

International Telecommunication Union



Report ITU-R F.2333-0
(11/2014)

**Sharing and compatibility study between
international mobile telecommunication
and the fixed service in the frequency
band 1 350-1 527 MHz**

F Series
Fixed service



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Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.

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REPORT ITU-R F.2333-0

Sharing and compatibility study between international mobile telecommunication and the fixed service in the frequency band 1 350-1 527 MHz

(2014)

1 Introduction

This Report presents an analysis of the feasibility of co-channel compatibility/sharing between international mobile telecommunication (IMT) systems and fixed service (FS) point-to-point links currently operating in the frequency band 1 350-1 527 MHz.

2 Technical characteristics

Table provides an overview of parameter values assumed for the interference analysis in this document.

TABLE 1
Modelling parameters for interference analysis

Parameter	Value	Notes
IMT transmitter		
Channel bandwidth	10 MHz	
Base-station maximum ant gain	15 dBi	Including feeder losses
User equipment (UE) maximum ant gain	−3 dBi	Omnidirectional
Typical body loss	4 dB	
Base-station height (a.g.l.)	30 m	
UE height (a.g.l.)	1.5 m	
Base-station antenna downtilt	3 degrees	
base-station TX e.i.r.p. (macro-cell)	58 dBm	
Base-station TX e.i.r.p. (small cell outdoor)	37 dBm	
UE TX e.i.r.p.	20 dBm	
Fixed link receiver		
Channel bandwidth	2 MHz	
Maximum ant gain	14 dBi	Including 3 dB feeder loss
Height (a.g.l.)	30 m	Antenna mast height above ground level
Height above terrain	100 m	1.4 GHz fixed links are largely deployed on top of hills
Polarization discrimination (for IMT base-station interference)	3 dB	In general, FS links operate in V/H polarization while IMT links are slant polarized

TABLE 1 (*end*)

Parameter	Value	Notes
Noise figure	4 dB	
Noise floor	−107 dBm	kTBNF
Interference criterion	−113 dBm to be exceeded for 20% of time	I/N = −6 dB

IMT base station transmitter antenna patterns

It is assumed that the base-station azimuth and elevation patterns are based on Recommendation ITU-R F.1336. In line with information provided by ITU-R, it is further assumed that the horizontal beamwidth is 65 degrees and the factor ‘k’ is 0.7 for both peak and average sidelobes.

The assumed azimuth and elevation patterns are illustrated in the following figures for the peak and average sidelobes.

