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CHARACTERISTICS OF IEEE 802.16 SYSTEMS IN 2500-2690 MHZ

1 Introduction

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 802.16 working group[1] 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 the IEEE Standard 802.16-2004[2] for broadband wireless access systems, which will enable deployments in various bands, including 2500-2690 MHz fixed and nomadic broadband access based on this standard will be a significant part of future broadband wireless services delivered to a variety of user devices including fixed outdoor modems, indoor modems, laptops and other nomadic devices. Systems based on IEEE Standard 802.16-2004 are considered for deployments in several countries.

IEEE Standard 802.16-2004 supports fixed/nomadic applications, providing a variety of services to fixed outdoor as well as nomadic indoor users. Work is underway on a mobile extension, referred to as Project 802.16e, supporting new capabilities needed for the mobile environment.

In general, it is expected that operators will deploy IEEE 802.16-2004 fixed wireless architecture in one of two fashions with typical cell sizes that are largely dependent on market size and topology in an effort to support a successful business case. The result will be larger and fewer cells for rural markets and smaller cell sizes for the urban markets. 802.16e will be designed for mobility. For the purposes of illustrating the range of configurations to suit these markets, this contribution will provide parameters for typical systems based upon the IEEE 802.16-2004 standard for cell sizes of 56 km and 3-10 km, as well as the 802.16e 3-10 km mobility case. The latter is based on estimates, considering that 802.16e exists in only draft form.

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[1] Contact: José M. Costa — IEEE 802.16 ITU-R Liaison Official — Tel: +1 613 763-7574 — E-mail: costa@nortel.com

[2] Doc. 9B/83 (Annex 6), "Preliminary Draft New Recommendation ITU-R F.[9B/BWA] "Radio interface standards for broadband wireless access (BWA) systems in the fixed service operating below 66 GHz".

2 Equipment Characteristics for Fixed Service Systems in the 2500-2690 MHz Band

2.1 Fixed Base Station Characteristics

TABLE 2.1.1

Typical IEEE 802.16-2004 Fixed Base Station receive parameters

Cell size (km radius)	56	3 to10
Antenna type	Omni or sectored	Sectored
Max antenna gain (dBi) including feeder loss	18	18
Downtilt angle (deg)	.5	1
Antenna height (m) HAAT	1000	50
Polarization	Linear	Linear
Receiver Noise Figure (dB)	3	3
Receiver Thermal Noise (dBW/MHz)	–141	–141
Interference criteria (Isat/Nth) (dB)	–10	–10
Adjacent Channel Selectivity	FDD: Varies * TDD: Varies *	FDD: Varies * TDD: Varies *

[*] Varies by supplier

TABLE 2.1.2

Typical IEEE 802.16-2004 Fixed Base Station transmit parameters

Cell size (km radius)	56	3 to 10
Maximum Transmit Power for a 5.5 and 6 MHz channel (dBm) (standards) (*See Note 2 in Attachment 1*)	63	63
Typical Transmit power for 5.5 and 6 MHz channel (dBm)	47	43
Operating bandwidth (MHz)	5 to 6	5 to 6
Antenna type	Omni or Sectored	Sectored
Max antenna gain (dBi) including feeder loss	18	18
Downtilt angle (deg)	.5	1
Antenna height (m) HAAT	1000	50
Polarization	Linear	Linear

ACLR *(See Note 1 in Attachment 1)*	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.

2.2 Fixed Subscriber Station Characteristics

TABLE 2.2.1

Typical IEEE 802.16-2004 Fixed Subscriber Station receive parameters

Cell size (km radius)	56	3 to 10
Antenna type	Omni or directional	Omni or directional
Max antenna gain (dBi)	16 dBi	7 dBi
Antenna feed loss (dB)	.5	0
Antenna height (m)	100	1.5
Polarization	Linear	Linear
Receiver Noise Figure (dB)	3 dB	4.5 dB
Receiver Thermal Noise (dBW/MHz)	–141	–139.5
Interference criteria (I/Nth) (dB)	–10	–10
ACS	Typical 40 dB	Typical 40 dB

TABLE 2.2.2

Typical IEEE 802.16-2004 Fixed Subscriber Station transmit parameters

Cell size (km radius)	56	3 to 10
Average Transmit Power (dBm)	23 dBm	17 dBm
Average Transmit Power (dBm) in TDD including 50% activity factor	Activity factor = 3 to 10 dB	Activity factor = 3 to 10 dB
Operating bandwidth (MHz)	5 to 6	5 to 6
Antenna type	Omni or directional	Omni or directional
Max antenna gain (dBi)	16	7
Antenna feed loss (dB)	.5	0
Antenna height (m)	100	1.5
Polarization	Linear	Linear

ACLR *(See Note 1 in Attachment 1)*	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.

