Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** <**http://grouper.ieee.org/groups/802/20/**>
Title	**Evaluation of 802.20 Proposals – Coexistence Affecting Characteristics**
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Re:	MBWA Call for Contributions: **Session # 5** - November 10-14, 2003
Abstract	This contribution discusses key RF characteristics that were included in the ITU-R IMT-2000 specifications and evaluation process and are now recommended for use in the IEEE 802.20 proposals evaluation process.
Purpose	Proposed for incorporation in the evaluation criteria document
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1. Purpose

This contribution identifies key RF characteristics that need to be specified and evaluated by all contending IEEE 802.20 proposals in the context of demonstrating their quality performance in the presence of interference and their ability to control unwanted emissions consistent with the need to coexist with other public land mobile and satellite communication systems operating in frequency bands below 3.5 GHz.

2. Reference Documents

1. ITU-R, Recommendation **M.1455**: KEY CHARACTERISTICS FOR THE INTERNATIONAL MOBILE TELECOMMUNICATIONS-2000 (IMT-2000) RADIO INTERFACES

2. ITU-R, Recommendation **SM.329-7:** SPURIOUS EMISSIONS

3. ITU-R, Recommendation **M.1225:** GUIDELINES FOR EVALUATION OF RADIO TRANSMISSION TECHNOLOGIES FOR IMT-2000

3. Coexistence-Affecting Radio Characteristics

Background: The ITU-R IMT-2000 candidate technologies definition and selection process included a comprehensive definition of key characteristics for the third generation mobile terrestrial and satellite radio interfaces. ITU Recommendation M.1455 [1], Table 1, defines the **RF** key characteristics. In the following sections some of the more important coexistence-affecting characteristics are identified.

3.1 Transmitter

- Transmit channel **emission mask** relative to its assigned channel bandwidth
- Adjacent channel leakage power ratio (**ACLR**)
- **Spurious** emissions (including **Intermodulation** products**)**
- **Frequency** accuracy and stability

3.2 Receiver

- Receiver **Sensitivity**
- Receiver **Intermodulation** sensitivity
- Receiver **Blocking**
- **Spurious** response
- Adjacent channel **Selectivity**

Note: **Power control** is also an important characteristic and may have a significant impact on the system performance and the overall interference level.

This performance characteristic may be viewed as in-band emission and may not need to be evaluated. It is open for discussion and decision by the 802.20 working group.

3.3 RF Characteristics Definition and Evaluation Requirements

3.3.1 Emission Mask

The maximum transmit power should be stated. ITU-R Recommendation [1] defines a maximum MS output power of +33 dBm. Regulators define maximum BS transmit power as well. If the proposed radio technology supports several *power classes*, they should be specified as well.

⇒ **Test results and a statement on the specified emission mask(s) are required.**

3.3.2 ACLR

ACLR – Adjacent Channel Leakage Ratio – is defined as the attenuation of the transmit power which is "spilled" into the adjacent channel (due to filtering imperfections). It is measured relative to the carrier signal power and expressed as dBc attenuation values. ACLR is a function of the frequency offset from the assigned channel frequency.

⇒ **Test results and a statement on the specified ACLR are required.**

3.3.3 Spurious Emissions

ITU-R Recommendation M.329-7 [2] defines spurious emissions as "Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include **harmonic** emissions, **parasitic** emissions, **intermodulation** products and **frequency conversion** products but exclude out-of-band emissions."

Spurious emissions are generated by non-linear components in the transmitter in the process of carrier signal generation, mixing, modulation and amplification. These non-linearities are inherent in practical radio designs. Intermodulation spurious emissions are generated within the transmitter as well as in external power amplifiers. Multi-carrier and OFDM transmitters are more prone to generating intermodulation emission than single-carrier transmitters.

⇒ **Test results and a statement on the specified performance levels for each type of spurious emission are required.**

3.3.4 Frequency Accuracy and Stability

Frequency accuracy is expressed in PPM (parts per million) and is a measure of the frequency deviation from the assigned carrier frequency. Frequency stability

is a measure of this deviation that is caused by operational time-varying factors such as temperature, humidity etc. Typical values specified in [1] are 0.1 PPM for the MS and 0.05 PPM for the BS.

⇒ **Test results and a statement on the specified frequency accuracy and stability are required.**

3.3.5 Receiver Sensitivity

Receiver sensitivity is an important performance characteristic. In the context of coexistence, an MS radio with inadequate sensitivity requires higher transmit power from the BS and results in an elevated noise floor in the cell as well as in neighboring cells. The down side of a good receiver having high sensitivity is its ability to pick up more co-channel and adjacent channel interference.

Reference Document [1] defines receiver sensitivity as the minimum power, measured at the antenna port, at which the frame error rate or bit error rate are below a certain specified limit. Sensitivity is a function of the information bit rate, E_b/N_o, temperature and the receiver noise-figure (NF).

⇒ **Test results and a statement on the specified receiver sensitivity levels are required.**

3.3.6 Intermodulation Sensitivity

This characteristic is a measure of the receiver non-linearities. When two RF signals, having frequencies separated from each other and from the receiver's tuned frequency, are mixed in the receiver front-end, they may produce a third order non-linearity product – a signal whose frequency falls in-band of the tuned receiver channel. Performance is specified in the levels of the out-of- band interfering signals. [1] cites a typical level of –46 dBm.

⇒ **Test results and a statement on the specified receiver intermodulation sensitivity levels are required.**

3.3.7 Receiver Blocking

Receiver blocking is the effect of a strong out-of-band signal, present at the input of the receiver, on the receiver's ability to detect an in-band wanted signal. Thus, the blocking signal reduces the specified receiver sensitivity by a certain number of dB's.

⇒ **Test results and a statement on the specified receiver blocking performance levels are required.**

3.3.8 Spurious Response

Spurious response in a receiver occurs when unwanted signals, having frequencies other than the tuned frequency, produce a receiver output as if they

were wanted signals. Spurious response is specified in terms of the frequencies and signal levels that produce such unwanted receiver output.

⇒ **Test results and a statement on the specified receiver spurious-response performance are required.**

3.3.9 Selectivity

Receiver selectivity is a measure of the receiver's ability to reject signals from adjacent channels while receiving a wanted signal on its tuned frequency. Selectivity is specified as the ratio (in dB) of the adjacent channel signal level to the assigned channel signal level in which a reference BER/FER is maintained.

⇒ **Test results and a statement on the specified receiver selectivity performance are required.**

4. The ITU-R IMT-2000 Evaluation Model

ITU-R Recommendation M.1225 [3] was successfully applied in the IMT-2000 3G Radio Transmission Technologies (RTT) evaluation process. It is proposed that applicable parts from [3] be adopted and used by the IEEE 802.20 proposals evaluation process. These are:

- A.3.2.2 Transmitter Power and System Linearity Requirements
- A.3.2.3 Power Control Characteristics (*)
- A.3.2.4 Transmitter/Receiver Isolation Requirement (*)
- A.3.2.6 Antenna System
- A.3.2.7 BS Frequency Synchronization/Time Alignment Requirements

(*) – These items have important impact on system performance, but may not be essential for Coexistence performance evaluation. Discussion is suggested.

5. Recommendation

Adopt this document as guideline for the evaluation process phase of the IEEE 802.20 standard development project. Detailed procedures and evaluation tools may also be needed in conjunction with these guidelines.