FIGURE 1
IMT base-station azimuth patterns

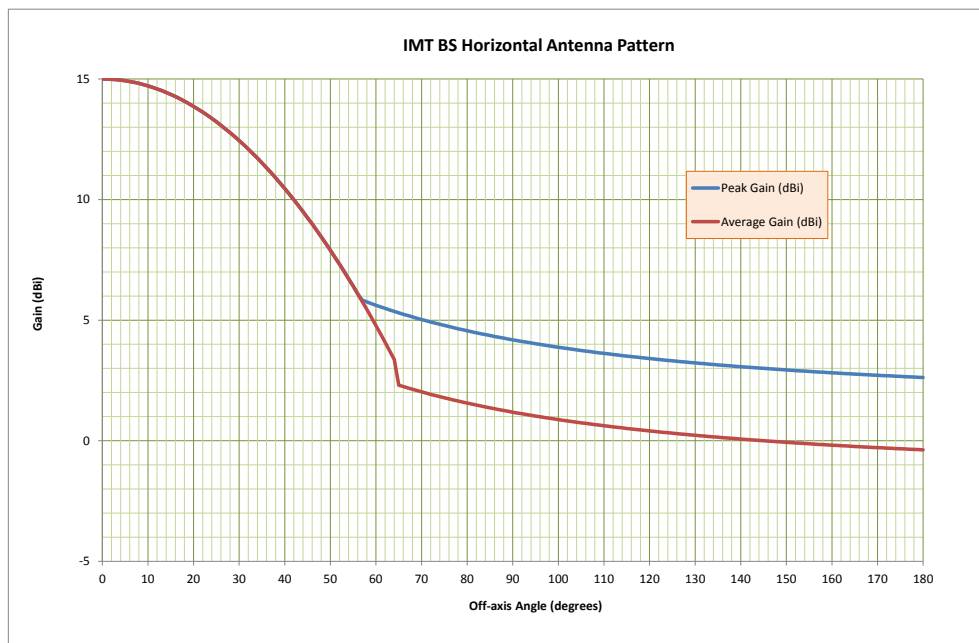
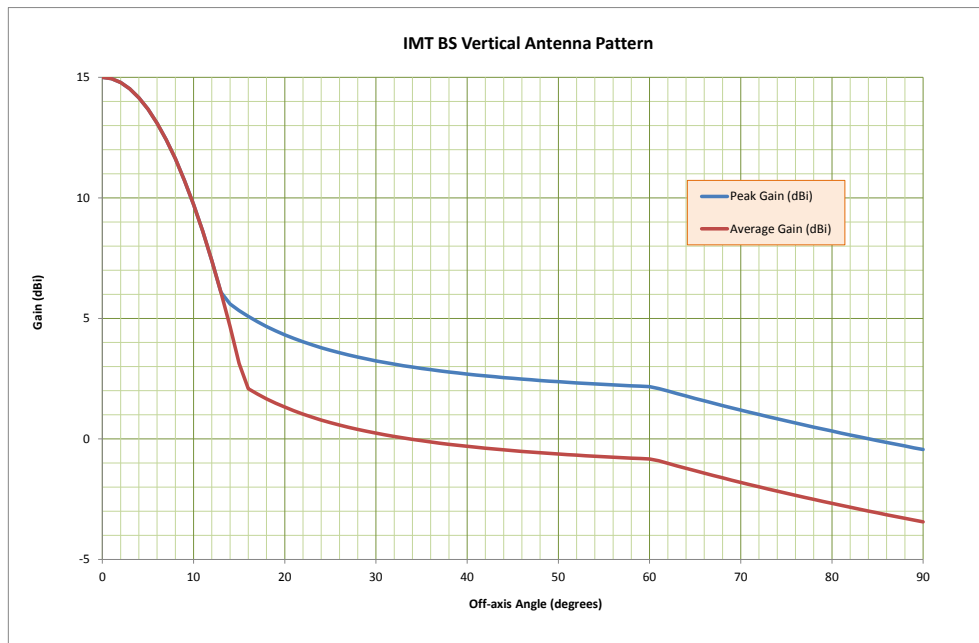


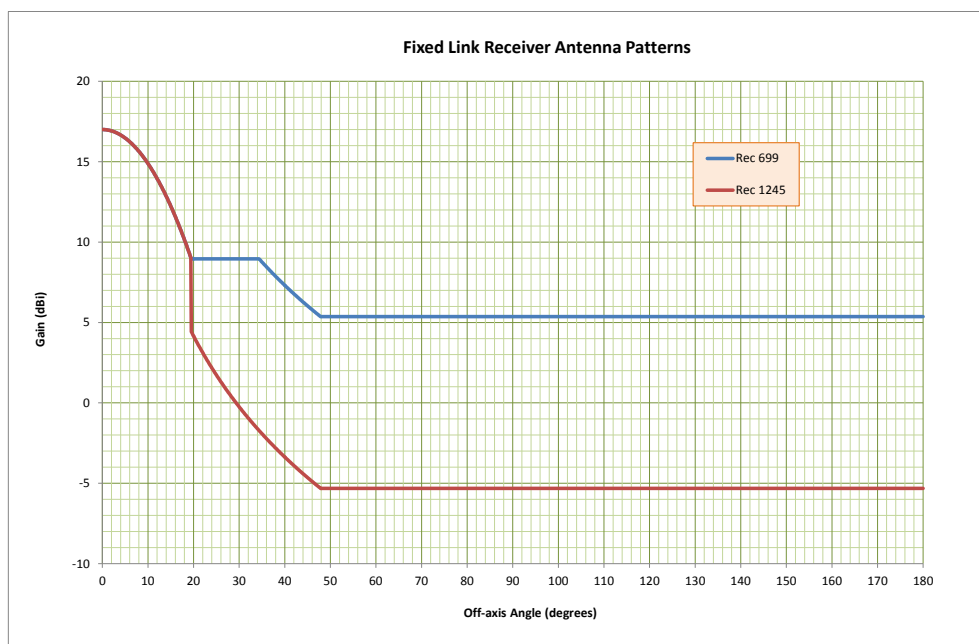
FIGURE 2
IMT base-station elevation patterns



