

RECOMMENDATION ITU-R M.1635

**General methodology for assessing the potential for interference
between IMT-2000 or systems beyond
IMT-2000 and other services**

(2003)

Summary

Consideration of the potential for interference between IMT-2000 and systems beyond IMT-2000 and other services is essential for administrations in planning the use of frequency bands where the mobile service exists on a co-primary basis with other services.

Networks of IMT-2000 and systems beyond IMT-2000 are likely to accommodate significant numbers of cellular customers and hence networks will require significant transmission capacity, involving the deployment of high-density infrastructures. This needs to be considered in analysis to assess sharing between IMT-2000 and systems beyond IMT-2000 and other services.

This Recommendation provides recommendations for administrations for a methodology for assessing the potential for interference between IMT-2000 and systems beyond and other services under co-frequency as well as adjacent band conditions.

The ITU Radiocommunication Assembly,

considering

- a) that shared use of the frequency spectrum is supportive for the general objective of efficient use of the spectrum;
- b) that due to congestion in frequency bands suitable for broadband mobile service applications shared use of the spectrum with other services has to be considered as one possible option;
- c) that shared use of frequency bands by IMT-2000 and/or systems beyond IMT-2000 and other services needs careful consideration of the coexistence conditions concerned;
- d) that reducing the necessary guardband to services operated in frequency bands adjacent to IMT-2000 to the greatest extent possible is a supportive measure to improve efficient use of the spectrum,

recognizing

- a) that IMT-2000 and its enhancements will continue to operate in the bands identified by the ITU at WARC-92 and WRC-2000;
- b) that the further development of systems beyond IMT-2000 may require spectrum in addition to that now identified for IMT-2000;

- c) that the suitable frequency ranges for systems beyond IMT-2000 that support broadband wide area full mobility services may be, among others, the ones that are not far away from the existing frequency bands identified for IMT-2000;
- d) that the additional spectrum is requested especially in densely populated regions;
- e) that Recommendation ITU-R M.1461 provides a methodology for conducting sharing studies between the radiodetermination service and other services,

recommends

1 that the procedures in Annex 1 be used for assessing the potential for interference between IMT-2000 and systems beyond IMT-2000 and systems in other services under co-frequency as well as adjacent band conditions taking into account other relevant ITU-R Recommendations on the subject of interference assessment concerning the services under consideration.

Annex 1

General methodology for assessing the potential for interference between IMT-2000 or systems beyond IMT-2000 and other services

1 Introduction

Consideration of potential for interference between IMT-2000 and systems beyond IMT-2000 and other services is essential for administrations in planning the use of frequency bands where the mobile service exists on a co-primary basis with other services or in adjacent frequency bands.

This Annex describes the principles of a compatibility assessment methodology in order to perform sharing studies between the mobile service and other services in co-frequency and adjacent band scenarios. This methodology covers worst-case considerations as well as a more representative approach, in order to get a full picture of the interference scenarios under consideration. Parts of the assessment procedures need to be based on a statistical methodology, well known as the Monte Carlo technique. The results may be focused on the cumulative distributions of I/N or C/I at the receivers of the applications concerned, in order to demonstrate the probability of interference.

The equations in this Annex describe a general calculation methodology. The units for the parameters in the equations must be consistent when they are applied to a specific study.

2 Interference assessment methodology

In order to perform sharing studies between mobile services and other services in co-frequency and adjacent band scenarios, simulation models need to be applied analysing the different parts of the interference path:

- transmitter,
- receiver,
- antennas,
- propagation.

On the other hand, it is necessary to operate with assumptions concerning future mature deployments of the mobile networks and applications in other services, in the phase before rolling out these networks. This allows at an early stage to achieve results which are as realistic as possible. Since interference scenarios between various applications may be analysed using this methodology, the concept of calculating the power spectral density at a victim receiver should be applied. This allows consideration of all kinds of modulation and bandwidth combinations, as well as the various requirements concerning the tolerable interference levels.

The methodologies to model the different parts of the interference path should be based on ITU-R Recommendations to the extent possible.

2.1 Interference level at victim receiver

2.1.1 Assessing the power spectral density at a victim receiver

The power spectral density of an interfering signal at a victim receiver is a key element of the interference calculation process. Due to the large variety of interference spectra and receivers to be considered in assessing the potential of interference between the mobile service and other services in co-frequency sharing as well as adjacent frequency band consideration, the concept of power spectral density calculation gives the most flexible approach. All kinds of combinations of frequency spectra and receiver selectivity may be applied in order to assess the potential for interference between systems in the mobile service and other services. Thus the method for calculation of the interference power spectral density at the input of a victim receiver is the essential part in any compatibility assessment.

The receiving power density spectrum at a victim receiver can be obtained from the following algorithm:

$$P_{Rx}(f, p) = \frac{P_{Tx}(f) \cdot G_{Tx}(\varphi) \cdot G_{Rx}(\theta) \cdot PM_{Rx}(\theta) \cdot S(f)}{R_{Tx} \cdot R_{Rx} \cdot L_b(f, p)} \quad (1)$$

where:

- $P_{Rx}(f, p)$: interfering power density spectrum at receiver
- $P_{Tx}(f)$: transmitter output power spectral density
- $G_{Tx}(\varphi)$: gain of the transmitting antenna in the direction of the receiver
- $G_{Rx}(\theta)$: gain of the receiving antenna in the direction of the transmitter
- $PM_{Rx}(\theta)$: polarization mismatch factor of receiving antenna
- $S(f)$: selectivity of receiver
- R_{Tx} : feeder loss of transmitting antenna
- R_{Rx} : feeder loss of receiving antenna
- $L_b(f, p)$: attenuation due to propagation effects
- f : frequency
- p : percentage of time
- φ : angle between the transmitting antenna boresight and the receiving antenna
- θ : angle between receiving antenna boresight and the transmitting antenna

with the isolation between transmitter and receiver:

$$I_S(p) = \frac{G_{Tx}(\varphi) \cdot G_{Rx}(\theta) \cdot PM_{Rx}(\theta)}{R_{Tx} \cdot R_{Rx} \cdot L_b(f, p)} \quad (2)$$

where:

$I_S(p)$: isolation between transmitter and receiver

and the power spectrum at the output of the transmitter:

$$P_{Tx}(f) = P_{out} \cdot M_E(f) \quad (3)$$

where:

$P_{Tx}(f)$: transmitter output power spectral density

P_{out} : transmitter power output level

$M_E(f)$: modulation envelope of the transmitter output.

The interfering power density spectrum is defined by:

$$P_{Rx}(f, p) = P_{out} \cdot (M_E(f) \cdot I_S(p) \cdot S(f)) \quad (4)$$

This result represents the full picture of the interference level as a function of frequency and time percentage and thus allows assessment of all kinds of interference effects and scenarios in co-frequency as well as in adjacent band situations.

2.1.2 Aggregation of interference from several sources

Interference scenarios where several transmitters operate in the same frequency range and geographical area require methodologies for aggregating several interference signals suffered by a victim receiver. For assessing the overall interference prediction in such scenarios, the interfering signals should be aggregated by power:

$$P_I(f, p) = \sum_{I=1}^N P_{Rx}(f, p) \quad (5)$$

where:

$P_I(f, p)$: aggregated interfering power density spectrum at receiver

N : number of interfering signals.