3-10
Antenna type	Omnidirectional
Max antenna gain (dBi)	7
Antenna feed loss (dB)	0
Antenna height (m)	1.5
Polarization	Linear
Receiver noise figure (dB)	5
Receiver thermal noise (dBW/MHz)	–139
Trigger for Sharing Studies (Isat/Nth) (dB)	–10
ACS	Typical 40 dB

Non-IMT-2000 mobile station transmit parameters

Cell size (km radius)	3-5	5-10
Average transmit power (dBm)	17	21
Average transmit power (dBm) in TDD including 50% activity factor	Activity factor = 3 – 10 dB for TDD	
Maximum transmit power (dBm)	33	
Operating bandwidth (MHz)	5	
Antenna type	Omnidirectional	
Max antenna gain (dBi)	7	
Antenna feed loss (dB)	0	
Antenna height (m)	1.5	
Polarization	Linear	
ACLR	The maximum out-of- band power shall be attenuated at the channel edges at least 25 dB relative to the average 6 MHz channel transmitter output power level (P), then attenuated along a linear slope to at least 40 dB or 33+10log(P) dB, whichever is the lesser attenuation, at 250 kHz beyond the nearest channel edge, then attenuated along a linear slope from that level to at least 60 dB or 43+10log(P) dB, whichever is the lesser attenuation, at 3 MHz above the upper and below the lower licensed channel edges, and attenuated at least 60 dB or 43+10log(P) dB, whichever is the lesser attenuation, at all other frequencies	

4 **Characteristics of Wireless Metropolitan Area Networks** (Doc 21 (IEEE))

TBD.