Fixed link receiver antenna patterns

Fixed link reference antenna patterns are defined in Recommendation ITU-R F.699 and Recommendation ITU-R F.1245. Recommendation ITU-R F.699 describes the peak envelope for the antenna sidelobes while Recommendation ITU-R F.1245 provides the average envelope of sidelobes. The following figure illustrates both patterns for an assumed maximum antenna gain of 17 dBi (which corresponds to an antenna diameter of approximately 60 cm at 1.4 GHz).

FIGURE 3
Fixed link receiver antenna patterns



3 Analysis

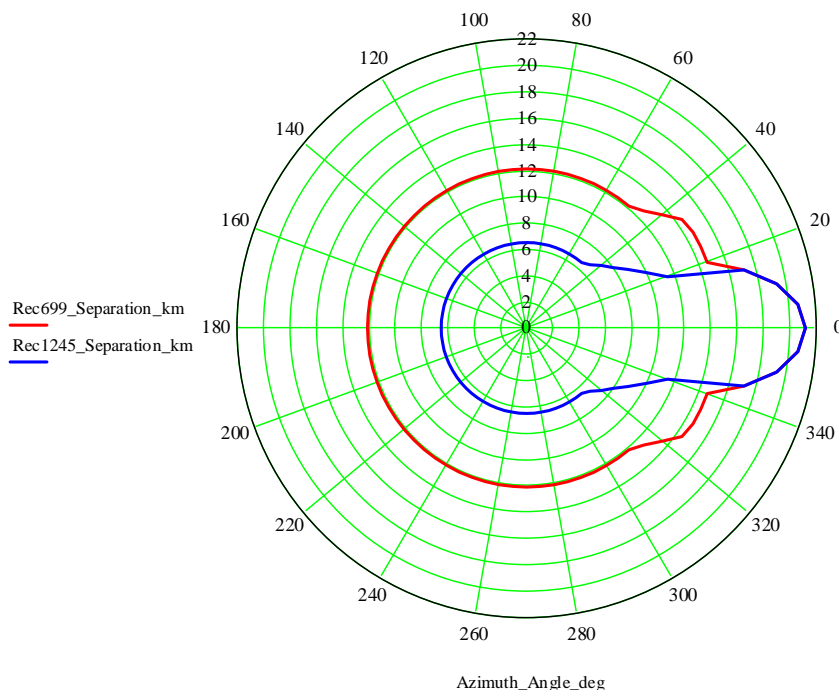
In this section, the implications of IMT base station and mobile service (MS) user equipment (UE) transmissions have been examined for the co-channel coexistence.

3.1 Results – IMT base station interference

Separation distances required for co-channel coexistence between IMT and fixed links will inevitably be larger than those required for adjacent channel/adjacent band coexistence. For example, separation distances in excess of 100 km can be calculated to satisfy a short-term interference criterion by assuming that an interfering macro IMT base-station with full e.i.r.p. is pointing at a victim FS receiver and the interference path is above the clutter. However these separation distances do not represent typical separation distances that will be necessary to avoid interference in reality, but are more like coordination distances and can give a misleading impression about the potential for coexistence.

Using parameters from section 2 above for a typical macro urban IMT base station deployment and assuming an attenuation of 20 dB to account for urban clutter effects, the separation distances are such that long-term interference becomes the dominant mechanism. The following co-channel separation distances are calculated using Recommendation ITU-R P.1546-4, which includes generic path loss curves for a number of path/frequency/time percentage/height combinations.