3 Equipment Characteristics for 802.16e Mobile Systems in the 2500-2690 MHz Band

3.1 802.16e Mobile Base Station Characteristics

TABLE 3.1.1

802.16e Mobile Base Station receive parameters

Cell size (km radius)	3 to 10
Antenna type	Sectored
Max antenna gain (dBi) including feeder loss	18
Downtilt angle (deg)	1
Antenna height (m) HAAT	50
Polarization	Linear
Receiver Noise Figure (dB)	3
Receiver Thermal Noise (dBW/MHz)	–141
Interference criteria (Isat/Nth) (dB)	–10
Adjacent Channel Selectivity	FDD: Varies * TDD: Varies *

* Varies by supplier

TABLE 3.1.2

802.16e Mobile Base Station transmit parameters

Cell size (km radius)	3 to 10
Maximum Transmit Power for a 5.5 or 6 MHz channel (dBm) (standards) *(See Note 2 in Attachment 1)*	63
Typical Transmit power for a 5 MHz channel (dBm)	43
Operating bandwidth (MHz)	5 to 6
Antenna type	Sectored
Max antenna gain (dBi) including feeder loss	18
Downtilt angle (deg)	1
Antenna height (m) HAAT	50
Polarization	Linear

3.2 802.16e Mobile Station Characteristics

TABLE 3.2.1

802.16e Mobile Station receive parameters

Cell size (km radius)	3 to 10
Antenna type	Omni or directional
Max antenna gain (dBi)	4 dBi
Antenna feed loss (dB)	0
Antenna height (m)	1.5
Polarization	Linear
Receiver Noise Figure (dB)	5 dB
Receiver Thermal Noise (dBW/MHz)	–139
Interference criteria (I/Nth) (dB)	–10
ACS	Typical 40 dB

TABLE 3.2.2

802.16e Mobile Station transmit parameters

Cell size (km radius)	3 to 10
Average Transmit Power (dBm)	24 dBm
Average Transmit Power (dBm) in TDD, including 50% activity factor	Activity factor = 3 to 10 dB
Maximum Transmit Power E.I.R.P.(dBm)	33 dBm
Operating bandwidth (MHz)	5 to 6 MHz
Antenna type	Omni or directional
Max antenna gain (dBi)	4
Antenna feed loss (dB)	0
Antenna height (m)	1.5
Polarization	Linear
ACLR *(See Note 1 in Attachment 1)*	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 Proposal

IEEE proposes that the parameters outlined in the aforementioned tables be used in the sharing studies conducted by JTG 6-8-9.

Attachment: 1

Attachment 1

In the USA, the FCC has adopted a Report and Order and Further Notice of Proposed Rulemaking which will result in new rules for the 2496-2690 MHz band. This will result in changes to the ACLR requirements and the power limit requirements and channel bandwidths as described in Note 1 and Note 2 below.

Note 1:

In the USA, the FCC has adopted a Report and Order and Further Notice of Proposed Rulemaking which will result in new rules for the 2496-2690 MHz band. The new rules are expected to be in force in early 2005 and the will change the ACLR requirements as follows:

§ 27.53 Emission limits

(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee. Provided that the complaint cannot be mutually resolved between the parties, both licensees of existing and new systems shall reduce their out-of-band emissions by at least 67 + 10 log (P) dB measured at 3 MHz from their channel's edges for distances between stations exceeding 1.5 km. For stations separated by less than 1.5 km, the new licensee shall reduce attenuation at least 67 + 10 log (P) – 20 log(Dkm/1.5), or when colocated, limit the undesired signal level at the affected licensee's base station receiver(s) at the colocation site to no more than -107 dBm.

Note 2:

In the USA, the FCC has adopted a Report and Order and Further Notice of Proposed Rulemaking which will result in new rules for the 2496 -2690 MHz band. The new rules are expected to be in force in early 2005 and the will change the power limit requirements and channel bandwidths as follows:

§ 27.50 Power limits

(h) The following power limits shall apply in the BRS and EBS:

(1) *Main, booster and base stations.*

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in subparagraph (ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula:

EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the half-power points.

(2) *Mobile and other user stations.* Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

(3) For television transmission, the peak power of the accompanying aural signal must not exceed 10 percent of the peak visual power of the transmitter. The Commission may order a reduction in aural signal power to diminish the potential for harmful interference.

(4) For main, booster and response stations utilizing digital emissions with non-uniform power spectral density (e.g. unfiltered QPSK), the power measured within any 100 kHz resolution bandwidth within the 6 MHz channel occupied by the non-uniform emission cannot exceed the power permitted within any 100 kHz resolution bandwidth within the 6 MHz channel if it were occupied by an emission with uniform power spectral density, i.e., if the maximum permissible power of a station utilizing a perfectly uniform power spectral density across a 6 MHz channel were 2000 watts EIRP, this would result in a maximum permissible power flux density for the station of 2000/60 = 33.3 watts EIRP per 100 kHz bandwidth. If a non-uniform emission were substituted at the station, station power would still be limited to a maximum of 33.3 watts EIRP within any 100 kHz segment of the 6 MHz channel, irrespective of the fact that this would result in a total 6 MHz channel power of less than 2000 watts EIRP.