FIGURE 4
Co-channel separation distances for an urban macro IMT base-station interferer



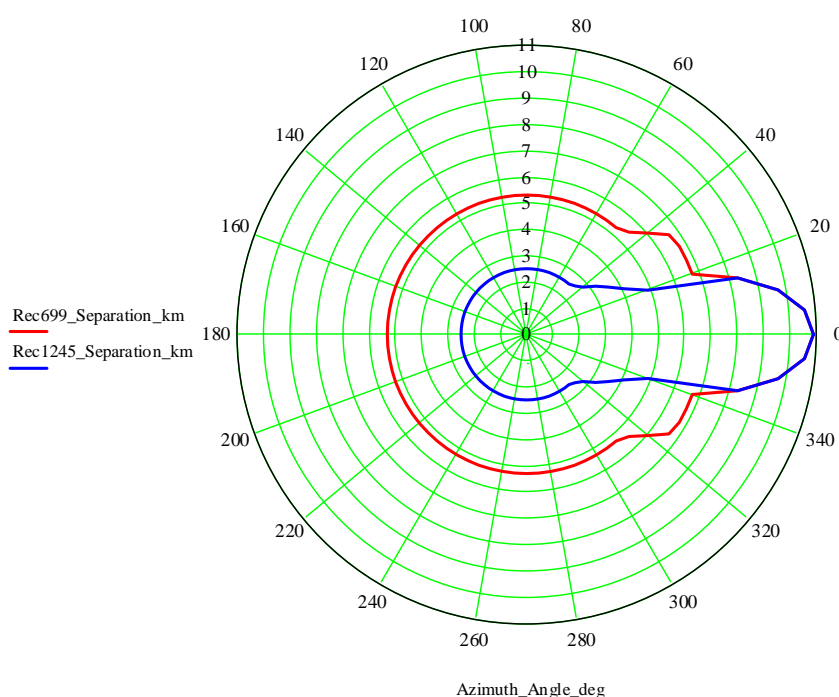
As can be seen, the main-beam separation distance is 21 km while the interference entries through the fixed link receiver back-lobe require 12 km for the Recommendation ITU-R F.699 antenna pattern and 6.5 km for the Recommendation ITU-R F.1245 antenna pattern.

The above represents a typical scenario for IMT deployment in urban areas. Using the cluttered transmitter correction algorithm in Recommendation ITU-R P.1546, for example, a 20 dB correction corresponds to a case where the IMT transmitter is at 30 m height above the ground and the path towards the fixed link receiver includes clutter at approximately 34 m height. The

correction becomes greater if the clutter is higher, whereas if the clutter height is lower, the correction is reduced. Clearly the separation distances calculated for some scenarios where IMT macro base stations are deployed at dominant sites will be greater than those shown above, as noted elsewhere in this document, however in other cases the separation distances will be smaller.

An alternative IMT deployment scenario for urban areas is that outdoor micro cells could be deployed to provide omnidirectional coverage for local capacity enhancement in urban areas. The corresponding separation distances are shown in Fig. 5 below.

FIGURE 5
Co-channel separation distances for an urban micro IMT base-station interferer



In this case, the required distances vary between 2.5 and 11 km depending on the interference alignment and assumed receiver antenna pattern.

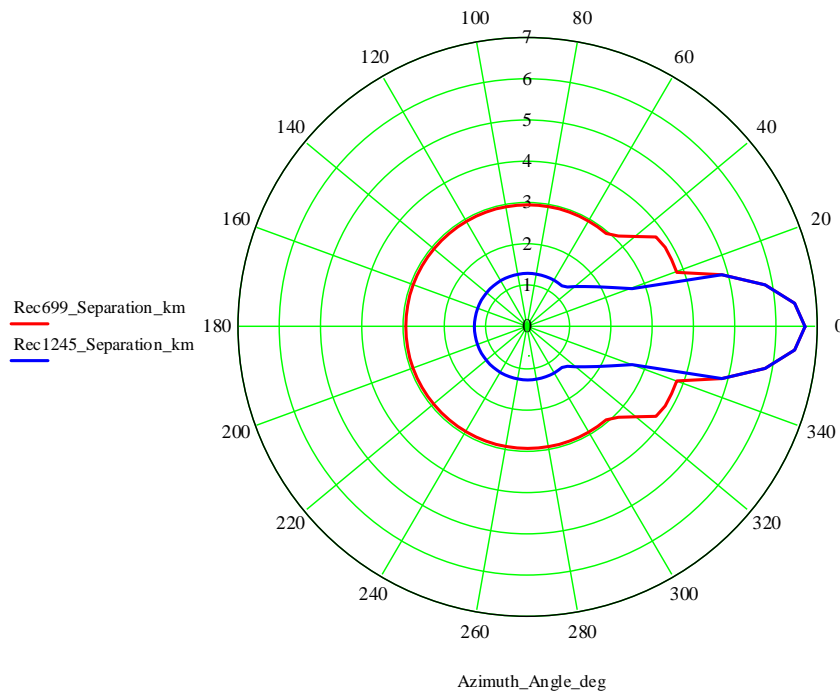
3.2 Results – IMT UE interference

Due to relatively low IMT UE e.i.r.p. values and antenna heights, separation distances are lower than those required for the IMT base-station transmitters. The implications of co-channel IMT UE interference have therefore been examined for the fixed link long-term interference criterion.

The interference path loss has been modelled using Recommendation ITU-R P.1546-4. The Recommendation ITU-R P.1546-4 path loss curves refer to signal strength at a local clutter level. When UE are considered an additional loss needs to be introduced as they are likely to be located below the clutter. In this modelling, an additional loss of 10 dB has been added to reflect the height loss.

The following distances have been calculated to satisfy the fixed link receiver long-term interference criterion for an IMT UE interferer.

FIGURE 6
Co-channel separation distances for an IMT MS interferer



As can be seen, the separation distance requirements are in the range of 3 and 6.7 km for a fixed link receiver with Recommendation ITU-R F.699 antenna and 1.3 and 6.7 km for a fixed-link receiver with Recommendation ITU-R F.1245 antenna.

4 Summary

Separation distances required for co-channel coexistence between IMT and fixed links will inevitably be larger than those required for adjacent channel/adjacent band coexistence. Separation distances that are calculated for co-channel operation under worst-case assumptions may appear quite large, however these are more like coordination distances than minimum separation distances that will be required to avoid interference in reality, and can give a misleading impression about the potential for coexistence.

The geographic separation required between an IMT transmitter and a co-channel fixed link is highly dependent on the orientation of the fixed link antenna, the transmitter and receiver antenna heights relative to the clutter/terrain, the power transmitted, and fixed link receiver antenna performance. A much greater separation is required for base station transmitters than for UE, especially where base stations are located above the local clutter and their emission levels are high in order to provide wide area coverage for UE.

There are likely to be mitigation factors associated with many deployment scenarios that would significantly decrease separation distances. For example, the required separation will decrease where there is additional shielding introduced by local terrain and clutter. This is likely to be the case, for example, if the base station transmitters are deployed to serve micro/pico cells located in cluttered urban environments. The separation distances calculated in this study range from 6.5 to 21 km for IMT macro base stations deployed in urban areas. When the urban deployment is restricted to micro cells, the separation distances are reduced to between 2.5 and 11 km.

The above mentioned separation distances were calculated under the assumption of 20 dB additional clutter loss from nearby buildings, this however may not be applicable in the case where a macrocell IMT base station antenna is located above roof top level and also taking into account that FS station antenna is normally located above rooftop, at least relative to the buildings in the direction of the main lobe.

These calculated separation distances are going to be dependent on a number of local level considerations including deployment and geographical distribution of both IMT and FS stations at national level and may require coordination with neighbouring administrations.

In actual deployment cases where a terrain database is available a more accurate case-specific separation distance may be calculated using a point-to-point propagation model such as Recommendation ITU-R P.452.

In the case of IMT UE the required separation is likely to be much smaller than for base stations. Interference aggregation through the fixed link receiver main beam is unlikely to be significant since the UE are likely to be located below terrain/clutter and the individual interference paths will be subject to different propagation losses. It is likely that coexistence of fixed links with IMT uplinks will be possible provided that the fixed links are not located close to major population centres or busy transport infrastructures where UE are likely to be used in close proximity.
